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SECTION 3

INTERNATIONAL TELEPHONE CIRCUITS

3.1 Bringing an international telephone circuit into service

Recommendation M.560

INTERNATIONAL TELEPHONE CIRCUITS — PRINCIPLES, DEFINITIONS AND RELATIVE TRANSMISSION LEVELS

1 General

The purpose of this Recommendation is to provide the necessary background information for other Recommendations in the M Series.

The CCITT transmission plan and international telephone connections are explained. The Recommendation also introduces the concepts of ‘‘virtual analogue switching points’’, and their conventional relative transmission levels. Appropriate definitions are given where necessary.

Extracts from the relevant Recommendations in Volume III and from Recommendation Q.45 [1] are included in this Recommendation.

2 The CCITT Transmission Plan

2.1 *Principles*

The CCITT transmission plan has been drawn up with the object of making use, in the international service, of the advantages offered by 4-wire switching considered to be met if the use of technical media other than those described give an equivalent performance at the international centre.

Note — Short transfrontier circuits are not covered by the transmission plan; they should be the subject of agreement between the Administrations concerned.

2.2 *International telephone connections*

A complete **international telephone connection** has three parts, as shown in Figure 1/M.560, namely:

— an **international chain**

an international chain is made up of one or more 4-wire international circuits. These are connected on a 4-wire basis to other international circuits in transit international centres or to national systems in terminal international centres;

— two **national systems** , one at each end

These may comprise one or more 4-wire amplified national circuits with 4-wire interconnection, and circuits with 2-wire connection to terminal exchanges and subscribers.

Figure 1/M.560, (M), p.

2.3 *International telephone circuits , virtual analogue switching points and relative transmission levels*

2.3.1 From a transmission planning point of view, an international telephone circuit is defined by its ‘‘virtual analogue switching points’’ in the international centre.

2.3.2 *Virtual analogue switching points*

Virtual analogue switching points are theoretical points with specified relative levels.

For circuits terminating at a digital international centre, the concept of virtual analogue switching points postulates the existence of ideal analogue-to-digital coders and digital-to-analogue decoders, via which the desired analogue points could be derived.

The virtual analogue switching points may not be the same as the points at which the circuit terminates physically in a switching equipment. These latter points are known as the circuit terminals; the exact position of the terminals is decided in each case by the Administration concerned (see Figure 2/M.560).

For illustrative purposes, Figure 2/M.560 depicts the virtual analogue switching points for wholly digital and wholly analogue international telephone circuits. Recommendation M.562 deals in detail with circuits provided by a mixture of analogue and digital systems.

2.3.3 *Relative transmission levels at virtual analogue switching points*

The virtual analogue switching points of an international 4-wire telephone circuit are fixed by convention at points of the circuit where the nominal relative levels at the reference frequency are:

— sending: —3.5 dBr;

— receiving: —4.0 dBr, for analogue circuits and the analogue end of mixed analogue/digital circuits;

—3.5 dBr for digital circuits.

The nominal transmission loss of circuits at the reference frequency between virtual analogue switching points is therefore 0.5 dB for both analogue and mixed analogue/digital circuits and 0 dB for digital circuits.

Two international circuits interconnected in an international centre are considered to be connected together directly at their virtual analogue switching points without any pad or amplifier between those virtual analogue switching points (see Figure 3/M.560).

The relationship between the actual switching points and the virtual analogue switching points in a practical international exchange is illustrated in Figure 3/M.560.

Figure 2/M.560, (M), p.

3 Access points for line-up and maintenance purposes

Recommendation M.565 describes the types of access points which should be provided on international telephone circuits for line-up and maintenance purposes.

Figure 3/M.560, (M), p.

Reference

[1] CCITT Recommendation *Transmission Characteristics of an International Exchange* , Vol. VI, Rec. Q.45.

Recommendation M.562

TYPES OF CIRCUIT AND CIRCUIT SECTION

1 General

1.1 The purpose of this Recommendation is to describe the terms ‘‘circuit section’’ and ‘‘circuit’’, as they are used in the Series M Recommendations, taking into consideration analogue, digital, and mixed analogue/digital constitutions.

1.2 The circuit types described in this Recommendation differ somewhat from those in Recommendation G.101 [1], in order to emphasize distinctions that are useful in setting forth maintenance procedures.

2 Circuit sections

Each of the first three section types listed below corresponds to one of the three channel types defined in Recommendation M.300. Each of the last two circuit section types corresponds to one of the two terminal types also defined in Recommendation M.300.

2.1 *Analogue circuit section*

An analogue circuit section comprises two analogue channels, one for each direction of transmission.

2.2 *Mixed circuit section*

A mixed circuit section comprises two mixed channels, one for each direction of transmission.

2.3 *Digital circuit section*

A digital circuit section comprises two digital channels, one for each direction of transmission.

2.4 *Mixed analogue/digital terminal circuit section*

A mixed analogue/digital terminal circuit section comprises the two directions of transmission, for one equivalent voice-frequency signal, through a PCM multiplex equipment. In the analogue to digital direction, the mixed analogue/digital terminal circuit section extends from the audio input of the PCM multiplex equipment, to the associated 64 kbit/s time slot appearance at the digital output. In the digital to analogue direction, the mixed analogue/digital terminal circuit section extends from the 64 kbit/s time slot appearance of a particular channel at the digital input to the PCM multiplex equipment, to the associated audio output.

2.5 *Digital terminal circuit section*

A digital terminal circuit section comprises the two directions of transmission, for one equivalent voice-frequency signal, through a digital terminal. For each direction of transmission, the digital terminal circuit section extends from a particular 64 kbit/s time slot appearance, in the input bit sequence to the digital terminal, to the corresponding 64 kbit/s time slot appearance in the output bit sequence of the digital terminal.

3 Circuits

International circuits comprise various combinations of national and international circuit sections, together with ancillary equipment as required. The following circuit types are defined in terms of their constituent circuit sections, as a basis for recommending appropriate maintenance procedures.

3.1 *Analogue circuit*

An analogue circuit comprises one or more analogue circuit sections. These circuits terminate at both ends in analogue switching machines. A schematic drawing is shown in Figure 1/M.562.

Figure 1/M.562, (M), p.

3.2 *Mixed analogue/digital circuit*

A mixed analogue/digital circuit comprises any combination of circuit sections that includes one or more analogue to digital, or digital to analogue, conversion processes. Mixed analogue/digital circuits may terminate at either end in analogue or digital switching machines. Combinations of various types of circuit sections that are acceptable in making up mixed analogue/digital circuits are constrained by the need to avoid excessive transmission impairments. These constraints are discussed in § 5 below. Examples of permitted mixed analogue/digital circuit configurations are shown schematically in Figure 2/M.562.

Figure 2/M.562, (M), p.

Figure 2/M.562 (suite), (M), p. MEP: Les 2 figures en regard = non car pages courtes, DÉSOLÉE

3.3 *Digital circuit*

A digital circuit comprises one or more digital circuit sections. In addition to the digital circuit section(s), a digital circuit may include one or more digital terminal circuit sections. These circuits terminate at both ends in digital switching machines. A schematic drawing is shown in Figure 3/M.562.

4 Allocation of losses in mixed analogue/digital circuits

In Figure 2/M.562, the attenuators needed to control any variability in the analogue portions of the circuits, arising from loss variations with time, or attenuation distortion, are shown symmetrically for both directions of transmission. However, in practice, such arrangements may require nonstandard levels at the boundaries between circuit sections.

Administrations are advised that should they prefer to adopt an asymmetric arrangement, e.g., by putting all the loss into the receive direction at only one end of a circuit or circuit section, then, provided that the loss is small, e.g., a total of not more than 1 dB, the small amount of asymmetry that results in the international portion of the connection will be acceptable, bearing in mind the small number of international circuits encountered in most actual connections.

Figure 3/M.562, (M), p.

5 Number of unintegrated PCM digital processes

5.1 *General principle*

It is recognized that in the mixed analogue/digital period, there could be a considerable presence of unintegrated digital processes in the worldwide telephone network. Consequently, it is important that the incorporation of these processes should take place in such a way that when integration of functions can occur, unnecessary items of equipment will not remain in the all-digital network.

5.2 *Restrictions due to transmission impairments*

In the mixed analogue/digital period, it may be necessary to include a substantial number of unintegrated digital processes in international telephone connections. To ensure that the resulting transmission impairments (quantization, attenuation and group-delay distortion) introduced by such processes do not accumulate to the point where overall transmission quality can be appreciably impaired, it is recommended that the planning rule given in Recommendation G.113, § 3 [2], be complied with. The effect of this rule is to limit the number of unintegrated digital processes in both the national and international parts of telephone connections.

In the case of all-digital connections, transmission impairments can also accumulate due to the incorporation of digital processes (e.g., digital pads). The matter of accumulating such impairments under all-digital conditions is also dealt with in Recommendation G.113, § 3 [2].

References

[1] CCITT Recommendation *The transmission plan* , Vol. III, Rec. G.101.

[2] CCITT Recommendation *Transmission Impairments* , Vol. III, Rec. G.113.

Recommendation M.565

ACCESS POINTS FOR INTERNATIONAL TELEPHONE CIRCUITS

1 General

This Recommendation specifies the access points required for testing and measuring purposes on international telephone circuits. (Access points for other types of circuit are dealt with in Recommendation M.110.)

2 Types of access point and their uses

2.1 Three basic types of access points are required for international telephone circuits. These should be provided and used in accordance with the following principles:

2.1.1 The international circuit for public telephony includes the international line (as defined in Recommendation M.700). Points serving to distinguish the ends of the international line should be provided, where possible, in the form of 4-wire access points called line access points as defined below.

line access points (points d'accès à la ligne — puntos de acceso a la línea)

Points used by the CCITT to define the limits of an international line, and from which measurements are made. Only one ''line access point'' exists at each end of an international line. The precise location of each such point depends on the Administration concerned

Where a digital international exchange is interfaced with the transmission network by primary (or higher order) digital paths, a line access point at ''circuit'' level cannot generally be provided. In this case, any necessary testing of circuits normally carried out at the line access point may be performed at the digital path access point nearest to the international exchange. Circuit tests which involve the sending of test signals should be carried out from the circuit access point as defined in § 2.1.2 below.

2.1.2 At the international switching centres, at the terminals of a circuit, ''circuit access points'' as defined below should be provided.

circuit access points (points d'accès au circuit — puntos de acceso al circuito)

Four-wire access points so located that as much as possible of the international circuit is included between corresponding pairs of these access points at the two centres concerned. These points, and their relative level (with reference to the transmission reference point) are determined in each case by the Administration concerned. They are taken as the basic practical reference points of known relative level to which other transmission measurements will be related. In other words, for measurement and lining-up purposes, the level at the appropriate circuit access point is the relative level with respect to which other levels are adjusted.

The requirement to provide a circuit access point within a digital international exchange will be met by any suitable method of obtaining access to the digital bit sequence (time slot) corresponding to an individual telephone circuit.

Where a circuit uses channel associated signalling it should be possible to identify and measure at the circuit access points, the signal-transmission parameters, e.g., type of signal, sequence, timing, duration, level and frequency.

A compandor, if fitted, should be connected on the line side of the line access points and not between the line access point and the circuit access point. In this way the relationship between the nominal transmission levels at these two points on a circuit with a compandor is the same as for other circuits.

The access points required for digital leased circuits have yet to be specified. This matter is for further study by Study Group IV, in association with Study Group XV.

2.1.3 Where an international telephone circuit appears at its basic frequencies or basic bit rate within a transit country, an intermediate access point for testing and measuring purposes should be provided at that location in the transit country.

2.2 The line access points and circuit access points (and any intermediate access points in transit countries) will be used by the appropriate testing points in all tests and measurements for the line-up and maintenance of international telephone circuits.

2.3 At the discretion of Administrations, means of giving access to the circuit access points and/or the line access points from remote locations may be provided — such remote locations being within or outside the international centre. Such arrangements avoid the need for staff to enter equipment areas for circuit testing purposes, and increase the flexibility and efficiency of the maintenance organization where large numbers of circuits must be maintained.

2.4 In order to line-up and maintain circuits routed on a mixture of analogue and digital systems it is necessary to carry out measurements of analogue circuit parameters at digital international exchanges. If this requirement cannot be met by suitable digital test equipment, it may be necessary to provide a ‘‘test coder/decoder’’ to convert digital access points (operated at 64 kbit/s for example) to analogue access points (at voice frequency), thus enabling analogue measuring equipment to be used.

2.5 Figure 1/M.565 shows typical access and test equipment arrangements for analogue and digital international exchanges. Subject to meeting the requirements in §§ 2.1 to 2.4 above, the actual arrangements at a particular international centre are left to the discretion of the Administration concerned.

Note — Remote access arrangements, as described in § 2.3, are only a physical extension of the access points to a more convenient location(s). Thus, in the Series M Recommendations, the terms ‘‘line access points’’ and ‘‘circuit access points’’ are used (without qualification) irrespective of the manner in which the required access is obtained.

3 Transmission characteristics and choice of levels at analogue access points

3.1 The impedance at analogue access points should have a return loss against the nominal impedance of the measuring apparatus of the station (for example 600 ohms, nonreactive) of not less than 20 dB over the range 600-3400 Hz and not less than 15 dB over the range 300-600 Hz.

3.2 It should be recognized that the analogue link access point shown in Figure 1b/M.565 is suitable only as a maintenance access point. It is not intended for the setting-up or lining-up of individual circuits, because the circuits levels at these points are not specifically defined. This occurs because the shape of the group and supergroup filters have not been compensated for at this point by the channel translating equipment adjustments.

3.3 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 choosing the transmission levels at these points. However, bearing in mind that the attenuation between the circuit access points and the virtual analogue 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 and receive level at the circuit access point should be chosen such that the circuit level diagram is respected.

3.4 It is advantageous to adopt the same value of relative level at the send line access points for every circuit connected to the exchange. Similarly, all the receive line access points could also be at a particular common nominal value of relative level. When relative levels are made uniform in this way, line-up and maintenance activity is greatly simplified. Also, lines can be readily cross-connected at the line access points, which is useful in the immediate replacement of faulty lines in an emergency.

3.5 If the nominal relative level at the receive line access point is chosen to be higher than that at the send line access point of the same exchange, this level difference can be used to offset the inherent transmission loss in the signalling and switching equipment, and the requirements of the CCITT transmission plan can be met without the obligation to install supplementary audio-frequency amplifiers.

Note — It is preferred to make transmission measurements between 4-wire access points but, as a permissible alternative, a terminating unit may be provided together with an associated 2-wire access point for measurement

For example, those defined in Recommendations M.717 and M.718.

purposes. The transmission levels and losses must be chosen so that the nominal loss between virtual analogue switching points is 0.5 dB (or 0.0 dB for wholly digital circuits), and the circuit level diagram is respected.

Figure 1/M.565, à l'italienne, (M), p.

4 Interface requirements at digital access points

4.1 Digital access points at 64 kbit/s should be operated in the contradirectional mode and should meet the interface requirements of § 1.2.3 of Recommendation G.703 [1].

4.2 Digital path access points, operated at 1544 kbit/s or 2048 kbit/s (or higher hierarchical bit rates) should meet the interface requirements of Recommendation G.703 [1].

4.3 Interface requirements for digital access points on circuits using an encoding technique other than PCM are under study by Study Group IV.

Reference

[1] CCITT Recommendation, *Physical electrical characteristics of hierarchical digital interfaces* , Vol. III, Rec. G.703.

Recommendation M.570

CONSTITUTION OF THE CIRCUIT;

PRELIMINARY EXCHANGE OF INFORMATION

1 As soon as it is decided to bring a new circuit into operation, the technical services of the terminal countries should agree upon the circuit control station , and the technical service of each transit country should advise the other technical services concerned of the name of the sub-control station chosen for its territory. If the circuit is routed in a direct group or block crossing a transit country without demodulation or demultiplexing, no sub-control station need be provided for the transit country. When a circuit is subjected to analogue-to-digital conversion using, for example, a transmultiplexer, the location of the transmultiplexer should be designated as circuit sub-control station.

Also the technical services of all the countries concerned should send to the technical service responsible for the circuit control station information which will be required for the preparation of the circuit routing form (see the Appendix I to this Recommendation) using the letter and number code on the form. The information for a circuit without audio sections will consist of the numbers of the groups or blocks used and the number of the channel in each group or block.

In the case of a both-way circuit, the circuit order of selection should be stated, including the method by which the International Switching Centre selects circuits (i.e., sequentially by circuit, fully randomly or sequentially by block of circuits but randomly within the block, etc.).

When the circuit is assigned its designation (according to Recommendation M.140, § 1), the Administration with control station responsibility will assemble the necessary technical and operational information. This should be entered into the list of Related Information (as defined in Recommendation M.140, § 2) which consists of the items shown in Annex A.

2 Exchange of information

The information should preferably be sent by telex and the examples below show typical telex messages concerning the provision of Bucuresti-London 1 when the circuit is analogue, digital or mixed analogue/digital.

This method using the telex services enables agreement on routing details to be obtained quickly and also enables circuit routing forms to be completed by the technical services responsible for the circuit control stations as soon as a circuit is put into service or rearranged.

Example I — Telex message from the technical services of the United Kingdom to the technical services of the Federal Republic of Germany, Austria, Hungary and Roumania for an analogue circuit:

H.T. [T1.570]

{
NETWORK CONTROL DIVISION BTI LONDON
TO
FTZ DARMSTADT
GENTEL WIEN
GENTEL BUDAPEST
GENTEL BUCURE,STI
}
OUR REF.
{
PROPOSE PROVISION OF BUCURE,STI/A1—LONDON/M B1
}
{
USING FRANKFURT—LONDON 1201/9 SIGNALLING 500/20
}
{
GRATEFUL FOR YOUR AGREEMENT OR COUNTER PROPOSALS.
REGARDS.
}

Tableau [T1.570], p.

Example II — Telex message from the technical services of the Federal Republic of Germany in reply to telex in example I:

H.T. [T2.570]

{
FTZ SCHALT DMST A NETWORK CONTROL DIVISION BTI
LONDON
}
10 APR
YOUR REF. OUR REF.
{
2
= FEDERAL REPUBLIC OF GERMANY 3—BUCURE,,STI—LONDON 1
}
5 = FRANKFURT/MAIN
{
A
= FFT — L 1201/9 B = 840
}
{
A
= FFT — WIEN 1201/11 B = 740
}
REGARDS.
{
COPIES TO WIEN, BUDAPEST, BUCURE,STI.
}

Tableau, [T2.570] p.

Similar messages could be used for a digital circuit. The channel to be used then could be, for example, Frankfurt—London 30N003/22.

Example III — Telex message from the technical services of the United Kingdom to the technical services of the Federal Republic of Germany, Austria, Hungary, and Roumania for a mixed analogue/digital circuit using a transmultiplexer at Frankfurt:

H.T. [T3.570]

{
NETWORK CONTROL DIVISION BTI LONDON
TO
FTZ DARMSTADT
GENTEL WIEN
GENTEL BUDAPEST
GENTEL BUCURE,SI
}
OUR REF.
{
PROPOSE PROVISION OF BUCURE,STI—LONDON 1
}
{
USING FRANKFURT—LONDON 30NC004/7 SIGNALLING SYSTEM No. 5
}
{
GRATEFUL FOR YOUR AGREEMENT OR COUNTER PROPOSALS.
REGARDS.
}

Tableau, [T3.570] p.

Example IV — Telex message from the technical services of the Federal Republic of Germany in reply to the telex in Example III:

H.T. [T4.570]

{
FTZ SCHALT DMST TO NETWORK CONTROL DIVISION BTI LONDON
}
10 APR
YOUR REF. OUR REF.
{
2
= FEDERAL REPUBLIC OF GERMANY
}
{
3
= BUCURE,STI—LONDON 1
}
5 = FRANKFURT/MAIN
19 = FRANKFURT/MAIN
{
A
= FFT — L 30N0004/7 B = 840
}
{
A
= FFT — WIEN 12008/7 B = 740
}
REGARDS.
{
COPIES TO WIEN BUDAPEST BUCURE,STI.
}

Tableau [T4.570] p.

Using the above-mentioned information and the data supplied by sub-control stations, the circuit control station makes out a *circuit routing form* which is used as a level diagram for voice-frequency sections (see Appendix I to this Recommendation, which can serve as a routing form or level diagram). This routing form shows the nominal relative levels at:

— circuit control and sub-control stations;

— frontier stations, if the circuit is reduced to a voice-frequency section across a frontier;

— stations where the circuit is reduced to voice frequency, in those cases where the circuit passes via a series of groups or blocks.

The technical service of the circuit control station sends the routing form to the technical services of the sub-control stations of the international circuit concerned:

a) only at the specific request of one of the Administrations concerned when the circuits are routed on one channel of a single international group link or digital path;

b) in all cases for circuits otherwise constituted.

The despatches are sent in duplicate, one copy for the technical service and one for the sub-control station.

BLANC

ANNEX A
(to Recommendation M.570)

Designation information on international public switched circuits

A.1 *Designation*

The designation is according to Recommendation M.140, § 1.

A.2 *Related information*

The additional information on public switched circuits is covered by the following items:

RI 1. Urgency for restoration;

RI 2. Terminal countries;

RI 3. Carriers’ names;

RI 4. Control and sub-control station(s);

RI 5. Fault report points;

RI 6. Routing;

RI 7. Association;

RI 8. Equipment information;

RI 9. Use;

RI 10. Transmission medium information;

RI 11. Composition of transmission;

RI 12. Bandwidth or bit rate;

RI 13. Signalling information;

The various items will be dealt with in § 2 of Recommendation M.140.

BLANC

APPENDIX I
(to Recommendation M.570)

H.T. [T5.570]
Routing form for an international circuit

1.	Date of issue	
2. American Telephone and Telegraph Co. }	Technical service of	{
3. New York (10) — Stockholm 1 }	Circuit designation	{
4.	Length	7870 km
5a.	Control station	New York
5b.	Sub-control stations	London, Stockholm
6.	Date of putting into service	October 1972
7. Type of ISC at control station end }	{ Analogue	
8. Type of ISC at sub-control station end }	{ Analogue	
9a. New York (½) Stockholm (½) }	Echo suppressors at	{
9b.	Echo cancellers at	None
10.	Compandors at	None
11.	Signalling	System No. 5
12.	Switching equipment	
13.	Special equipment at	None
14.	Special concentrator | u1	None
15. Estimated weighted noise power }	{ —48 dBm0 (36 dBa)	
16. Special performance requirements at }	{ None	
17. Hangover time of suppressors at }	{ New York: 50 ms	Stockholm: 50 ms
18. Estimated total distorsion power }	{ Not applicable	
19.	Transmultiplexer at	None
20.	Echo cancellation stages at	
21. Echo path delay characteristics, per stage, at }	{	

Stations and constitution	Length of section (in km)	Direction ↓	Direction ↑ {		
(A)	(B)	(C)	(D)	(E)	(F)
New York	0.0	—4.5			
34-A-/C/-8	522	3.2			
Green Hill	+7.0	+7.0	1602-05-/A/-5	5813	

36.5 Through-group connection points Conil (Spain) Sesimbra (Portugal) }	London	+4.0	—4.0	{
1211/1	1535	9.5		
Stockholm	+3.5	—11.0		

Tableau [T5.570], p.

Recommendation M.580

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 ± | .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.

H.T. [T1.580]

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	{	
	Between circuit access points 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 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 }	{ {	

Tableau 1/M.580 [T1.580], p. 14

H.T. [T2.580]

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	{	
	Between circuit access points dB	{ dB
Below 200 not less than 0.0 otherwise unspecified } not less than —1.5 otherwise unspecified }	{ {	
200 to 250 not less than —1.5 otherwise unspecified }	+10.5 to —0.5	{
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 }	{ {	

Tableau 2/M.580 [T2.580], p. 15

–v’1P’

H.T. [T3.580]

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	{ Between circuit access points 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 }	{ {	

Tableau 3/M.580 [T3.580], p. 16

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 |) to 3.2.1 |) 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.

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

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 Hz 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.

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 circuit

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

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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.

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 Hz

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.

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 | fR + | fIequalizer* 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.

H.T. [T4.580]

TABLE 4/M.580

Noise objectives for public telephone circuit maintenance

Distance in kilometres	< | 20	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 | 00	10 | 01 to 20 | 00
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 an 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 | 00 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 | 00 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.

Tableau 4/M.50 [T4.580], p.

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.

H.T. [T5.580]

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	{						
			< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 | 00	10 | 01 to 20 | 00
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

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 | 00 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.

Tableau 5/M.50 [T5.580], p.

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.

H.T. [T6.580]

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	{						
			< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 | 00	10 | 01 to 20 | 00
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

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 | 00 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.

Tableau 6/M.50 [T6.580], p.

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 compandors 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).

H.T. [T7.580]
TABLE 7/M.580
Absolute power of signalling current

<table>
<tr><th rowspan="2">Type of signalling</th><th colspan="2">Signalling frequency</th><th rowspan="2">Absolute power</th></tr>
<tr><th>Nominal value</th><th>Tolerance</th></tr>
<tr><td></td><td></td><td>uninterrupted (500 Hz) 0
± | %</td><td></td></tr>
<tr><td>One-frequency signalling (System No. 3)</td><td>2280 Hz</td><td>± | Hz</td><td>—6</td></tr>
<tr><td>Two-frequency signalling (System No. 4)</td><td>2040 Hz 2400 Hz</td><td>± | Hz ± | Hz</td><td>—9 —9</td></tr>
<tr><td>Muli-frequency systems (Systems No. 5 and 5 | fIbis)
Line signals | ua) (two-frequency)</td><td>2400 Hz 2600 Hz</td><td>± | Hz ± | Hz</td><td>—9 —9</td></tr>
<tr><td>Register signals | ub) (multi-frequency)
700 Hz
900 Hz
1100 Hz
1300 Hz
1500 Hz
1700 Hz
± | Hz
± | Hz
± | Hz
± | Hz
± | Hz
± | Hz
—7
—7
—7
—7
—7
—7</td><td></td><td></td><td></td></tr>
<tr><td>Signalling System R1. Line signals</td><td>2600 Hz</td><td>± | Hz</td><td>—8/—20 | uc)</td></tr>
<tr><td>Register signals | ud)
700 Hz
900 Hz
1100 Hz
1300 Hz</td><td></td><td></td><td></td></tr>
</table>

1500 Hz
1700 Hz
}   {
± | .5%
± | .5%
± | .5%
± | .5%
± | .5%
± | .5%
}   {
—7
—7
—7
—7
—7
—7
}

{
Signalling System R2. Register signals | ub)
Forward
}   {
1380 Hz
1500 Hz
1620 Hz
1740 Hz
1860 Hz
1980 Hz
}   {
± | Hz
± | Hz
± | Hz
± | Hz
± | Hz
± | Hz
}   {
—8
—8
—8
—8
—8
—8
}
Backward   {
540 Hz
660 Hz
780 Hz
900 Hz
1020 Hz
1140 Hz
}   {
± | Hz
± | Hz
± | Hz
± | Hz
± | Hz
± | Hz
}   {
—8
—8
—8
—8
—8

—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.

Tableau 7/M.50 [T7.580], p. 20

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 ± | dB of its nominal level, the level should be adjusted to within ± | .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 ± | 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 compandors, 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 Hz , which can be applied internally either in turn or simultaneously in the analogue receive output direction to all the circuits.

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, (M), p. 21

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 impairements* , 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.

Recommendation M.585

BRINGING AN INTERNATIONAL DIGITAL CIRCUIT INTO SERVICE

1 Organization

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

An international digital circuit may consist of one or more digital circuit sections and digital terminal circuit sections. The types of digital circuit and digital circuit sections for public telephony are described in Recommendation M.562.

In establishing an international digital circuit, circuit access points define the limits of a circuit. These circuit access points are used as the means for performing functional tests including those for channel associated line signalling.

2 Transmission tests

2.1 *Error performance*

When a circuit is brought into service immediately after the digital path(s) over which it is routed are commissioned, the procedures in Recommendation M.555 (see also Recommendation M.550) are adequate to ensure a satisfactory initial error performance for the circuit.

When a circuit is brought into service some time after the digital path over which it is routed is commissioned, the circuit control station should ascertain, either directly or from the circuit sub-control station, that the digital path is satisfying the required performance objectives.

2.2 *Other tests*

When the circuit is to be fitted with a 64 kbit/s device e.g. echo canceller or µ/A law converter, these should first be tested before bringing the circuit into service (for echo suppressors and echo cancellers, see Recommendations M.660 and M.665 respectively).

3 Functional tests

A speaking test should be made including a subjective check of the satisfactory operation of echo control devices.

For a circuit using channel-associated signalling, the signal-transmission test 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.

Recommendation M.590

SETTING UP AND LINING UP A CIRCUIT FITTED WITH A COMPANDOR

1 The compandor should first be tested in accordance with the appropriate design information which should be made available in a suitable form to repeater station staff. In particular, because the unaffected level of a compandor is defined with reference to an 800 Hz signal, it should be verified for each type of compandor that use of a reference test frequency of 1020 Hz produces the same results as using a reference test frequency of 800 Hz.

2 Circuits fitted with compandors should be lined up to achieve the same limits as circuits without compandors. The compandor should be fitted to the circuit only after the circuit without its compandor is considered satisfactory in respect of loss and loss/frequency response. It should be noted that to achieve the limits for loss/frequency response on the companded circuit without equalization, it will be necessary for the loss/frequency response of the uncompanded circuit to be within one half of the circuit limits.

3 Measurements of total distortion and idle channel noise

After compandors have been fitted, total distortion and idle channel noise measurements should be made. The test signal used for the total distortion measurement should be applied at the unaffected level of the compandor.

In the case of a circuit which is fitted with a compandor to subjectively reduce the noise generated within a terrestrial circuit section, the measurements should be noted.

In the case of a circuit which is fitted with a compandor to subjectively reduce the noise generated by a satellite circuit section, the procedure is as follows:

The total distortion objective for INTELSAT single sideband Standard B satellite channels is —41 dBm0p (FM companded circuit).

— For analogue routed circuits , the noise objectives given in Table 4/M.580 for the appropriate terrestrial length of circuit should be combined with the total distortion objective for the satellite channel to produce a total distortion objective for the whole circuit. See Annex A for an example of this calculation.

— For mixed analogue/digital routed circuits, the total distortion objectives given in Table 5/M.580 for the appropriate terrestrial length of circuit should be combined with the total distortion objective for the satellite channel to produce a total distortion objective for the whole circuit. See Annex A for an example of this calculation.

— If the measured total distortion is higher than the calculated total distortion objective, then a fault should be suspected and action should be taken to locate and remedy any fault where possible.

— When the total distortion measurement has been made and is found to meet the calculated total distortion objectives, an idle channel noise measurement should be made.

— The idle channel noise measurement should be compared with the maintenance objective given in Table 4/M.580 for the appropriate length of circuit, taking into account the note associated with that table which states that the satellite section of the circuit may be considered to have an equivalent length of 2500 km. This is a valid consideration provided that the total distortion objective of the satellite channel is not greater than —30 dBm0p.

— If the measured value is higher by 5 dB or more than the noise objective given in Table 4/M.580 or is higher than —37 dBm0p, whichever is the more stringent requirement, then a fault should be suspected and action should be taken to locate and remedy any fault where possible.

4 A speaking test should be made on the circuit to verify the correct operation of the compandors.

It should be noted that in the case of mixed analogue/digital circuits, if the unaffected level is other than —10 dBm0 then this procedure will produce less accurate results and in this case it should be used as a general guide only.

5 Designations

Companded circuits and groups of circuits which are all companded should be designated in accordance with Recommendation M.140.

Note — Repeater station staff should be well instructed as to the subjective effect of errors and the location of faults affecting compandors.

ANNEX A
(to Recommendation M.590)

Total distortion and idle channel noise objectives for circuits

which are fitted with compandors in order to subjectively reduce the effect of noise generated on satellite channels

A.1 A distinction is made between:

a) circuits which are fitted with compandors to subjectively improve the noise generated by a terrestrial section, and

b) circuits which are fitted with compandors to subjectively improve the noise generated by a satellite section.

This distinction is made because in case a) it is not possible to specify noise or total distortion objectives. However, in case b), the satellite system operator can specify noise objectives for the satellite section. Thus these limits can be combined with those contained in Recommendation M.580 to calculate an overall limit.

A.2 *Examples of calculations of total distortion for case b)*

Example 1

Consider an analogue circuit which has a terrestrial length of 1600 km and which is routed via a satellite which has a specified idle channel noise objective of —41 dBm0p for analogue channels.

From Table 4/M.580, the noise objective for a length of 1600 km is —51 dBm0p.

Combining —41 dBm0p and —51 dBm0p gives a total distortion of —40.59 dBm0p.

Thus the total distortion objectives should be —41 dBm0p.

Example 2

Consider a mixed analogue/digital circuit which has a terrestrial length of 1600 km, two analogue/digital conversions using 8 bit coding (i.e., 2 QDUs) and which is routed via a satellite which has a specified idle channel noise objective of —41 dBm0p for analogue channels.

From Table 5/M.580, the total distortion objective for a length of 1600 km is —30 dB or —40 dBm0p.

Combining —41 dBm0p and —40 dBm0p gives a total distortion of —37.46 dBm0p.

Thus the total distortion objective should be —37 dBm0p.

A.3 *Idle channel noise objectives for case b)*

It is stated in § 3 that provided the total distortion objective of the satellite channel is not greater than —30 dBm0p, it is valid to consider that this section of the circuit has an equivalent length of 2500 km.

This statement is justified because the compandor characteristic which is illustrated in Figure A-1/M.590 indicates that an idle channel noise of —30 dBm0p generated in a satellite section would be reduced to —50 dBm0p. This value of noise is that which from Table 4/M.580 is attributed to an equivalent circuit length of 2500 km.

Figure A-1/M.590, (N), p. 22

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