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**MAINTENANCE :
INTERNATIONAL TELEPHONE CIRCUITS**

**SETTING UP AND LINING UP
AN INTERNATIONAL CIRCUIT
FOR PUBLIC TELEPHONY**

ITU-T Recommendation M.580

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation M.580 was published in Fascicle IV.1 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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**SETTING UP AND LINING UP AN INTERNATIONAL CIRCUIT
FOR PUBLIC TELEPHONY**

1 Introduction

This Recommendation applies to all circuits operated on a manual, semi-automatic or fully automatic basis, whether provided solely by analogue transmission and switching systems or by a mixture of analogue and digital systems.

As an alternative to the procedures given in §§ 7 to 14 which require testing personnel to be present at both ends of the circuit, § 15 gives a procedure involving the use of the CCITT Automatic Transmission Measuring and Signalling Testing Equipment (ATME) No. 2 (Recommendation O.22 [1]) (with Type a responding equipment) which may be used subject to the agreement of the Administrations involved.

2 Organization

The guiding principles for the general maintenance organization of international circuits are given in Recommendation M.70.

2.1 An international circuit may consist of various national and international circuit sections; these circuit sections consist of two telephony channels, one for each direction of transmission, or a mixed analogue/digital terminal section or a digital terminal section. The types of circuits and circuit sections for public telephony are described in Recommendation M.562.

2.2 At the terminal stations of the circuit, access points are provided in accordance with Recommendation M.110 (see also Recommendation M.565). At intermediate stations an access point is provided (see also Recommendation M.110 for transit circuits), its position in the circuit being so chosen that as much as possible of the audio-frequency apparatus in the station is included in any measurement made at that station in the direction of transmission concerned.

2.3 In establishing an international circuit, the circuit, line and circuit section access points define the limits of the circuit, line and circuit section, and these are used as the basic elements involved in setting-up, lining-up, and fault location.

Note – The line access point at the terminal station will also be used as the circuit section access point at that station.

3 Limits for the overall loss of a circuit and circuit sections

3.1 *Limits for overall loss at 1020 Hz*

The objective is to make the value of overall loss at 1020 Hz as near as possible to its nominal value. When adjustment is provided in steps, these should enable the loss to be adjusted to within ± 0.3 dB of the nominal value.

3.2 *Limits for the overall loss/frequency characteristic*

National telephone networks are planned and provided by Administrations to give satisfactory telephone transmission on national calls in the most economical way and will, in consequence, have but little margin against additional transmission impairment in calls on the longest connections.

International telephone calls require the two corresponding parts of the national networks in the terminal countries to be interconnected by a switched chain of international circuits. The present CCITT plan for worldwide telephone connections specifies a maximum of six international circuits in a connection. In some circumstances the nominal reference equivalent of the connection could be 3 dB greater than in the past. This additional loss, in combination with increased line noise, makes it very desirable to minimize the transmission impairments introduced by the international circuits.

In order to have an objective for a circuit for maintenance purposes, the following principles should be applied.

3.2.1 The overall loss/frequency distortion of a circuit depends on whether it is set up entirely on 4-kHz spaced channels, or entirely on 3-kHz spaced channels or on combinations of such channels, even including small sections of audio cable. Three sets of limits are given in Tables 1/M.580, 2/M.580 and 3/M.580.

The principles on which the tables are based are as follows:

- a) the maximum loss in the relevant frequency range should not be greater than 9.0 dB relative to the loss at 1020 Hz in order to avoid disturbing the noise power distribution in the circuit to any extent;
- b) the use of equalizers at intermediate stations should be avoided as far as possible;
- c) where a mixed type of composition is used the arrangement of 3-kHz plus 4-kHz spaced channels in a circuit would cater for most of the cases of composition likely to be encountered in practice (for example, one 3-kHz channel in series with two 4-kHz channels);
- d) Administrations should be allowed some flexibility to use a measure of pre-equalization if necessary in order to avoid low-level signals entering a long section.

TABLE 1/M.580

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 4 kHz spacing

Frequency Hz	Overall loss relative to that at 1020 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 300	not less than 0.0 otherwise unspecified	not less than -3.0 otherwise unspecified
300 to 400	+3.5 to -1.0	+9.0 to -3.0
400 to 600	+2.0 to -1.0	+6.0 a -3.0
600 to 2400	+1.0 to -1.0	+6.0 to -3.0
2400 to 3000	+2.0 to -1.0	+6.0 to -3.0
3000 to 3400	+3.5 to -1.0	+9.0 to -3.0
Above 3400	not less than 0.0 otherwise unspecified	not less than -3.0 otherwise unspecified

TABLE 2/M.580

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 3 kHz spacing

Frequency Hz	Overall loss relative to that at 1020 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 200	not less than 0.0 otherwise unspecified	not less than -1.5 otherwise unspecified
200 to 250	+10.5 to -0.5	not less than -1.5 otherwise unspecified
250 to 300	+6.5 to -0.5	+9.0 to -1.5
300 to 2700	+1.0 to -0.5	+7.0 to -1.5
2700 to 2900	+2.5 to -0.5	+7.0 to -1.5
2900 to 3050	+6.5 to -0.5	+9.0 to -1.5
Above 3050	not less than 0.0 otherwise unspecified	not less than -1.5 otherwise unspecified

TABLE 3/M.580

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 3 kHz and 4 kHz spacing

Frequency Hz	Overall loss relative to that at 1020 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 300	not less than 0.0 otherwise unspecified	not less than -3.0 otherwise unspecified
300 to 400	+3.5 to -1.0	+9.0 to -3.0
400 to 600	+2.0 to -1.0	+6.0 to -3.0
600 to 2400	+1.0 to -1.0	+6.0 to -3.0
2400 to 2700	+2.0 to -1.0	+6.0 to -3.0
2700 to 2900	+2.5 to -1.0	+9.0 to -3.0
2900 to 3050	+6.5 to -1.0	+9.0 to -3.0
Above 3050	not less than 0.0 otherwise unspecified	not less than -3.0 otherwise unspecified

3.2.2 Table 1/M.580 is based on the limits recommended for a pair of 4-kHz channel equipments (Recommendation G.232 [2]), a small addition having been made to the recommended limits to allow for the additional distortions likely to be introduced by the group link and by the circuit and exchange apparatus. The equalization limits are three times the circuit limits.

Table 2/M.580 is similarly based on the limits recommended for a pair of 3-kHz channel equipments (Recommendation G.235 [3]) with an allowance for the group link and for circuit and exchange apparatus.

For international circuits composed of 4-kHz and 3-kHz sections, the limits given in Table 3/M.580 are a combination of the limits given in Tables 1/M.580 and 2/M.580, taking into account the factors given in 3.2.1 a) to 3.2.1 c) above.

The limits to be imposed on the loss/frequency characteristic at intermediate stations are also shown in Tables 1/M.580, 2/M.580 and 3/M.580.

Where a circuit or circuit section contains mixed analogue/digital channels, the table to be used should be based on the channel spacing of the analogue carrier associated with the mixed circuit or circuit section.

A circuit section or that portion of a circuit made up of wholly digital channels should be treated as an analogue circuit section or circuit having 4 kHz spaced channels.

Circuit sections made up of digital or mixed analogue/digital terminals should follow the limits given for measurements between circuit access points in Table 1/M.580.

4 Setting up and lining up analogue and mixed circuit sections

4.1 The circuit sub-control stations responsible for the various national and international circuit sections should arrange to set up these sections.

The circuit sections are lined up and the overall loss/frequency characteristic of each is recorded from terminated-level measurements.

This is done by sending at a level of -10 dBm₀ at the reference test frequency at the access point at the intermediate sub-control station or at the line access point at the control station or terminal sub-control station and adjusting the received level at the access point at the adjacent intermediate sub-control station as close as possible to its nominal level in the direction of transmission concerned.

4.2 The loss/frequency characteristic should then be measured at frequencies chosen from the following list, according to the characteristics of the circuit section to be set up:

200, 250, 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2700, 2900, 3000, 3050 and 3400 Hz.

Technical services may agree to make measurements at other frequencies if it is considered useful to do so. The test signals should be applied at a level of -10 dBm₀.

For circuit sections effectively transmitting up to only 3000 Hz (for example, circuits using 3 kHz spaced channels) the measurement at 3400 Hz is, of course, not applicable.

The overall loss at 1020 Hz¹⁾ should be as near as possible to the nominal value.

The overall loss at other frequencies should lie within the limits given in Tables 1/M.580, 2/M.580 and 3/M.580 (see § 3.2.1).

For each circuit section the results for each direction of transmission are forwarded to the control and terminal sub-control stations.

At terminal stations, during these measurements, the signalling connections to the automatic equipment should be disconnected if the signalling units are incorporated in the carrier terminal equipment. When the line-signalling relay sets are included in the lines and apparatus being measured, any voice-frequency signalling receiver must be made inoperative.

¹⁾ For further information about the choice of test signal frequency, refer to Recommendation O.6 [4].

5 Setting up and lining up mixed analogue/digital and digital terminal circuit sections

5.1 As shown in Figure 2/M.562, mixed analogue/digital and digital terminal circuit sections can occur at both terminal and intermediate locations in a circuit. However, in both cases these terminal circuit sections fall wholly within an individual Administration's boundaries. Thus, they would normally be set up and lined up independently according to national practices. However, Administrations may bilaterally choose to apply a single procedure for setting up and lining up a combination of a digital circuit section terminated at each end by a mixed analogue/digital terminal section. In this case, the procedures and limits given in § 4 above for analogue circuit sections should be applied to this combination of circuit sections.

5.2 In order to provide some guidelines for the setting up and lining up of mixed analogue/digital terminal sections, two suggested procedures are described in Annex A.

6 Setting up and testing digital circuit sections

6.1 As with digital channels, because the test procedures required for setting up and initially testing the digital path also set-up and test the digital circuit section, no additional tests on a circuit section are recommended.

7 Setting up and lining up an international circuit²⁾

7.1 Setting up the circuit

7.1.1 The sub-control station responsible for the various circuit sections having completed the setting-up and lining-up of those sections should arrange to connect them together and advise the control station. In addition, the control and terminal sub-control stations, in conjunction with their testing points, should ensure that all associated signalling, switching and other terminal equipment has been connected, is free from faults, and is operating satisfactorily.

7.1.2 When the control station has been advised by all the sub-control stations that the sections constituting the circuit have been connected together, the control station should agree with the sub-control stations upon a time at which the whole circuit may be lined up.

7.2 Lining up the circuit

7.2.1 Preliminary work

7.2.1.1 The receiving terminal sub-control station studies the test results of the individual circuit sections, particularly observing the way in which the variations within the permissible tolerances will accumulate when the sections are interconnected. The receiving terminal sub-control station for each direction of transmission determines from these studies and observations the amount of gain and equalization adjustment which will be required at intermediate and terminal stations to obtain a satisfactory overall characteristic.

7.2.1.2 From the test results the cumulative overall loss over the frequency band at intermediate sub-control stations is calculated with respect to the overall loss at 1020 Hz. An equalizer should be fitted at the request of the receive terminal sub-control station at those stations at which the sum of the measured overall loss/frequency characteristics of the individual sections exceeds the provisional limits (see 3.2.2). In determining the limits, due account must be taken of the presence of 3-kHz spaced channel translating equipment.

The number of intermediate equalizers should be kept to a minimum. When the receiving terminal sub-control station has been advised by all the other sub-control stations that the circuit sections and any prescribed equalizers have been connected together, a time at which the circuit can be lined up should be agreed upon.

7.2.2 Adjustment of the overall loss at the reference test frequency

7.2.2.1 At the appropriate time of line-up, the control station, in cooperation with the various sub-control stations, proceeds with the overall line-up of the circuit, first at a frequency of 1020 Hz³⁾.

For this, the control station arranges to send an 1020 Hz test signal at a level of -10 dBm₀, for example at the circuit access point of the circuit. In addition, the level at the line access point at the terminal stations should be adjusted as close as possible to the nominal value.

²⁾ The procedure given in § 15 may be followed as an alternative to those given in §§ 7 to 14 if agreement has been reached with the distant Administration to use ATME No. 2 for lining up, measurement of circuit noise and functional tests. It should be noted that this procedure does not include the tests in § 12. The Administrations involved should consider scheduling such tests, if applicable, when cooperative effort can be arranged.

³⁾ For further information about the choice of test signal frequency, refer to Recommendation O.6 [4].

7.2.2.2 The intermediate sub-control stations will then arrange to measure the level of the 1020 Hz test signal and to adjust it to the nominal value at the access points of the circuit (as defined in § 2.2) in that direction of transmission. Measurements and adjustments should also be made at frontier stations where the circuit includes an audio-frequency section crossing a frontier.

7.2.2.3 At the distant terminal sub-control station the received level of the test signal should be adjusted until the required overall loss is obtained at the circuit access point.

The procedure is then repeated for the other direction of transmission of the circuit.

In order to minimize cumulative gain or loss at 1020 Hz the receive terminal sub-control station may request intermediate sub-control stations to alter the gain setting for the receive direction of their sections by not more than one gain control step. In this way it should be possible to compensate, at successive stations, the departures from the nominal value while staying within the permissible limits. Theoretically, this adjustment will be needed in not more than half the stations.

7.2.2.4 It is not possible to recommend a value for the nominal transmission loss between the circuit access points of a switched public telephony circuit because of the freedom accorded to Administrations in arranging the relative levels at these points. However, bearing in mind that at each end of the circuit the attenuation between the circuit access point and the virtual switching points will have a fixed and known value and that it is possible to *build out* the wiring to circuit access points to a known loss, the send level at the circuit access point should be so chosen that, on the circuit, the circuit level diagram is respected.

7.2.3 *Measurement of the overall loss/frequency response*

7.2.3.1 When the circuit has been lined up at 1020 Hz, measurements should be made between circuit access points at the terminal stations and also at intermediate sub-control stations and frontier stations when an audio-section crosses a frontier. The loss/frequency characteristic should then be measured at frequencies chosen from the following list, according to the characteristics of the circuit to be set up:

200, 250, 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2700, 2900, 3000, 3050 and 3400 Hz.

Technical services may agree to make measurements at other frequencies if it is considered useful to do so. The test signals should be applied at a level of -10 dBm0.

7.2.3.2 If necessary, the receiving terminal sub-control station may equalize the circuit at this stage by means of an equalizer in that station, so that the overall loss/frequency characteristic lies within the required limits. Minor adjustments to compensate for accumulated manufacturing tolerances in pad and equalizer values can now also be made at intermediate stations. Those stations at which receive equalizers were necessary should remeasure the section including the equalizer, making terminated-level measurements. The results of those measurements should be passed to the receive terminal station.

These results now replace those previously submitted under operation § 7.2.1.2 for these sections, and are the results with which comparison is to be made in subsequent maintenance. (The overall loss/frequency characteristic of a *section + equalizer* may not now lie within the limits appropriate to a circuit section. It should be noted that one consequence of this is that such a combination cannot be used as a replacement for a faulty circuit section; for such replacement purposes the circuit section should be transferred without the equalizer.)

7.2.4 When the above measurements and necessary adjustments have been carried out, the control and terminal sub-control stations ensure that the limits are achieved. The circuit can be regarded as being lined up.

8 Measurement of circuit noise

8.1 Where a circuit is routed via a circuit multiplication system employing digital speech interpolation techniques, it may not be possible to make a reliable noise test using the method described in this section. In this case, a total distortion measurement should be made instead, as described in § 9.3.

8.2 The measurement of circuit noise should be made for both directions of transmission.

For the measurements of noise in one direction of transmission, the far end of the circuit should be terminated at the circuit access point, with an appropriate value of pure resistance.

At the circuit access point at the other end of the circuit (near end) a measurement of the psophometric voltage should be made, using a psophometer having the characteristics recommended by the CCITT (see the weighting curve for this psophometer in Recommendation O.41 [5]).

8.3 Circuit line-up noise measurements should be compared with the noise maintenance objectives shown in Table 4/M.580 according to the length of the circuit concerned. The values in Table 4/M.580 apply to single

measurements (see Note). It is assumed that the noise measurement will follow the measurements and adjustments outlined in §§ 7.2.2 and 7.2.3.

8.4 Where the measured noise is higher by 5 decibels or more than the appropriate value from Table 4/M.580, or is higher than -37 dBm0p, whichever is the more stringent requirement, action should immediately be taken to locate and remedy any fault where possible. It may be useful to compare noise measurements on circuits of identical or similar constitution to help locate a possible fault.

TABLE 4/M.580
Noise objectives for public telephone circuit maintenance

Distance in kilometres	< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 000	10 001 to 20 000
Noise (dBm0p)	-55	-53	-51	-49	-46	-43	-40

Note – At the present time the section of a circuit provided by a satellite employing FDM techniques with a earth station at its receiving end conforming to the INTELSAT Standard A (Figure of merit 40.7 dB/K) or Standard C (Figure of merit 39.0 dB/K) contributes approximately 10 000 pW0p (-50 dBm0p) of noise. The noise contributed by earth stations with revised figures of merit are for further study. Therefore, for the purpose of determining maintenance limits for noise measurements on international public telephony circuits, the length of this section may be considered to be equivalent to a terrestrial length of 2500 km.

The section of a circuit provided by a satellite employing FDM techniques with an earth station at its receiving end conforming to the INTELSAT Standard B contributes approximately 80 000 pW0p (-41 dBm0p) of noise for FM companded circuits. The methods of determining total distortion and/or noise objectives for such a circuit are given in Recommendation M.590.

The contribution to noise of a circuit section provided by a satellite employing TDM techniques remains a subject for further study.

8.5 Where the measured noise is greater than -44 dBm0p, and once it is ensured that no fault exists, the fitting of a compandor should be considered. Such consideration is particularly necessary if the circuit is likely to be used in a 6-circuit chain. Reference should be made to Recommendation G.143 [6] for technical guidance on the fitting of compandors. In particular, note should be taken of the need to restrict their use to circuit sections provided on inherently stable transmission systems.

8.6 The noise measured at the circuit access point during the initial line-up should be recorded for comparison against subsequent maintenance measurements.

9 Measurement of total distortion

9.1 General

This measurement is required for composite (i.e. mixed analogue/digital) circuits only. The measurement of total distortion should be made for both directions of transmission. The measuring equipment should be as specified in Recommendation O.132 [7]. The measurement equipment should be applied at the circuit access points. A test frequency of 1020 Hz should be used.

It is assumed that the measurements and adjustments outlined in §§ 7.2.2 and 7.2.3 above have already been carried out.

9.2 Measurement of total distortion using a test signal level of -10 dBm0

9.2.1 The results of the total distortion measurement should be compared with the total distortion objectives shown in Table 5/M.580 according to the number of Quantizing Distortion Units (QDUs) in the circuit and the total length of the analogue circuit sections.

9.2.2 If these objectives are exceeded by a circuit which has satisfied the noise objectives described in § 8, then a fault on a digital equipment causing excessive quantizing distortion should be suspected.

TABLE 5/M.580

**Signal-to-total distortion ratio for public telephone circuit maintenance using
a test frequency level of -10 dBm0**

Type of circuit	Number of QDU (Note 1)	Unit	Distance in analogue transmission (km) (Note 3)						
			< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 000	10 001 to 20 000
Analogue	0 (Note 2)	dB	45	43	41	39	36	33	30
Composite circuit	0.5	dB	35	35	34	34	33	31	29
	1	dB	33	33	32	32	31	30	28
	2	dB	30	30	30	29	29	28	27
	3	dB	28	28	28	28	28	27	26
	3.5	dB	27	27	27	27	27	26	26
	4	dB	27	27	27	27	26	26	25

Note 1 – The number of QDUs contributed by various digital processes are given in Table 1/G.113 [8].

Note 2 – The values are idle noise terminated with a nominal impedance of 600 Ω .

Note 3 – The section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pWp (-50 dBm0p) of noise. Therefore, for the purpose of determining the total distortion limits for international public telephony circuits, the length of this section may be considered, from Table 4/M.580, to be equivalent to 2500 km.

9.3 Measurement of total distortion using a test signal level of -25 dBm0

9.3.1 On circuits routed via a circuit multiplication system employing digital speech interpolation, this measurement may be regarded as a substitute for a measurement of circuit noise. The results of the measurement should be compared with the objectives shown in Table 6/M.580.

9.3.2 If the measured total distortion is higher by 5 dB or more than the appropriate value from Table 6/M.580 or is higher than -37 dBm0p, whichever is the more stringent requirement, on a circuit which has satisfied the test in § 9.2 above, then a fault on an analogue circuit section causing excessive noise should be suspected.

9.3.3 For maintenance purposes, a measurement of total distortion using a -25 dBm0 signal level can be useful on all composite circuits. In conjunction with a measurement using a -10 dBm0 signal level, it may be possible to identify whether a fault lies in an analogue or digital circuit section, from end-to-end measurements using the same instrument. If the circuit satisfies the objectives of Table 5/M.580 but exceeds the objectives of Table 6/M.580, a faulty analogue circuit section should be suspected. Conversely, if the objectives of Table 6/M.580 are satisfied but those of Table 5/M.580 are not, faulty digital equipment is likely.

Note – If the number of QDUs is 4 and the analogue noise level is -55 dBm0p, this procedure will produce less accurate results. In this case, a -30 dBm0 test tone will be appropriate to check the analogue section, when a circuit is not fitted with an echo-canceller or the echo canceller can be disabled.

TABLE 6/M.580

**Signal-to-total distortion ratio for public telephone circuit maintenance using
a test frequency level of -25 dBm0**

Type of circuit	Number of QDU (Note 1)	Unit	Distance in analogue transmission (km) (Note 3)						
			< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 000	10 001 to 20 000
Analogue	0 (Note 2)	dB	30	28	26	24	21	18	15
Composite circuit	0.5	dB	29	27	26	24	21	18	15
	1	dB	28	27	25	23	21	18	15
	2	dB	27	26	25	23	20	18	15
	3	dB	26	25	24	23	20	18	15
	3.5	dB	26	25	24	22	20	18	15
	4	dB	25	24	23	22	20	17	15

Note 1 – The number of QDUs contributed by various digital processes are given in Table 1/G.113 [8].

Note 2 – The values are idle noise terminated with a nominal impedance of 600 Ω .

Note 3 – The section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pWp (-50 dBm0p) of noise. Therefore, for the purpose of determining the total distortion limits for international public telephony circuits, the length of this section may be considered, from Table 4/M.580, to be equivalent to 2500 km.

10 Measurements of other parameters

Circuits used for reserve purposes in certain applications, for example, data and facsimile transmission, have particular requirements in respect of group-delay distortion, noise, etc. Reference should be made to the CCITT Recommendations relating to the type of circuit concerned in order to find what these requirements are.

11 Check of signalling level

Measurements should also be made to check that the absolute power level of the signalling current at the transmitting end of the circuit in each direction of transmission has a nominal value in accordance with Table 7/M.580, or as agreed between Administrations for signalling systems not covered by CCITT Recommendations.

Reference should be made to Recommendation M.470 for the check of Signalling System R2 line signals. The interregister signals will be found in Table 7/M.580.

Note – Such a check is not appropriate for speech circuits of Signalling Systems No. 6 and No. 7.

12 Functional tests

12.1 When the line-up procedure as described above has been completed, a check should be made of the functioning of the companders where appropriate in accordance with Recommendation M.590. This should be followed by a speaking test including a check of the satisfactory operation of echo suppressors and echo cancellers and a check that signalling transmission over the circuit is satisfactory. For an automatically operated circuit using channel-associated signalling, the signal-transmission testing facilities available at the control station should at least enable a check to be made of the line-signals transmitted between circuit access points, for example, to verify that the forward signals are followed by the return of the appropriate backward signals.

12.2 For manually operated circuits a check should be made to confirm that line-signalling to the distant end is satisfactory.

Where possible, both for manually and automatically operated circuits, test calls should be made to the distant-end operators or technical staff, as the case may be, to check the circuit both for signalling and transmission performance.

12.3 Some Administrations find a rapid check of the echo control devices useful when setting up a circuit. A suitable method is described in [9] which can be carried out by agreement between Administrations.

In addition, a check of the echo control device with the corresponding tester as specified in Recommendations O.22 [1] and O.25 [10] should be made if available.

13 Exchange of information on echo canceller test capability

When echo cancellers are fitted to a circuit, tests by other Administrations using test facilities specified in Recommendation O.22 [1] can successfully be carried out only if the canceller stages and echo path delay characteristic are programmed into the test sequence. Therefore, the Administration placing echo cancellers in their international switching centre should so apprise the other Administration(s). This may be done by a specific communication, for example a telex message, or by including such information with the exchange of routine maintenance schedules (Recommendation M.605).

14 Records of results

Each station should keep a careful record of the measurement results for the receiving direction of transmission of the sections terminating in the station. A record should be kept of the overall loss at the reference frequency and also of the overall loss/frequency characteristic relative to the overall loss at 1020 Hz.

The measurements made must include the characteristics of any equalizers which have been fitted and the final choice of gain setting must be stated.

The receiving terminal stations will also maintain a careful record of all the section measurements in the receiving direction of transmission. In addition the terminal sub-control station should send a copy of the overall records to the control station which thus will hold records for both directions of transmission. (Stations should prepare local records of in-station tests of equalizers and records of equalizer and gain settings.)

Careful records of the results of tests given in §§ 4 to 13 above should be made by both terminal stations. The control station should hold a copy of the records for both directions of transmission.

15 Setting up and lining up an international circuit using ATME

15.1 The following procedure should be followed when it has been agreed between the Administrations concerned that ATME No. 2 can be used. Generally, it is suitable only when there are no intermediate circuit sub-control stations and for circuits which do not have particular measurement requirements (see § 10).

TABLE 7/M.580

Absolute power of signalling current

Type of signalling	Signalling frequency		Absolute power	
	Nominal value	Tolerance	Nominal value in dBm0 (tolerance ± 1 dB)	
Manual signalling (System No. 1)	500 Hz interrupted at 20 Hz	$\pm 2\%$	uninterrupted (500 Hz) 0	
		$\pm 2\%$	interrupted (500/20 Hz) -3	
One-frequency signalling (System No. 3)	2280 Hz	± 6 Hz	-6	
Two-frequency signalling (System No. 4)	2040 Hz	± 6 Hz	-9	
	2400 Hz	± 6 Hz	-9	
Multi-frequency systems (Systems No. 5 and 5 bis) Line signals ^{a)} (two-frequency)	2400 Hz	± 6 Hz	-9	
	2600 Hz	± 6 Hz	-9	
	Register signals ^{b)} (multi-frequency)	700 Hz	± 6 Hz	-7
		900 Hz	± 6 Hz	-7
		1100 Hz	± 6 Hz	-7
		1300 Hz	± 6 Hz	-7
		1500 Hz	± 6 Hz	-7
1700 Hz	± 6 Hz	-7		
Signalling System R1. Line signals	2600 Hz	± 5 Hz	-8/-20 ^{c)}	
	Register signals ^{d)}	700 Hz	$\pm 1.5\%$	-7
		900 Hz	$\pm 1.5\%$	-7
		1100 Hz	$\pm 1.5\%$	-7
		1300 Hz	$\pm 1.5\%$	-7
		1500 Hz	$\pm 1.5\%$	-7
		1700 Hz	$\pm 1.5\%$	-7
Signalling System R2. Register signals ^{b)}	1380 Hz	± 4 Hz	-8	
	1500 Hz	± 4 Hz	-8	
	1620 Hz	± 4 Hz	-8	
	1740 Hz	± 4 Hz	-8	
	1860 Hz	± 4 Hz	-8	
	1980 Hz	± 4 Hz	-8	
	Backward	540 Hz	± 4 Hz	-8
		660 Hz	± 4 Hz	-8
		780 Hz	± 4 Hz	-8
		900 Hz	± 4 Hz	-8
		1020 Hz	± 4 Hz	-8
		1140 Hz	± 4 Hz	-8

a) For compound signals, the difference between the sent levels of f_1 and f_2 should not exceed 1 dB.

b) The difference between the sent levels of two frequencies of which a signal is composed should not exceed 1 dB.

c) -8 dBm0 for the duration of the signal or for a minimum of 300 ms (whichever is the shorter) and for a maximum of 550 ms after which the level of the signal shall be reduced to -20 dBm0.

d) The difference between the sent levels of the two frequencies of which a signal is composed should not exceed 0.5 dB.

15.2 *Setting up the circuit*

The circuit control and sub-control stations in conjunction with their testing points should ensure that all associated signalling, switching and other terminal equipment has been connected, is free from faults and is operating satisfactorily. This should include the check of signalling level specified in § 11. The sub-control station should advise the control station that these checks have been made.

15.3 *Lining up the circuit*

On receiving the advice from the sub-control station, the control station should test the circuit using ATME No. 2. The time at which the tests are performed should take into account the availability schedules of the ATME No. 2 responding equipments and the period of peak traffic at the distant terminal exchange (see Recommendation M.605, § 3). The ATME No. 2 should be programmed to perform the full range of transmission measurements and signalling tests.

If the transmission level in the receive direction at the control station is not within ± 1 dB of its nominal level, the level should be adjusted to within ± 0.3 dB of its nominal level, and the circuit should then be retested.

If the transmission level in the receive direction at the sub-control station distant end is not within ± 1 dB of its nominal level or if any of the other limits specified in this Recommendation are not met in either direction of transmission, then the procedures given in §§ 7 to 14 should be followed.

When the ATME No. 2 tests have been successfully completed, the control station informs the sub-control station of the results.

15.4 *Other tests*

When the line-up procedure, as described above, has been completed, a check should be made of the functioning of the companders, where appropriate, in accordance with Recommendation M.590. This should be followed by a speaking test including a check of the satisfactory operation of echo suppressors and echo cancellers.

15.5 *Recording of results*

The control station should record all results given by ATME No. 2 for both directions of transmission.

ANNEX A

(to Recommendation M.580)

Methods proposed for setting up and lining up of mixed analogue/digital terminal sections

A.1 *Check of the mixed analogue/digital terminal equipment*

The mixed analogue/digital terminal equipment must be checked to ensure that it meets CCITT Recommendations and the other relevant specifications (e.g. the check should include a general visual inspection and vibration tests, if applicable). The check should, if possible, also include a test of both the equipment and transmission system related alarms and alarm indicators associated with the mixed terminal. This is of particular importance if the equipment has remained unused since acceptance tests were carried out after installation.

A.2 *Measurement and adjustment of levels*

Either of the methods A or B below may be used in lining up the circuit sections on a mixed terminal, depending on the features of the equipment and on the availability of digital test equipment. Note, both methods require all of the circuit sections associated with the particular primary block on the mixed terminal to be out-of-service.

A.2.1 *Method A – use of internal test tone*

This method is only applicable for mixed analogue/digital terminals equipped with an internally generated digital test signal with a power of -10 dBm₀ at 1020 Hz⁴⁾, which can be applied internally either in turn or simultaneously in the analogue receive output direction to all the circuits.

⁴⁾ For further information about the choice of test signal frequency, refer to Recommendation O.6 [4].

As shown in a) of Figure A-1/M.580, in the first step the internal digital test signal is actuated. Then for each internal circuit the analogue receive direction pad is adjusted, using an analogue meter to bring the receive level as near as possible to its nominal value.

To complete the measurement in step 2 as shown in b) of Figure A-1/M.580, first the internal digital test signal is removed and the digital side of the terminal is looped (either internally or externally). Next, using external analogue test equipment a nominal 1020 Hz, -10 dBm0 tone is applied to the analogue transmit input port of each channel in turn. The transmit pad is then adjusted using the analogue meter connected to the analogue receive output port of the terminal to again bring the receive level as near as possible to its nominal value.

A.2.2 *Method B – use of digital test equipment*

This method, as shown in c) of Figure A-1/M.580, assumes that the appropriate digital test equipment is available to make measurements on individual 64 kbit/s time slots within the 2048 (1544) kbit/s digital path on the digital side of the mixed terminal section.

To make the measurements on the circuit sections, in the analogue to digital direction, a nominal 1020 Hz test signal is sent over each circuit section in turn at a level of -10 dBm0. The 64 kbit/s time slot corresponding to each circuit is monitored in turn at the primary PCM hierarchical level, using appropriate digital test equipment, and each circuit is adjusted, where applicable, to obtain the correct bit sequence.

Next, in the digital to analogue direction, a bit sequence corresponding to a nominal 1020 Hz test tone at -10 dBm0 is applied to the 64 kbit/s time slot corresponding to each circuit section in turn, at the primary PCM hierarchical level, using a digital word generator, and each circuit is adjusted to bring the received level as near as possible to its nominal value.

A.3 *Other measurements*

No other measurements are recommended at the time when the mixed analogue/digital terminal circuit sections are being set up and lined up. However, other measurements may be required when the need is indicated during circuit line-up.

A.4 *Mixed analogue/digital sections at terminal exchanges*

A.4.1 *At analogue switching exchanges*

Where a mixed analogue/digital terminal circuit section is connected to an analogue switching exchange, method B described above could be extended to include all the audio equipment associated with the switching exchange. In this case the measurements would be made between the digital path access point and the circuit access points (see Figure 1/M.110). The types of measurements to be performed for this case should be dictated by national practices.

A.4.2 *At digital switching exchanges*

Where a mixed analogue/digital terminal circuit section is connected to a digital switching exchange, method B can also be applied. In this case the digital test equipment shown in c) of Figure A-1/M.580 would be connected at the circuit access point through the digital exchange. The analogue test equipment would be connected at an intermediate access point. The types of measurements to be performed for this case should be dictated by national practices.

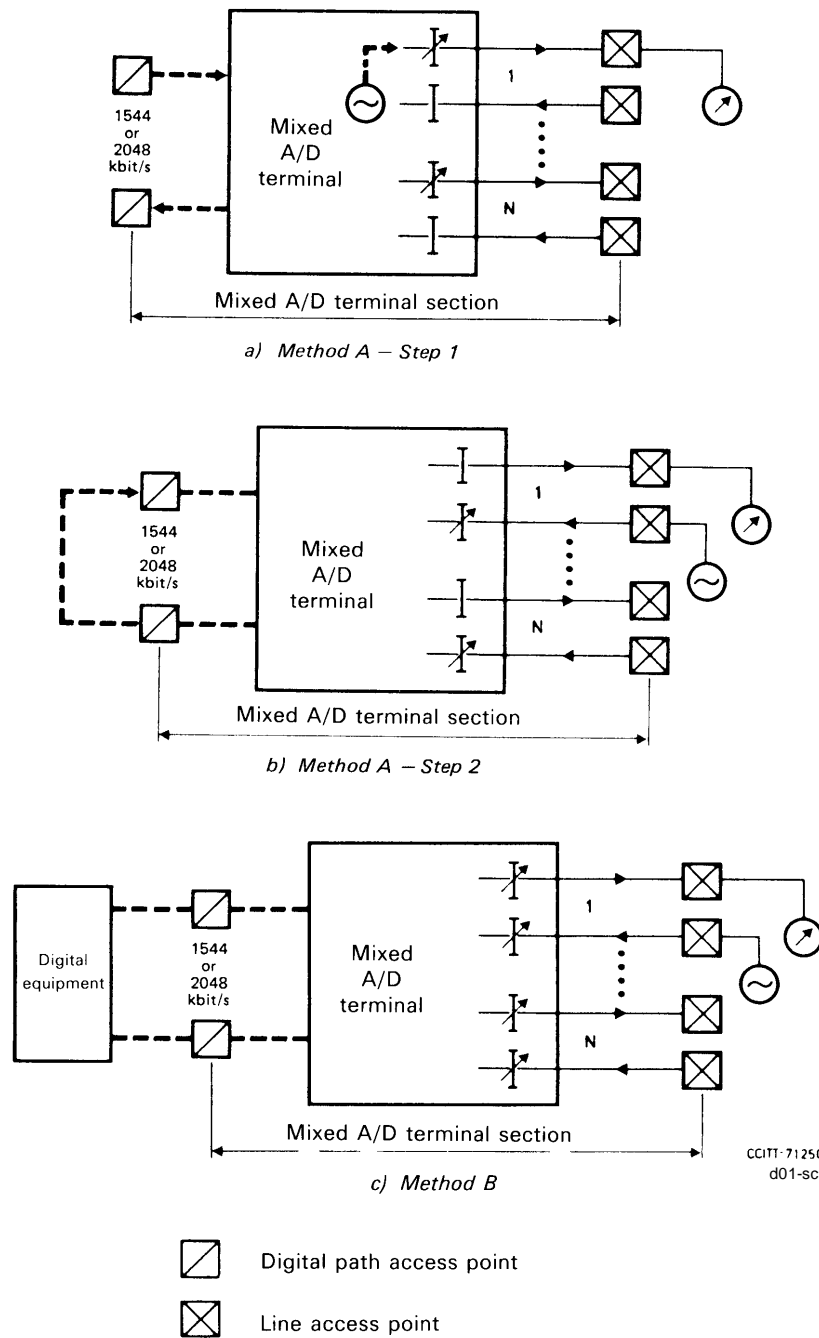


FIGURE A-1/M.580

References

- [1] CCITT Recommendation *CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.
- [2] CCITT Recommendation *12-channel terminal equipments*, Vol. III, Rec. G.232.
- [3] CCITT Recommendation *16-channel terminal equipments*, Vol. III, Rec. G.235.
- [4] CCITT Recommendation *1020 Hz reference test frequency*, Vol. IV, Rec. O.6.

- [5] CCITT Recommendation *Psophometer for use on telephone-type circuits*, Vol. IV, Rec. O.41.
- [6] CCITT Recommendation *Circuit noise and the use of compandors*, Vol. III, Rec. G.143.
- [7] CCITT Recommendation *Quantizing distortion measuring equipment using a sinusoidal test signal*, Vol. IV, Rec. O.132.
- [8] CCITT Recommendation *Transmission impairments*, Vol. III, Rec. G.113.
- [9] CCITT Supplement *Rapid verification test for echo control devices*, Vol. IV, Supplement No. 2.11.
- [10] CCITT Recommendation *Semi-automatic in-circuit echo suppressor testing system*, Vol. IV, Rec. O.25.