INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

YELLOW BOOK

VOLUME IV - FASCICLE IV.3

MAINTENANCE; INTERNATIONAL SOUND-PROGRAMME AND TELEVISION TRANSMISSION CIRCUITS

RECOMMENDATIONS OF THE N SERIES

VII[TH] PLENARY ASSEMBLY
GENEVA, 10–21 NOVEMBER 1980

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CONTENTS OF THE CCITT BOOK
APPLICABLE AFTER THE SEVENTH PLENARY ASSEMBLY (1980)

YELLOW BOOK

Volume I – Minutes and reports of the Plenary Assembly.

Opinions and Resolutions.

Recommendations on:
- the organization and working procedures of the CCITT (Series A);
- means of expression (Series B);
- general telecommunication statistics (Series C).

List of Study Groups and Questions under study.

Volume II

FASCICLE II.1 – General tariff principles – Charging and accounting in international telecommunications services. Serie D Recommendations (Study Group III).

FASCICLE II.2 – International telephone service – Operation. Recommendation E.100 - E.323 (Study Group II).

FASCICLE II.3 – International telephone service – Network management – Traffic engineering. Recommendations E.401 - E.543 (Study Group II).

FASCICLE II.4 – Telegraph and "telematic services"[1] operations and tariffs. Series F Recommendations (Study Group I).

Volume III

FASCICLE III.1 – General characteristics of international telephone connections and circuits. Recommendations G.101 - G.171 (Study Group XV, XVI, CMBD).

FASCICLE III.2 – International analogue carrier systems. Transmission media – characteristics. Recommendations G.211 - G.651 (Study Group XV, CMBD).

FASCICLE III.3 – Digital networks – transmission systems and multiplexing equipments. Recommendations G.701 - G.941 (Study Group XVIII).

FASCICLE III.4 – Line transmission of non telephone signals. Transmission of sound programme and television signals. Series H, J Recommendations (Study Group XV).

Volume IV

FASCICLE IV.1 – Maintenance; general principles, international carrier systems, international telephone circuits. Recommendations M.10 - M.761 (Study Group IV).

FASCICLE IV.2 – Maintenance; international voice frequency telegraphy and facsimile, international leased circuits. Recommendations M.800 - M.1235 (Study Group IV).

FASCICLE IV.3 – Maintenance; international sound programme and television transmission circuits. Series N Recommendations (Study Group IV).

FASCICLE IV.4 – Specifications of measuring equipment. Series O Recommendations (Study Group IV).

[1] "Telematic services" is used provisionally.

Volume V	–	Telephone transmission quality. Series P Recommendations (Study Group XII).
Volume VI		
FASCICLE VI.1	–	General Recommendations on telephone switching and signalling. Interface with the maritime service. Recommendations Q.1 - Q.118 *bis* (Study Group XI).
FASCICLE VI.2	–	Specifications of signalling systems Nos. 4 and 5. Recommendations Q.120 - Q.180 (Study Group XI).
FASCICLE VI.3	–	Specifications of signalling system No. 6. Recommendations Q.251 - Q.300 (Study Group XI).
FASCICLE VI.4	–	Specifications of signalling systems R1 and R2. Recommendations Q.310 - Q.480 (Study Group XI).
FASCICLE VI.5	–	Digital transit exchanges for national and international applications. Interworking of signalling systems. Recommendations Q.501 - Q.685 (Study Group XI).
FASCICLE VI.6	–	Specifications of signalling system No. 7. Recommendations Q.701 - Q.741 (Study Group XI).
FASCICLE VI.7	–	Functional Specification and Description Language (SDL). Man-machine language (MML). Recommendations Z.101 - Z.104 and Z.311 - Z.341 (Study Group XI).
FASCICLE VI.8	–	CCITT high level language (CHILL). Recommendation Z.200 (Study Group XI).
Volume VII		
FASCICLE VII.1	–	Telegraph transmission and switching. Series R, U Recommendations (Study Group IX).
FASCICLE VII.2	–	Telegraph and "telematic services"[1] terminal equipment. Series S, T Recommendations (Study Group VIII).
Volume VIII		
FASCICLE VIII.1	–	Data communication over the telephone network. Series V Recommendations (Study Group XVII).
FASCICLE VIII.2	–	Data communication networks; services and facilities, terminal equipment and interfaces. Recommendations X.1 - X.29 (Study Group VII).
FASCICLE VIII.3	–	Data communication networks; transmission, signalling and switching, network aspects, maintenance, administrative arrangements. Recommendations X.40 - X.180 (Study Group VII).
Volume IX	–	Protection against interference. Series K Recommendations (Study Group V). Protection of cable sheaths and poles. Series L Recommendations (Study Group VI).
Volume X		
FASCICLE X.1	–	Terms and definitions.
FASCICLE X.2	–	Index of the Yellow Book.

[1] "Telematic services" is used provisionally.

CONTENTS OF FASCICLE IV.3 OF THE YELLOW BOOK

Part I – Series N Recommendations

Maintenance of international sound-programme and television transmission circuits

SECTION 2 – *International television transmissions*

2.1 International television transmissions – Definitions and responsibilities

2.2 Lining-up and monitoring of an international television connection

2.3 Maintenance of leased circuits for television transmissions

Part II – Supplements to Series M and N Recommendations

1 Technical information

2 Measuring techniques

3 Supplements to the Series O Recommendation

4 Transmission performance of the international network

REMARKS

1 The Questions entrusted to each Study Group for the Study Period 1981-1984 can be found in Contribution No. 1 to that Study Group.

2 The list of Supplements in the table of contents includes some which are not published in the Yellow Book. Reference information for these Supplements can be found on the page indicated in the table of contents.

CCITT NOTE

In this fascicle, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

PART I

Series N Recommendations

MAINTENANCE OF INTERNATIONAL SOUND-PROGRAMME AND TELELVISION TRANSMISSION CIRCUITS

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SECTION 1

INTERNATIONAL SOUND-PROGRAMME TRANSMISSION

1.1 International sound-programme transmissions – Definitions

Recommendation N.1

DEFINITIONS FOR APPLICATION TO INTERNATIONAL SOUND-PROGRAMME TRANSMISSIONS

The following definitions apply to the maintenance of international sound-programme transmissions. Other definitions are used for other purposes, e.g., an international sound-programme link and international multiple destination sound-programme link as defined in §§ 11 and 12 respectively below, are within the definition of an international sound-programme circuit as defined by the CMTT.

Note 1 – It is intended that the definitions given in Recommendations N.1 and N.51 should remain identical, so far as is practical, by use of only simultaneous amendments.

Note 2 – A sound-programme circuit section, circuit, link or connection is considered to be permanent for maintenance purposes if it is always available for use when required, whether or not it is continuously in use. Such a circuit may be used for the purposes of occasional transmission, that is, transmissions of short duration, e.g. less than 24 hours, or it may be used for a long duration, i.e. one day or more. A permanent sound-programme connection between broadcasting organizations' premises may be used at any time, except only for periods of maintenance as agreed between the Administrations and broadcasting organizations concerned.

A sound-programme circuit section, circuit, link or connection is considered to be temporary for maintenance purposes when it has no existence outside the period of transmission (including line-up and testing time) for which it is required.

1 international sound-programme transmission

The transmission of sound signals over the international telecommunication network for the purpose of interchanging sound-programme material between broadcasting organizations in different countries.

2 broadcasting organization

A broadcasting organization is an organization which is concerned with either or both sound and television broadcasting. Most of the customers ordering facilities for sound-programme and television transmission are broadcasting organizations; for convenience, the term broadcasting organization is used to denote the activity of any user or customer and, where so used, it is equally applicable to any other customer requiring sound-programme or television transmissions.

3 broadcasting organization (send)

The broadcasting organization at the sending end of an international sound-programme transmission.

4 **broadcasting organization (receive)**

The broadcasting organization at the receiving end of an international sound-programme transmission.

5 **international sound-programme centre (ISPC)**

A centre at which at least one international sound-programme circuit (see § 9) terminates and in which international sound-programme connections (see § 13) can be made up by the interconnection of international and national sound-programme circuits.

The responsibility of an ISPC is given in Recommendation N.5.

6 **national sound-programme centre (NSPC)**

A centre at which two or more national sound-programme circuits terminate and at which national sound-programme circuits may be interconnected.

7 **sound-programme circuit section**

The unidirectional national or international sound-programme transmission path between two stations at which the programme is accessible at audio frequencies. The transmission path may be established via terrestrial or single destination satellite routing. (See Note 2 above and Figures 1/N.1 and 3/N.1.)

8 **international multiple destination sound-programme circuit section**

The unidirectional sound-programme transmission path from one frontier station to two or more of the frontier stations at which interconnection is made at audio frequencies. (See Note 2 above and Figure 4/N.1.)

9 **international sound-programme circuit**

The transmission path between two ISPCs which comprises one or more sound-programme circuit sections (national or international), together with any necessary audio equipment. The transmission path may be established via terrestrial or single destination satellite routing. (See Note 2 above and Figures 1/N.1 and 3/N.1.)

10 **international multiple destination sound-programme circuit**

The unidirectional transmission path from one ISPC to two or more other ISPCs comprising sound-programme circuit sections (national or international) one of which is an international multiple destination circuit section, together with any necessary audio equipment. (See Note 2 above and Figure 4/N.1.)

11 **international sound-programme link**

The unidirectional transmission path between the ISPCs of the two terminal countries involved in an international sound-programme transmission. The international sound-programme link comprises one or more international sound-programme circuits (see Figures 1/N.1 and 3/N.1 below) interconnected at intermediate ISPCs. It can also include national sound-programme circuits in transit countries. (See Note 2 above and Figure 2/N.1.)

12 **international multiple destination sound-programme link**

The unidirectional transmission path between the ISPCs of the terminal countries involved in an international multiple destination sound-programme transmission. The international multiple destination sound-programme link comprises international sound-programme circuits, one of which is an international multiple destination sound-programme circuit. (See Note 2 above and Figure 5/N.1.)

13 international sound-programme connection

The unidirectional transmission path between the broadcasting organization (send) and the broadcasting organization (receive) comprising the international sound-programme link extended at its two ends over national sound-programme circuits to the broadcasting organization. (See Note 2 above and Figure 2/N.1.)

14 international multiple destination sound-programme connection

The unidirectional transmission path between the broadcasting organization (send) and two or more broadcasting organizations (receive) comprising the international multiple destination sound-programme link extended at its ends over national sound-programme circuits to the broadcasting organizations. (See Note 2 above and Figure 5/N.1.)

15 send reference station

The transmit sub-control station of an international multiple destination sound-programme circuit section (see § 8), circuit (see § 10) or link (see § 12). (See Figures 4/N.1 and 5/N.1.)

16 effectively transmitted signals in sound-programme transmission

For sound-programme *transmission*, a signal at a particular frequency is said to be effectively transmitted if the nominal overall loss at that frequency does not exceed the nominal overall loss at 800 Hz by more than 4.3 dB. This should not be confused with the analogous definition concerning telephone circuits given in the Recommendation cited in [1].

For sound-programme *circuits*, the overall loss (relative to that at 800 Hz) defining effectively transmitted frequency is 1.4 dB, i.e. about one third of the allowance.

17 types of sound-programme circuit [1)]

The various types of international sound-programme circuit or sections of such circuits should be referred to by quoting the top nominal frequency, in kHz, effectively transmitted.

Example: 10-kHz sound-programme circuit.

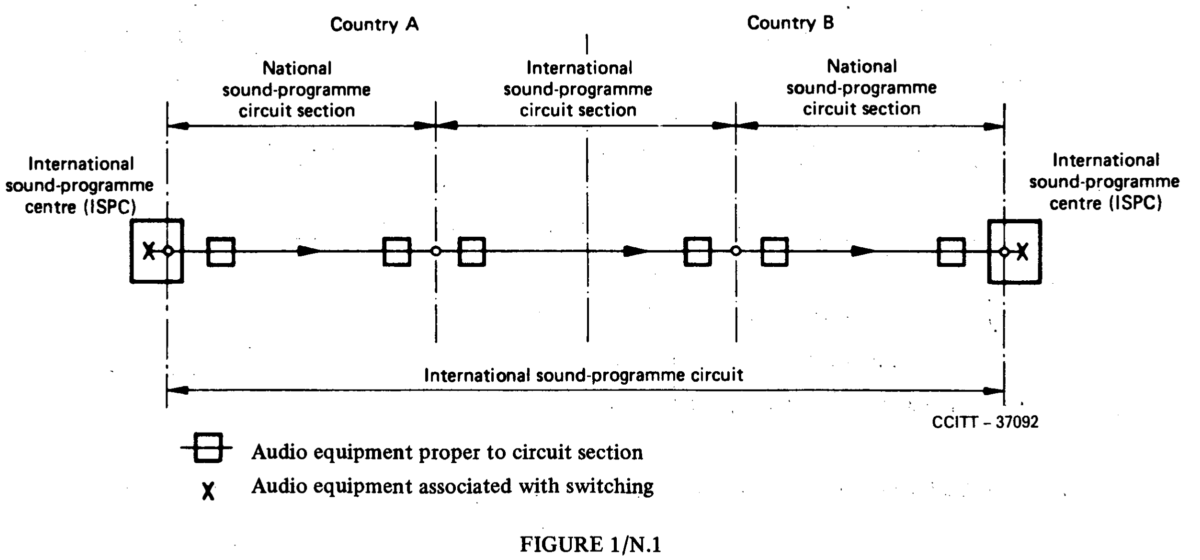

FIGURE 1/N.1

An international sound-programme circuit composed of two national and one international sound-programme circuit-sections

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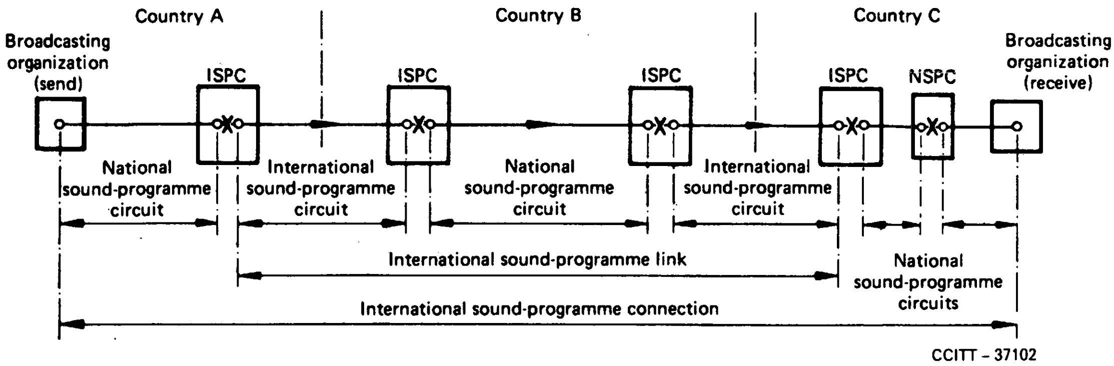
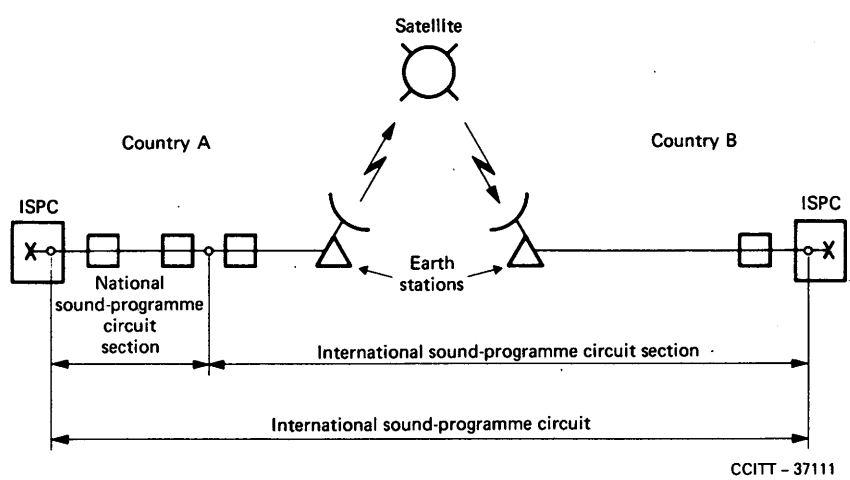
1) To reduce problems in ordering and charging for sound-programme circuits, Study Group II has a classification of circuits based on their approximate bandwidth (see the Recommendation cited in [2]).



X Audio equipment associated with switching

FIGURE 2/N.1

An international sound-programme link composed of international and national sound-programme circuits and extended on a national sound-programme circuit at each end to form an international sound-programme connection



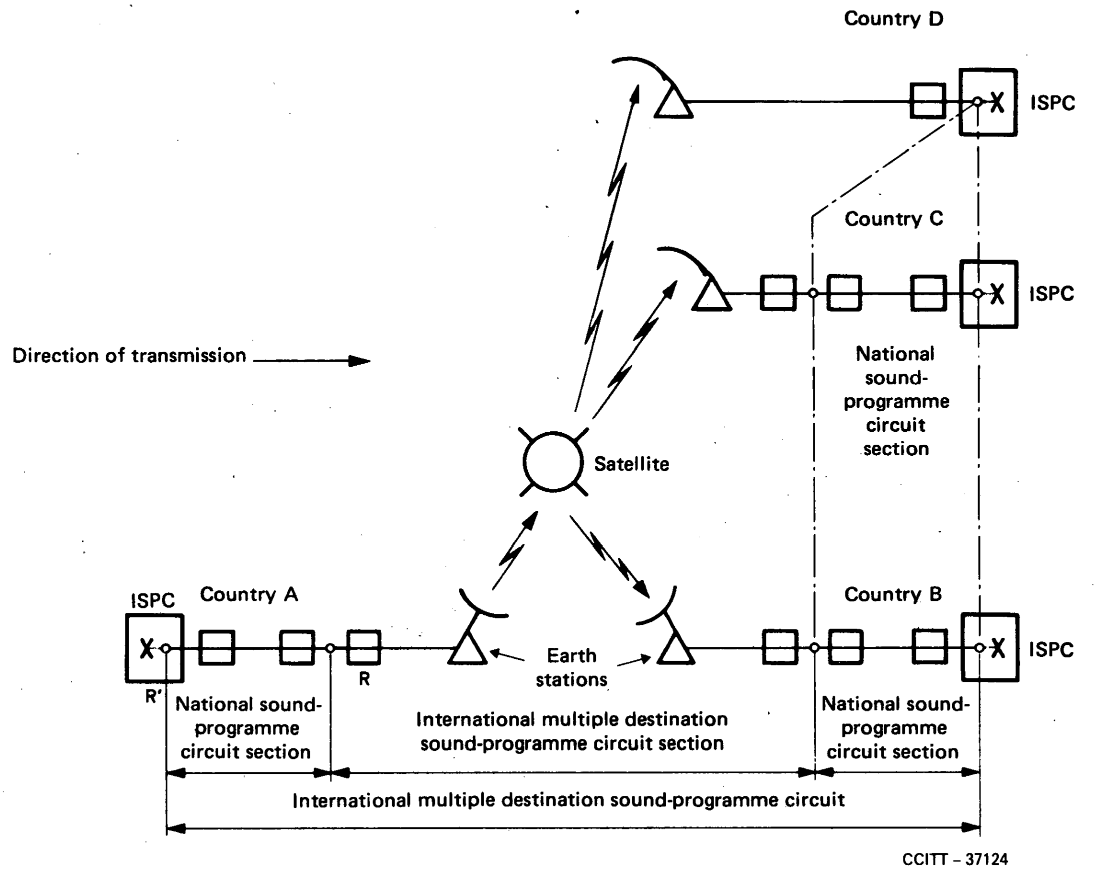
Audio equipment proper to the circuit section

X Audio equipment associated with switching

ISPC International sound-programme centre

FIGURE 3/N.1

Single-destination international sound-programme circuit routed via a communication satellite system



⊟ Audio equipment proper to a circuit section

X Audio equipment associated with switching

ISPC International sound-programme centre

R *Send reference* station for the multiple destination international sound-programme circuit section

R′ *Send reference* station for the multiple destination international sound-programme circuit

FIGURE 4/N.1

International multiple destination sound-programme circuit routed via a communication satellite system

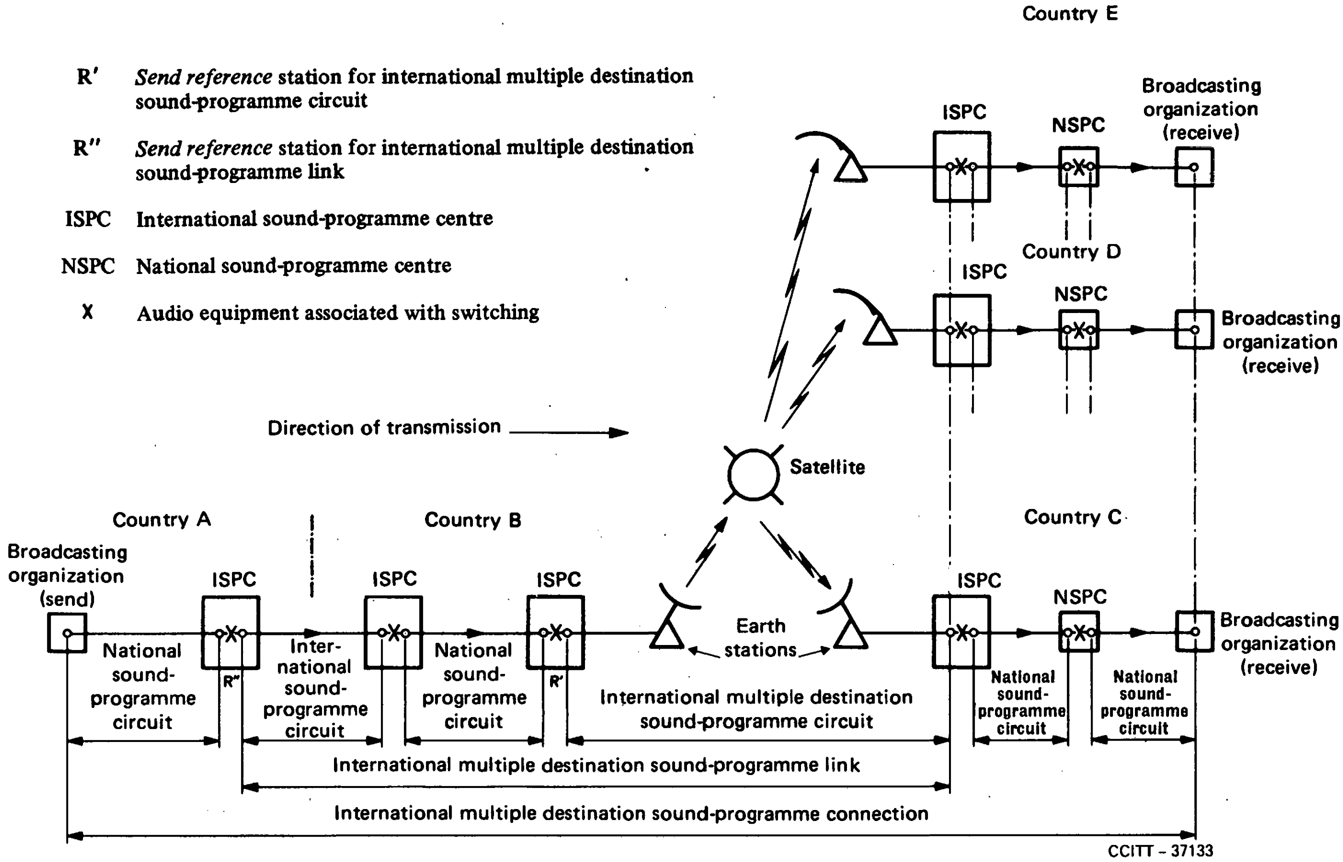


FIGURE 5/N.1

International multiple destination sound-programme link extended to form a connection routed via a communication satellite system

References

[1] CCITT Recommendation *General performance objectives applicable to all modern international circuits and national extension circuits*, Vol. III, Fascicle III.1, Rec. G.151, Note 1, Division A.

[2] CCITT Recommendation *International sound- and television-programme transmissions*, Vol. II, Fascicle II.1, Rec. D.180, § 3.

Recommendation N.2

DIFFERENT TYPES OF SOUND-PROGRAMME CIRCUIT

The characteristics of the various types of international sound-programme circuit defined in Recommendations J.21 [1], J.22 [2] and J.23 [3] are as follows:

15 kHz;
10 kHz;
6.4 kHz.

From the point of view of sound-programme transmission ordinary telephone circuits are generally considered to be suitable only for the transmission of speech. It should be noted that the limits of the loss/frequency distortion cannot be guaranteed to be better than the limits shown in Recommendation M.580 [4].

When a telephone circuit is used for a sound-programme transmission the terminating sets and the signalling equipment must be disconnected to avoid echo effects and false operation of the signal receiver.

When a telephone circuit is used for a sound-programme transmission, a point of zero relative level of the telephone circuit must coincide with a point of zero relative level on the sound-programme circuit. (However, see § 2 of Recommendation N.15 in which it is pointed out that a 6-dB loss should be introduced in order to reduce the mean power level delivered to the telephone circuit system).

References

[1] CCITT Recommendation *Performance characteristics of 15-kHz type sound-programme circuits*, Vol. III, Fascicle III.4, Rec. J.21.

[2] CCITT Recommendation *Performance characteristics of 10-kHz type sound-programme circuits*, Vol. III, Fascicle III.4, Rec. J.22.

[3] CCITT Recommendation *Performance characteristics of narrow-bandwidth sound-programme circuits*, Vol. III, Fascicle III.4, Rec. J.23.

[4] CCITT Recommendation *Setting up and lining up an international circuit for public telephony*, Vol. IV, Fascicle IV.1, Rec. M.580.

Recommendation N.3

CONTROL CIRCUITS

1 Definition of control circuit

A control circuit is a telephone-type circuit between the point of origin of the programme and the point where it terminates (recording equipment, studio, switching centre, transmitter, etc.) used by a broadcasting organization for the supervision and coordination of a sound or television transmission.

More than one control circuit may be used in association with the different programme connections involved in a single transmission, such as:

a) the *television* connection;

b) the *international sound* connection (for supervising the programme effects circuit provided for transmitting, for example, the background noises of a programme);

c) the *commentary* connection (for supervising the sound-programme circuit transmitting a commentary in a given language);

d) the *complete programme* connection (for supervising the sound-programme circuit transmitting the whole of the sound part of a programme).

2 Provision of control circuits for sound-programme and television transmission [1)]

The conditions governing the provisions and lease of control circuits for sound-programme and television transmissions are given in Recommendation D.180 [1].

Reference

[1] CCITT Recommendation *International sound- and television-programme transmissions*, Vol. II, Fascicle II.1, Rec. D.180.

---

1) The CCITT has noted the fact that broadcasting organizations use a tone having a frequency of 1900 Hz ± 6 Hz and a level not exceeding −10 dBm0, for their signalling purposes on control circuits. Under the conditions of use specified in the CCITT Recommendations for control circuits, the CCITT has no objections to the use of this tone.

Recommendation N.4

DEFINITION AND DURATION OF THE LINE-UP PERIOD AND THE PREPARATORY PERIOD

For each international sound-programme transmission a distinction is made between:

- **line-up period**

  The period during which the Administrations line up the international sound-programme link before handing it over to the broadcasting organizations; and

- **preparatory period**

  The period during which these broadcasting organizations do their own adjustments, tests and other work before the sound-programme transmission itself commences.

1 Line-up period

1.1 *Duration*

In principle, the duration of the line-up period should be 15 minutes. However, in the case of sound-programme transmissions involving more than two countries, the duration may be increased. On the other hand, in certain cases, by agreement between the Administrations concerned, the duration may be less than 15 minutes, provided the line-up is properly carried out. This may be possible, for example, when there are two successive international sound-programme transmissions on the same route and the second involves extending the international sound-programme link already laid up for the first.

Note – In the case of multiple destination transmissions the line-up period can have a longer duration, to be fixed by agreement between the Administrations concerned, e.g., on the order of 25 to 30 minutes.

At the end of the line-up period the international sound-programme link and the control circuits are handed over to the broadcasting organizations at the booked time.

2 Preparatory period

2.1 *Beginning and duration*

When the tests during the line-up period are completed, the *international sound-programme link* is not made available to the broadcasting organizations at the two ends until the time fixed for the beginning of the preparatory period. The chargeable time for the sound-programme transmission commences at the beginning of the preparatory period. The duration of the preparatory period – i.e. the time between handing over the international sound-programme link to the broadcasting organizations and the moment when the programme properly begins – is chosen in each case by the broadcasting organizations so that they can carry out all the tests and adjustments necessary before proceeding with the sound-programme transmission.

Recommendation N.5

SOUND-PROGRAMME CONTROL, SUB-CONTROL AND SEND REFERENCE STATIONS

1 Responsibilities of control and sub-control stations

1.1 For a unidirectional international sound-programme circuit, the receiving end terminal ISPC is normally the control station. The other terminal ISPC is a terminal sub-control station. The functions of the control and sub-control stations are the same as for ordinary telephone circuits. (See Recommendations M.80 [1] and M.90 [2].)

Note – In the case of a reversible sound-programme circuit, setting-up reference measurements and maintenance measurements are carried out for each direction of transmission.

1.2 The international sound-programme link is in all cases the sole responsibility of the telephone Administrations. If the international sound-programme link passes through one or more transit countries, an intermediate sub-control station is also designated for each transit country.

1.3 The national sound-programme circuits at the ends of the link may be the responsibility of either the Administrations or the broadcasting organizations or the two together depending on local arrangements in each particular country.

1.4 The receiving ISPC stations on multiple destination sound-programme circuits or links act as control stations for the circuit or link in accordance with Recommendations M.80 [1] and M.90 [2]. In this case the following additional responsibilities should apply:

a) reporting to the appropriate send reference station (see § 2) the results of measurements made on the circuit and link and the quality assessments observed on the link;

b) reporting fault conditions to the circuit or link send reference station (see § 2).

1.5 The intermediate ISPCs are intermediate sub-control stations for the international sound-programme link.

1.6 The ISPC or the repeater station at the sending end (country A in Figures 2/N.1 and 5/N.1) is a terminal sub-control station for the international sound-programme connection. When a send reference station (see § 2) is associated with a multiple destination communications-satellite link, it has the following responsibilities:

a) coordination of lining up the multiple-destination sound-programme circuit sections, circuits and links, respectively;

b) keeping a record of the measurements made during the lining-up period of the circuit section, circuit or link, and recording the quality assessments observed at control stations during the lining-up of the link;

c) relevant maintenance action for the sub-control and control stations at the request of one of these stations.

However, the choice of the station nominated as the terminal sub-control station is left to the discretion of the Administration concerned.

2 Send reference stations

Sound-programme transmissions provided on a multiple destination basis using a communication satellite system, differ from those using only terrestrial facilities in that the common transmitting path extends through the transmitting earth station to the satellite. The receiving paths extend from the satellite through the receiving earth stations concerned to the terminal ISPC control stations.

Operations on the common path of the connection affect all receiving stations, whereas on any of the other paths the operations affect only the one receiving terminal station involved. These distinctive features of a multiple destination sound-programme transmission provided in the above manner require the assistance of certain stations designated as send reference stations.

Send reference stations are situated along the common path of the sound-programme circuit or link and are identified as follows:

a) a sub-control station located at the transmitting terminal of the circuit section containing the space segment;

b) the terminal sub-control stations for the circuit and link containing the space segment.

Figure 4/N.1 shows the basic composition for a multiple destination sound-programme circuit routed via a communication satellite system. The send reference stations are shown as R and R′ for the multiple destination circuit section and circuit respectively.

Figure 5/N.1 shows the basic composition for a multiple destination sound-programme link and connection routed via a communication satellite system. The send reference stations are shown as R′ and R″ for the multiple destination circuit and link respectively.

References

[1] CCITT Recommendation *Control stations*, Vol. IV, Fascicle IV.1, Rec. M.80.

[2] CCITT Recommendation *Sub-control stations*, Vol. IV, Fascicle IV.1, Rec. M.90.

1.2 Setting-up, lining-up and monitoring the international sound-programme links and connections

It is assumed that the international sound-programme connection is as shown in Figure 2/N.1. It is also assumed that the various sound-programme circuits to be interconnected to constitute the international sound-programme link are circuits established and maintained as given in Subsection 1.3 below.

Recommendation N.10

LIMITS FOR INTERNATIONAL SOUND-PROGRAMME LINKS AND CONNECTIONS

This Recommendation gives the limits, wherever possible, for the various components of the connection shown in Figure 2/N.1. The limits given in Tables 3/N.10 and 4/N.10 for 15-kHz links are target values and apply to links including no more than two intermediate audio interconnection points.

Some Administrations arrange their apparatus in an ISPC so that at the point of interconnection the output impedance of every receive channel or circuit over the frequency band of interest is substantially lower than the input impedance of any send channel or circuit. This is the so-called constant-voltage technique. Other Administrations arrange for an impedance match at the point of interconnection and choose the value of this impedance to be equal to the design resistance of measuring instruments. This is known as the impedance-matching technique (previously referred to as the constant electromotive force technique). It should be noted that in both cases the through-level measurement results relative to the through-level at 800 Hz will be the same. Furthermore the terminated-level measurement results relative to the terminated-level at 800 Hz will also be the same value. [1)]

Hence the limits recommended in the following tables are applicable regardless of the arrangement adopted by Administrations at their ISPCs.

1 Limits for the loss/frequency distortion on an international sound-programme link

The Tables 1/N.10, 2/N.10 and 3/N.10 give the limits for three types of international sound-programme links. Table 1/N.10 is for a link established wholly on 10-kHz circuits, Table 2/N.10 for a link established wholly on 6.4-kHz circuits and Table 3/N.10 for a link established wholly on 15-kHz circuits.

The majority of international sound-programme links are in practice established with three or less circuits in series. For 10-kHz and 6.4-kHz international sound-programme links the limits are three times those recommended for a circuit.

Many links could be established without additional equalizers but links comprising four or more circuits will probably require equalization. In this case the opportunity could again be taken to obtain as good a loss/frequency characteristic as possible.

[1)] This depends on the ratio of the impedances on the send and receive sides at the various frequencies being sensibly constant. (See § 4 of Recommendation N.11.)

TABLE 1/N.10
(Previously Table A/N.10)

Limits for the received level relative to that at 800 Hz for an international sound-programme link composed wholly of 10-kHz sound-programme circuits

Frequency range	Received level relative to that at 800 Hz a)
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz 100 to 200 Hz 200 Hz to 6 kHz 6 to 8.5 kHz 8.5 to 10 kHz	+1.8 to −4.2 dB +1.8 to −2.7 dB +1.8 to −1.8 dB +1.8 to −2.7 dB +1.8 to −4.2 dB
Above 10 kHz	Not greater than 0 dB; otherwise unspecified

a) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on many international circuits.

Multi-frequency measurements made to determine, for example, the loss/frequency characteristic will include a measurement at 800 Hz, and therefore the reference frequency for such characteristics can still be 800 Hz.

Reference should be made to Supplement No. 3.5 [1] concerning measuring frequencies to be used on circuits routed over PCM systems.

TABLE 2/N.10
(Previously Table B/N.10)

Limits for the received level relative to that at 800 Hz for a sound-programme link composed wholly of 6.4-kHz sound-programme circuits

Frequency range	Received level relative to that at 800 Hz a)
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz 100 to 200 Hz 200 Hz to 5 kHz 5 to 6 kHz 6 to 6.4 kHz	+1.8 to −4.2 dB +1.8 to −2.7 dB +1.8 to −1.8 dB +1.8 to −2.7 dB +1.8 to −4.2 dB
Above 6.4 kHz	Not greater than 0 dB; otherwise unspecified

a) See Note a) to Table 1/N.10.

TABLE 3/N.10

Limits for the received level relative to that at 800 Hz for a sound-programme link composed wholly of 15-kHz sound-programme circuits

Frequency range	Received level relative to that at 800 Hz a)
Below 40 Hz	Not greater than 0 dB; otherwise unspecified
40 to 50 Hz 50 to 100 Hz 100 Hz to 10 kHz 10 to 15.0 kHz	+1 to −2.0 dB +1 to −1.5 dB +1 to −1.0 dB +1 to −2.0 dB
Above 15.0 kHz	Not greater than 0 dB; otherwise unspecified

a) See Note a) to Table 1/N.10.

2 Limits for the loss/frequency distortion of an international sound-programme connection

It is not possible at the present time to recommend limits for the sound-programme connection, but every effort should be made by Administrations to provide national sound-programme circuits to as high a standard as possible so that the loss/frequency distortion of the sound-programme connection is not markedly more than that of the sound-programme link.

3 Limits for level and phase difference of a stereophonic pair of links

In addition to the limits specified in Table 3/N.10 for the individual links, Table 4/N.10 gives limits for the parameters which apply to a stereophonic pair of links.

TABLE 4/N.10

Limits for level and phase difference of a stereophonic pair of links

Frequency range	Difference between channels A and B	
	Level	Phase
40 to 50 Hz 50 to 100 Hz 100 Hz to 10 kHz 10 to 12.8 kHz 12.8 to 15.0 kHz	less than 2.0 dB less than 1.5 dB less than 1.2 dB less than 2.0 dB less than 2.0 dB	less than 40° less than 25° less than 20° less than 20° less than 40°

4 Additional parameters

In addition to the limits now specified in this Recommendation, limits for other parameters are under study.

Reference

[1] *Test frequencies on circuits routed over PCM systems*, Volume IV, Fascicle IV.4, Supplement No. 3.5.

ESSENTIAL TRANSMISSION PERFORMANCE OBJECTIVES FOR INTERNATIONAL SOUND-PROGRAMME CENTRES (ISPC)

1 Transmission level at interconnection points

The nominal relative level at interconnection points is not specified by the CCITT and Administrations are free to decide the level themselves, bearing in mind, among other things, the need to ensure an adequate signal-to-noise ratio within the ISPC. However, levels at interconnection points must be such that a signal level of 0 dBm0 on the incoming circuit gives rise to a signal level of 0 dBm0 on the outgoing circuit. It should be noted that some Administrations, particularly those which have adopted so-called constant-voltage techniques, have chosen a nominal relative level of +6 dBr at which to interconnect. However, other Administrations have chosen other levels.

2 Balance with respect to earth

The balance with respect to earth (measured by the method defined in [1] of nominally balanced apparatus should be at least 60 dB in order to give an adequate suppression against longitudinal interference induced by power supplies, alarm circuits, etc.

3 Access points

There should be a well-defined circuit access point associated with the input to a sound-programme circuit at which the transmission test levels at all frequencies over the band are nominally the same. This access point may be the interconnection point or separated therefrom by distortion-free loss or gain. A well-defined circuit access point should also be associated with the output of a sound-programme circuit.

The nominal relative level at each access point will be chosen by each Administration, bearing in mind the dynamic range of their testing and transmission apparatus.

Measurements on a sound-programme circuit should be made between such circuit access points.

Administrations may also find it convenient to arrange for sound-programme circuit sections to be equipped with similar access points. International sound-programme circuit sections which can be connected to a variety of other circuit sections should always be equipped with such access points.

4 Impedance at sound-programme interconnection points

4.1 *Constant voltage technique*

If the modulus of the output impedance of any source is not greater than one hundredth of the modulus of the lowest impedance that can be connected to it (bearing in mind that it is possible to connect two or more loads in parallel) then the change in level due to change of load will be negligibly small (less than 0.1 dB approximately).

4.2 *Impedance matching technique*

If the return loss versus the nominal design resistance of the measuring instruments of the impedance presented by incoming and outgoing circuits to the points where they are interconnected is at least 26 dB over the range 50 Hz to 10 or 15 kHz, the error due to mismatch will be insignificant, assuming that the impedance of testing apparatus has at least 30-dB return loss versus the nominal design resistance, which can be, for example, 600 ohms non-reactive.

Reference

[1] CCITT *Blue Book*, Vol. III, Annex 3, Figure 4B, ITU, Geneva, 1964.

MEASUREMENTS TO BE MADE DURING THE LINE-UP PERIOD THAT PRECEDES A SOUND-PROGRAMME TRANSMISSION

After the connection of the various circuits to form the international sound-programme link (conforming to the level diagrams of these circuits) it is necessary to verify, by means of an automatic measuring equipment (see Recommendations O.31 [1] and O.32 [2]) or by measurements at individual frequencies, that the received level at the distant incoming terminal ISPC is at the correct value (see Recommendation N.10) at the following frequencies:

for an international sound-programme link composed entirely of 15-kHz sound-programme circuits	40, 800 and 15 000 Hz
for an international sound-programme link composed entirely of 10-kHz sound-programme circuits	50, 800 and 10 000 Hz
for an international sound-programme link comprising at least one 6.4-kHz sound-programme circuit	50, 800 and 6 400 Hz
for an international sound-programme link comprising at least one ordinary telephone circuit	300, 800 and 3 400 Hz [1)]

The send level during these measurements should be -12 dBm0.

In the case of 15-kHz sound-programme links forming a stereophonic pair, it is necessary to verify the interchannel parameter limits specified in Table 4/N.10.

A measurement of other parameters such as nonlinear distortion and noise should be measured on all links and the results recorded. At the present time the limits cannot be specified.

The national sound-programme circuits should be so adjusted that, when they are connected to the international sound-programme link, the level diagrams of the international sound-programme circuits are respected.

Any necessary adjustments having been made, the national circuits are connected to the international sound-programme link at the terminal ISPCs. This is the end of the line-up period and the beginning of the preparatory period and is the instant when the complete connection is placed at the disposal of the broadcasting organizations.

The latter then proceed to measure and adjust as necessary.

References

[1] CCITT Recommendation *Specification for an automatic measuring equipment for sound-programme circuits,* Vol. IV, Fascicle IV.4, Rec. O.31.

[2] CCITT Recommendation *Specification for an automatic measuring equipment for stereophonic pairs of sound-programme circuits,* Vol. IV, Fascicle IV.4, Rec. O.32.

Recommendation N.13

MEASUREMENTS TO BE MADE BY THE BROADCASTING ORGANIZATIONS DURING THE PREPARATORY PERIOD

After the broadcasting organizations have taken possession of the international sound-programme connection, they make measurements on the complete connection in the band of frequencies effectively transmitted, from the point where the programme is picked up to the point where the programme is received.

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1) Or the frequency appropriate to the telephone-type circuit used.

The broadcasting organizations should, for their measurements, send to the origin of the international sound-programme connection a sinusoidal signal at the reference frequency (800 or 1000 Hz) only, whose maximum amplitude is 9 dB below that of the maximum instantaneous voltage that should never be exceeded at this point in the course of a sound-programme transmission.

The duration of the period during which the signal at this level is sent should be kept as short as possible, for example, of the order of 30 seconds. If necessary, the ISPCs should verify that the received level at the access point on the international sound-programme circuit is equivalent to 0 dBm0.

When it is necessary, either for purposes of fault location or to maintain a watch on the continuity of the circuit, to send a continuous tone, or when making measurements at other frequencies than the reference frequency, the amplitude at the origin of the international sound-programme connection should be 21 dB below the voltage that should never be exceeded at this point during the course of a sound-programme transmission. Under these circumstances the level at the access point on the international sound-programme circuit is equivalent to -12 dBm0.

During the preparatory period there is no occasion to readjust the output levels at intermediate ISPCs since these have already been set during the line-up period.

Note – The numerical values given above ensure that during the sound-programme transmission the peak voltage at a zero relative level point will not exceed that of a sinusoidal signal having an r.m.s. value of 2.2 volts.

The reason for sending the reference frequency only for short durations during this final line-up, at a voltage 9 dB below the peak voltage is that it is not desirable to subject carrier systems to overloading by continuously transmitting a test signal corresponding to the peak voltage reached only momentarily during the transmission of an actual programme.

Recommendation N.15

MAXIMUM PERMISSIBLE POWER DURING AN INTERNATIONAL SOUND-PROGRAMME TRANSMISSION

General

To check that the maximum power transmitted during a sound-programme transmission does not exceed the limits allowed by Administrations, it is recommended that broadcasting organizations and the terminal ISPCs of the international sound-programme connection should use volume-meters or peak programme meters, the same type of meter being used for preference by both the telephone Administration and the broadcasting organization of a country.

Since the international sound-programme connection is accurately adjusted before it is made available to the broadcasting organizations, there will be no danger of overloading the amplifiers during the sound-programme transmission if care is taken not to exceed the permissible limit at the sending end of the international sound-programme connection.

Hence, this check can be done only by the broadcasting organization and the ISPC of the transmitting country, and a check made further down the line would not seem to be very effective.

If so desired, monitoring equipment (volume-meters, peak-indicators) can be connected at the receiving end of the international sound-programme link and of the international sound-programme connection to obtain information about the general nature of the transmission. In this case, monitoring equipment at the two locations in the incoming country will have to be of the same type, but there is no need for the same kind of monitoring equipment to be used in both outgoing country and incoming country.

1 Maximum level permitted on sound-programme circuits

The peak power permitted on a sound-programme circuit should not exceed +9 dBm at a point of zero relative level on the sound-programme circuit.

(This corresponds to a peak voltage of 3.1 volts when measured as a 600-ohm through-level at a zero through relative level point. The r.m.s. value of the sinusoidal signal with this peak value is 2.2 volts).

2 Maximum level permitted on an international telephone circuit used to carry a sound-programme transmission

The power permitted on the international telephone circuit carrying a sound-programme transmission should not exceed +3 dBm at a point of zero relative level on the international telephone circuit. To allow the +9 dBm0 peak level permitted on a sound-programme circuit a 6 dB loss should be introduced at a point before the international telephone circuit enters a carrier system. At the receiving side a corresponding amplification of 6 dB at the end of the telephone circuit should be provided.

This reduction is necessary to avoid overloading on the carrier's system. Reasons for the possible overload are:

a) Commentary circuits are used in one direction only in comparison to a normal telephone connection. This leads to an increase of the mean power level.

b) In most cases the broadcasting authorities use better quality microphones compared with normal telephone sets.

Experience has shown that an attenuation of 6 dB is the most suitable value for this purpose.

Recommendation N.16

IDENTIFICATION SIGNAL

At times during the preparatory period when no test transmission is taking place and during pauses when no programme transmission is taking place it is very desirable for broadcasting organizations to arrange that their studios and transmitting stations send *identification signals* over the international sound-programme connection and over the control circuits whilst they are not in use to indicate that the circuits are connected. During the preparatory period, particularly, the identification signal will serve to show for which sound-programme transmission the circuit is to be used.

This identification signal will not be broadcast, so that it will not be heard by listeners, but will be transmitted from end to end of the international sound-programme connection, from the programme origin to the destination.

The level of the identification signal applied to a sound-programme connection should not exceed a mean absolute power level of −15 dBm0.

Recommendation N.17

MONITORING THE TRANSMISSION

The transmission may be monitored in the terminal ISPCs by means of loudspeakers and/or apparatus with a visual display (peak programme meters, vu-meters, oscilloscopes, etc.). The means for monitoring the transmission should allow both visible and audible indications.

MONITORING FOR CHARGING PURPOSES, RELEASING

The monitoring of an international sound-programme transmission for charging purposes is carried out at the terminal ISPC of the international sound-programme link.

The technical staff of the designated ISPCs should come to an arrangement among themselves so that at the end of the sound-programme transmission they have accurate knowledge of:

a) the time of handing over the sound-programme link to the broadcasting organization (beginning of chargeable duration);

b) the time at which the sound-programme link is released by the broadcasting organization (end of chargeable duration);

c) where appropriate, the times and duration of every interruption or incident which may have occurred (in order to allow the operating services to determine whether a rebate is due, and if so, its amount).

The times of the beginning and of the end of the chargeable duration, as well as the times of occurrence and duration of any breakdowns which may occur, are entered on a daily report. This daily report is sent on the same day to the service responsible for coordinating all the details necessary for the establishment of the international accounts.

The conditions governing charging for sound-programme circuits and control circuits are given in Recommendation D.180 [1].

Reference

[1] CCITT Recommendation *International sound- and television-programme transmissions,* Vol. II, Fascicle II.1, Rec. D.180.

1.3 Lining-up and maintenance of international sound-programme circuits

Recommendation N.21

LIMITS AND PROCEDURES FOR THE LINING-UP OF A SOUND-PROGRAMME CIRCUIT

This Recommendation gives, in § 1, the limits for the loss/frequency distortion of the circuit shown in Figures 1/N.1, 3/N.1 and 4/N.1 and, in § 2, the lining-up procedure of the circuit. The lining-up limits for 15-kHz circuits are under study. As a provisional guide the limits of Recommendation N.23 for the various parameters should be used.

1 Limits for the loss/frequency distortion of the component parts of an international sound-programme circuit (formerly Part A)

The limits are expressed in terms of the received level relative to the value of the received level at 800 Hz [1) 2)]. Some remarks with regard to the impedance at the points of interconnection are given in the introduction to Recommendation N.10.

1) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on many international circuits.

Multi-frequency measurements made to determine, for example, the loss/frequency characteristic will include a measurement at 800 Hz, and therefore the reference frequency for such characteristics can still be 800 Hz.

2) See CCIR Report 820 [1]

1.1 *Limits for loss/frequency distortion of sound-programme circuit sections*

It is not possible or desirable at this time to recommend limits for circuit sections.

1.2 *Limits for loss/frequency distortion of international sound-programme circuits*

The following Tables 1/N.21 and 2/N.21 give, respectively, the limits recommended for 10-kHz and 6.4-kHz sound-programme circuits.

TABLE 1/N.21
(Previously Table A/N.21)

Limits for the received level relative to that at 800 Hz for a 10-kHz sound-programme circuit

Frequency range	Received level relative to that at 800 Hz
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz 100 to 200 Hz 200 Hz to 6 kHz 6 to 8.5 kHz 8.5 to 10 kHz	+0.6 to −1.4 dB +0.6 to −0.9 dB +0.6 to −0.6 dB +0.6 to −0.9 dB +0.6 to −1.4 dB
Above 10 kHz	Not greater than 0 dB; otherwise unspecified

TABLE 2/N.21
(Previously Table B/N.21)

Limits for the received level relative to that at 800 Hz for a 6.4-kHz sound-programme circuit

Frequency range	Received level relative to that at 800 Hz
Below 50 Hz	Not greater than 0 dB; otherwise unspecified
50 to 100 Hz 100 to 200 Hz 200 Hz to 5 kHz 5 to 6 kHz 6 to 6.4 kHz	+0.6 to −1.4 dB +0.6 to −0.9 dB +0.6 to −0.6 dB +0.6 to −0.9 dB +0.6 to −1.4 dB
Above 6.4 kHz	Not greater than 0 dB; otherwise unspecified

International sound-programme circuits set up between ISPCs in any particular continent should usually be routed on a single group link (which includes only one circuit section, that is, one equipment for modulation from audio-frequencies and one for demodulation to audio-frequencies). Long international sound-programme circuits between ISPCs in different continents should not comprise more than three circuit sections.

Sound-programme circuits such as those associated with television transmissions using communication satellite systems are normally provided on a temporary basis. The international sound-programme circuit section is established via the satellite link(s) each time it is required for service. It should be noted that the group carrying the sound-programme circuit may terminate either at the earth station or at an international terminal repeater station.

The possible combination of group-terminals and the number of group-sections required for sound-programme circuits established by satellite link(s) are such that it may not be possible to meet the group-link limits without group-link equalization for each sound-programme circuit set up.

To avoid this situation, it may become necessary to tighten the limits for the loss at all frequencies and for the loss at the approximate mid-band frequency of the national and satellite group-sections.

Modern carrier sound-programme equipment for a 10 kHz sound-programme circuit can easily meet the characteristic proposed in Table 1/N.21. Furthermore, experience shows that such a characteristic can easily be met by a circuit provided on equalized unloaded cable pairs up to 320 km long. Hence the adoption of this characteristic as a target for the future should not be embarrassing. Some older types of carrier sound-programme equipment will probably need additional equalizers to comply with the limits. When a circuit is to be equalized, the opportunity should be taken to obtain as good a level/frequency characteristic as possible.

2 Lining-up procedures (formerly Part B)

When each national section of the international sound-programme circuit and each section crossing a frontier has been equalized for loss/frequency distortion and, where necessary, for phase/frequency distortion, so as to meet CCITT Recommendations, these various sections are interconnected to form the complete international sound-programme circuit.

When agreement has been reached between two countries, operating via a communication satellite, to provide sound-programme circuits on a temporary basis, it is necessary to carry out an initial line-up of the sound-programme circuit using the same satellite and terrestrial facilities as will be used each time a sound-programme transmission is required.

In the case of international multiple destination sound-programme circuits, the number and location of all destinations is known only at the time of a transmission booking. The lining-up can therefore be carried out only after the booking details are known and must be carried out prior to the transmission.

The individual basic groups will have been set up and lined up for single destination sound-programme circuit requirements. When these are formed into a multiple-destination group, only pilot levels need be checked. The send reference station for the multiple destination group will coordinate this work in accordance with Recommendation M.460 [2].

2.1 *Measurement of received level* [1]

A test signal of 800 Hz is applied to the sending end of the international sound-programme circuit at a level equivalent to -12 dBm0. The level is measured at the receiving end of the circuit (output of last amplifier) and is adjusted to the nominal value appropriate to the ISPC (for example, -6 dBm).

An automatic measuring equipment (see Recommendation O.31 [3]) may then be used to trace the curve of received level with frequency at the receiving end of the circuit. If no such equipment is available, individual measurements must be made at the terminal ISPC and at the frontier section at the following frequencies:

- for a 10-kHz circuit: 50, 80, 100, 200, 500, 800, 1000, 2000, 3200, 5000, 6000, 8500, 10 000 Hz; and if considered useful: 30, 40, 11 000, 12 000 and 15 000 Hz:

- for a 6.4-kHz circuit: 50, 80, 100, 200, 500, 800, 1000, 2000, 3200, 5000 and 6400 Hz.

The equalizers are adjusted to bring the curve within CCITT limits, which are given above.

2.2 *Measurement of group-delay distortion* [1]

If necessary, the group-delay distortion/frequency characteristic is plotted for the whole international sound-programme circuit.

2.3 *Measurement of circuit noise*

When, after all necessary adjustments, the international sound-programme circuit meets the CCITT Recommendations, noise measurements are made.

These should consist of:

- the unweighted noise reading at the end of the international sound-programme circuit, using a measuring set having a frequency range of about 30 to 20 000 Hz, an instrument showing r.m.s. values and an integrating time of about 200 ms (Recommendation P.53 [4]) or using a measuring set conforming to CCIR Recommendation 468-2 [5];
- the weighted noise reading using a meter and network conforming to Recommendation P.53 [4] or CCIR Recommendation 468-2 [5] or a combination of these (see Table 3/N.21).

Table 3/N.21 gives the limiting values at a point of zero relative sound-programme level for various types of circuit having a length of about 2500 km using various combinations of meter and network.

TABLE 3/N.21
(Previously Table C/N.21)
Noise measurements

Test conditions	Cable circuits Carrier circuits	Open-wire lines	Units
CCITT Recommendation P.53 [4] (meter and network) – unweighted – weighted	 –28 –48	 –20 –40	 dBm0s dBm0ps
CCITT Recommendation P.53 [4] meter CCIR Recommendation 468-2 [5] network – unweighted – weighted	 –28 –44	 –20 –36	 dBm0s dBm0ps
CCIR Recommendation 468-2 [5] (meter and network) – unweighted – weighted	 –23 –39	 –15 –31	 dBq0s dBq0ps

Note 1 – The figures given for the test conditions of CCITT Recommendation P.53 [4] represent the existing limits. A change of network to that of CCIR Recommendation 468-2 [5] will give a change of measurement of flat noise of +4 dB. Similarly, a change from an *r.m.s.* meter (Recommendation P.53 [4]) to the quasi-peak meter of CCIR Recommendation 468-2 [5] will give a change of measurement of +5 dB. These values have been incorporated in the above table in so far as they give the average change for different types of noise.

Note 2 – When measuring noise levels there may be cases when the weighted noise values are within those stated in the table and the unweighted noise values are not within the limits in the table or vice versa. This may show the presence of a single tone interference of high level. In such a case the maintenance staff should, by means of a selective set, determine the frequency of this interfering signal and take measures to eliminate it.

2.4 *Measurement of nonlinearity distortion*

For circuits routed entirely on audio pairs and not equipped with pre-emphasis equipment the nonlinearity distortion is measured at the end of the international sound-programme circuit by sending, for a few seconds, a sinusoidal signal at an appropriate frequency in the band to be transmitted at a level of +9 dBm0.

For a circuit which includes at least one carrier section no measurement of nonlinearity distortion should be made. However, if, in very exceptional cases, it should be essential, in order to provide service on such a circuit, to carry out a check of nonlinearity distortion, for example, to locate a fault, the frequency of the sent signal should not exceed 1000 Hz at +9 dBm0 and the period for which the tone is connected should be as short as possible – that is, not more than about four seconds. However the best procedure would be to use a suitable automatic measuring equipment if such is available (see Recommendation O.31 [3]).

The total harmonic-distortion coefficient for the sound-programme hypothetical reference-circuit (2500 km) must not exceed 4% (harmonic margin 28 dB) at any frequency [3)] within the transmitted band. For shorter and for less complex circuits, the distortion should be less.

Moreover, since end-to-end measurements of nonlinearity distortion on circuits routed on carrier systems might give rise to serious disturbance to transmission on other channels, especially if the group is transmitted on a transistorized carrier system, it is permitted to make only local measurements of non-linearity distortion on terminal modulating and demodulating equipments. For example, a sound-programme circuit modulating and demodulating equipment could be connected back-to-back via a suitable network (and suitable amplifiers if necessary) and the measurement made on the resulting complete assembly.

2.5 *Record of results*

The final measurements made under the above headings when the circuit has been lined up are reference measurements and should be carefully recorded.

References

[1] CCIR Report *Relative values of sound-programme signal levels established with the vu meter and with a peak-programme meter*, Vol. XII, Report 820, ITU, Geneva, 1978.

[2] CCITT Recommendation *Bringing international group, supergroup, etc., links into service*, Vol. IV, Fascicle IV.1, Rec. M.460.

[3] CCITT Recommendation *Specification for an automatic measuring equipment for sound-programme circuits*, Vol. IV, Fascicle IV.4, Rec. O.31.

[4] CCITT Recommendation *Psophometers (apparatus for the objective measurement of circuit noise)*, Vol. V, Rec. P.53.

[5] CCIR Recommendation *Methods of synchronizing various recording and reproducing systems*, Vol. X, Rec. 468-2, ITU, Geneva, 1978.

Recommendation N.23

ROUTINE MAINTENANCE MEASUREMENTS TO BE MADE ON INTERNATIONAL SOUND-PROGRAMME CIRCUITS

The following routine maintenance measurements should be made every two months:

1 10-kHz and 6.4-kHz sound-programme circuits

1.1 *Measurement of received level*

The level at the end of the international sound-programme circuits should be measured at 800 Hz. The send level should be −12 dBm0. The received level at 800 Hz should be adjusted, if necessary, to its nominal value.

The level at the end of the international sound-programme circuits should be measured at the following frequencies:

- for a 10-kHz circuit: 50, 100, 200, 800, 3200, 5000, 6000, 8500 and 10 000 Hz;
- for a 6.4-kHz circuit: 50, 100, 200, 800, 3200, 5000 and 6400 Hz.

If it is found that the level for a particular frequency at the receiving end of the international sound-programme circuit is not within the specified limits, the reference measurements should be repeated, calling in the frontier stations to determine the faulty sections. Further overall measurements are then made to ensure that the specified limits are respected.

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3) The European Broadcasting Union has stated that many of its members have expressed the opinion that for a circuit 1500 km long, acceptable limits for nonlinearity distortion would be:

40 dB at fundamental frequencies above 100 Hz,

34 dB at fundamental frequencies of 100 Hz and below.

1.2 *Measurement of circuit noise*

At the time of the two-monthly maintenance measurements the noise at the receiving end of the international sound-programme circuit should be measured [see Recommendation N.21, § 2.3].

1.3 *Measurement of nonlinearity distortion*

After measurements of level have been made and any necessary adjustment has been carried out, the nonlinearity distortion should be measured, to ensure that the circuit concerned can transmit sound-programme signals with the required quality.

Measurements are made under the conditions described in Recommendation N.21, § 2.4, and with the same restrictions concerning circuits on carrier groups or equipped with emphasis networks.

Provisionally, the CCITT recommends the use of a measuring instrument that indicates total harmonic power rather than a selective instrument of the wave-analyzer type with which the final value of harmonic margin is obtained only after much calculation.

2 15-kHz sound-programme circuits and stereophonic pairs of such circuits

Tables 1/N.23 and 2/N.23 give limits which apply to circuits containing no intermediate audio point and therefore differ from the circuit construction given in Figure 1/N.1.

TABLE 1/N.23

Limits for a 15-kHz sound-programme circuit

	Quality criteria		Limit	Unit
1	Received level at 800 Hz (−12 dBm0)		− 12 ± 1	dBm0
2	Weighted noise	(r.m.s.) old network	− 51	dBm0ps
		new network	− 47	dBm0ps
		(peak) old network	− 46	dBq0ps
		new network	− 42	dBq0ps
3	Unweighted noise	(r.m.s)	− 41	dBm0s
		(peak)	− 36	dBq0s
4	Nonlinear distortion	k_2 (0.09)	> 45	dB
		k_3 (0.06)	> 45	dB
		d_3 (0.8/1.42)	> 47	dB
		k_2 (0.8)	> 47	dB
		k_3 (0.533)	> 47	dB
5	Deviation of 12-dB step level (+ 6/− 6 dBm0)		< ± 0.5	dB
6	Level frequency response relative to 0.8 kHz	40 to 50 Hz	+ 0.5 to − 1.5	dB
		0.05 to 12.8 kHz	+ 0.5 to − 0.5	dB
		12.8 to 15 kHz	+ 0.5 to − 1.5	dB

TABLE 2/N.23

Additional limits to those of Table 1/N.23 in case of a stereophonic pair of circuits

Quality criteria		Limit	Unit
Level difference A/B	0.04 – 0.05 kHz	< 1	dB
	0.05 – 12.8 kHz	< 0.5	dB
	12.8 – 15.0 kHz	< 1	dB
Phase difference A/B	0.04 – 0.05 kHz	< 20	Degree
	0.05 – 12.8 kHz	< 10	Degree
	12.8 – 15.0 kHz	< 20	Degree
Crosstalk A/B at:	0.18 kHz	> 50	dB
	1.6 kHz	> 50	dB
	9.0 kHz	> 50	dB

The quality criteria given refer to those of Recommendation O.32 [1]. The limits can be easily measured with the aid of such equipments. If other measuring means are used, attention is drawn to the fact that the frequencies of 10, 11.92 and 14 kHz should be avoided because of possible stop filters which may be inserted in the transmission equipment concerned for reducing carrier leaks.

3 Release of circuit for routine measurements

Notwithstanding any understanding with a renter that routine tests shall, in general, be carried out at certain times, the ISPC must agree with the renter of a permanently leased circuit on the time that that circuit shall be taken for tests each time a routine test is to be carried out.

Reference

[1] CCITT Recommendation *Specification for an automatic measuring equipment for stereophonic pairs of sound-programme circuits*, Vol. IV, Fascicle IV.4, Rec. O.32.

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SECTION 2 [1)]

INTERNATIONAL TELEVISION TRANSMISSIONS

2.1 International television transmissions – Definitions and responsibilities

Recommendation N.51

DEFINITIONS FOR APPLICATION TO INTERNATIONAL TELEVISION TRANSMISSIONS

The following definitions apply to the maintenance of international television transmissions. Other definitions are used for other purposes, e.g. an international television link and international multiple destination television link as defined in §§ 11 and 12 respectively below, are within the definition of an international television circuit as defined by the CMTT.

Note 1 – It is intended that the definitions given in Recommendations N.1 and N.51 should remain identical, so far as is practical, by use of only simultaneous amendments.

Note 2 – A television circuit section, circuit, link or connection is considered to be permanent for maintenance purposes if it is always available for use when required, whether or not it is continuously in use. Such a circuit may be used for the purposes of occasional transmission, i.e. transmissions of short duration (e.g. less than 24 hours) or it may be used for a long duration, i.e. one day or more. A permanent television connection between broadcasting organizations' premises may be used at any time, except only for periods of maintenance as agreed between the Administrations and broadcasting organizations concerned.

A television circuit section, circuit, link or connection is considered to be temporary for maintenance purposes when it has no existence outside the period of transmission (including line-up and testing time) for which it is required.

1 international television transmission

The transmission of video signals over the international telecommunication network for the purpose of interchanging television material between broadcasting organizations in different countries.

2 broadcasting organization

A broadcasting organization is an organization which is concerned with either or both sound and television broadcasting. Most of the customers ordering facilities for sound-programme and television transmission are broadcasting organizations; for convenience, the term broadcasting organization is used to denote the activity of any user or customer and, where so used, it is equally applicable to any other customer requiring sound-programme or television transmissions.

1) In general, for CCIR Recommendations concerning television, see CCIR Vol. XII, Geneva, 1978.

3 **broadcasting organization (send)**

The broadcasting organization at the sending end of an international television transmission.

4 **broadcasting organization (receive)**

The broadcasting organization at the receiving end of an international television transmission.

5 **international television centre (ITC)**

A centre at which at least one international television circuit (see § 9) terminates and in which international television connections (see § 13) can be made up by the interconnection of international and national television circuits.

6 **national television centre (NTC)**

A centre at which two or more national television circuits terminate and at which national television circuits may be interconnected.

7 **television circuit section**

The unidirectional national or international television transmission path between two stations at which the programme is accessible at video frequencies. The transmission path may be established via terrestrial or single destination satellite routing. (See Note 2 above and Figures 1/N.51 and 3/N.51.)

8 **international multiple destination television circuit section**

The unidirectional television transmission path from one frontier station to two or more of the frontier stations at which interconnection is made at video frequencies. (See Note 2 above and Figure 4/N.51.)

9 **international television circuit**

The transmission path between two ITCs which comprises one or more television circuit sections (national or international) together with any necessary video equipment. The transmission path may be established via terrestrial or single destination satellite routing. (See Note 2 above and Figures 1/N.51 and 3/N.51.)

10 **international multiple destination television circuit**

The unidirectional transmission path from one ITC to two or more other ITCs comprising television circuit sections (national or international) one of which is an international multiple destination circuit section, together with any necessary video equipment. (See Note 2 above and Figure 4/N.51.)

11 **international television link**

The unidirectional transmission path between the ITCs of the two terminal countries involved in an international television transmission. The international television link comprises one or more international television circuits (see Figures 1/N.51 and 3/N.51) interconnected at intermediate ITCs. It can also include national television circuits in transit countries. (See Note 2 above and Figure 2/N.51.)

12 **international multiple destination television link**

The unidirectional transmission path between the ITCs of the terminal countries involved in an international multiple destination television transmission. The international multiple destination television link comprises international television circuits, one of which is an international multiple destination television circuit. (See Note 2 above and Figure 5/N.51.)

13 **international television connection**

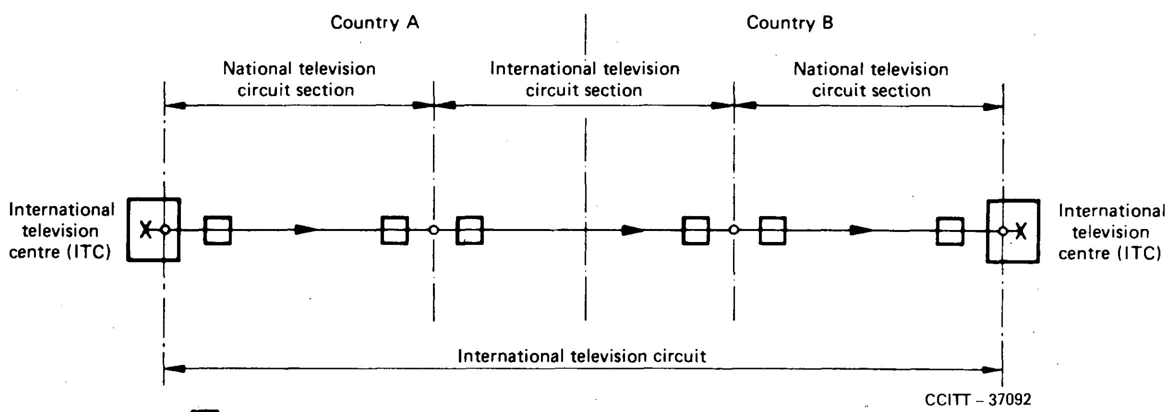
The unidirectional transmission path between the broadcasting organization (send) and the broadcasting organization (receive) comprising the international television link extended at its two ends over national television circuits to the broadcasting organization. (See Note 2 above and Figure 2/N.51.)

14 international multiple destination television connection

The unidirectional transmission path between the broadcasting organization (send) and two or more broadcasting organizations (receive) comprising the international multiple destination television link extended at its end over national television circuits to the broadcasting organizations. (See Note 2 above and Figure 5/N.51.)

15 send reference station

The transmit sub-control station of an international multiple destination television circuit section (see § 8), circuit (see § 10) or link (see § 12). (See Figures 4/N.51 and 5/N.51.)

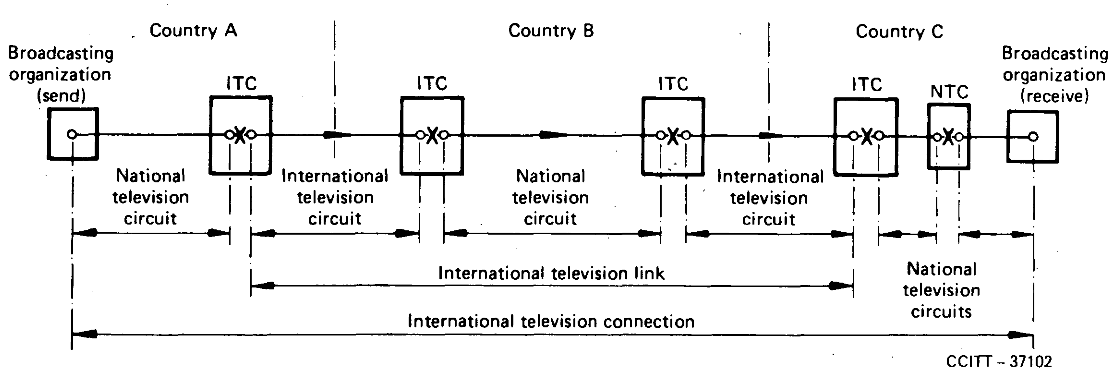


Video equipment proper to a circuit-section

X Video equipment associated with switching apparatus

FIGURE 1/N.51

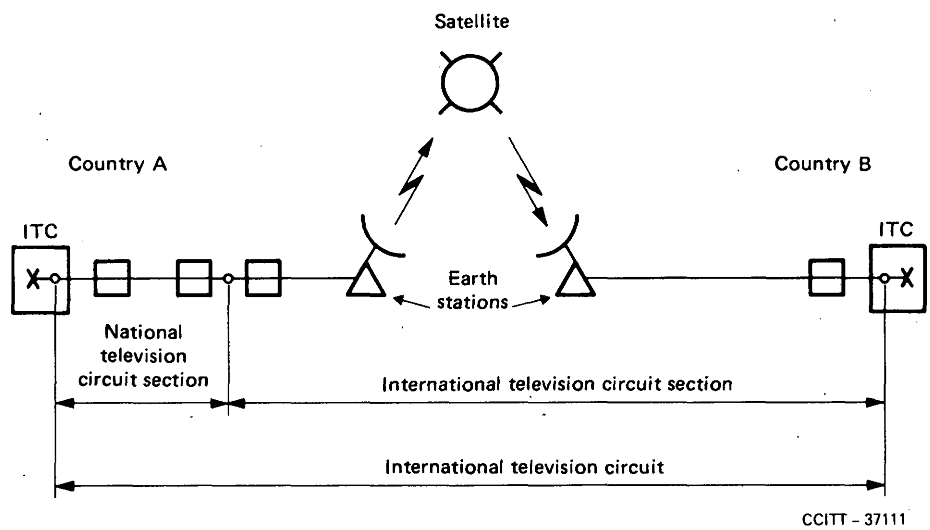
An international television circuit composed of two national and one international television circuit sections



X Video equipment associated with switching apparatus

FIGURE 2/N.51

An international television link composed of international and national television circuits and extended on national television circuits at each end to form an international television connection



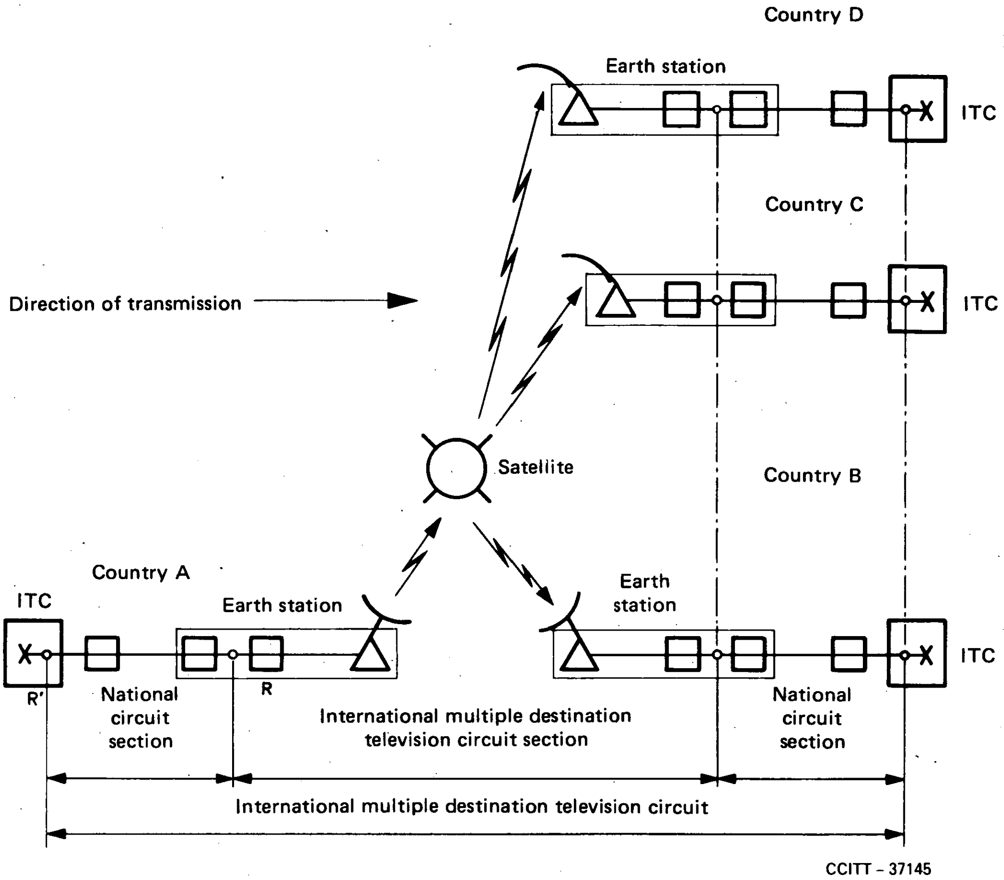
Video equipment proper to a circuit section

X Video equipment associated with switching apparatus

ITC International television centre

FIGURE 3/N.51

Single destination international television circuit routed via a communications satellite



⊟ Video equipment proper to a circuit section

X Video equipment associated with switching apparatus

ITC International television centre

R *Send reference* station for international circuit section

R′ *Send reference* station for international circuit

FIGURE 4/N.51

International multiple destination television circuit comprising an international multiple destination satellite circuit section and national terrestrial circuit sections

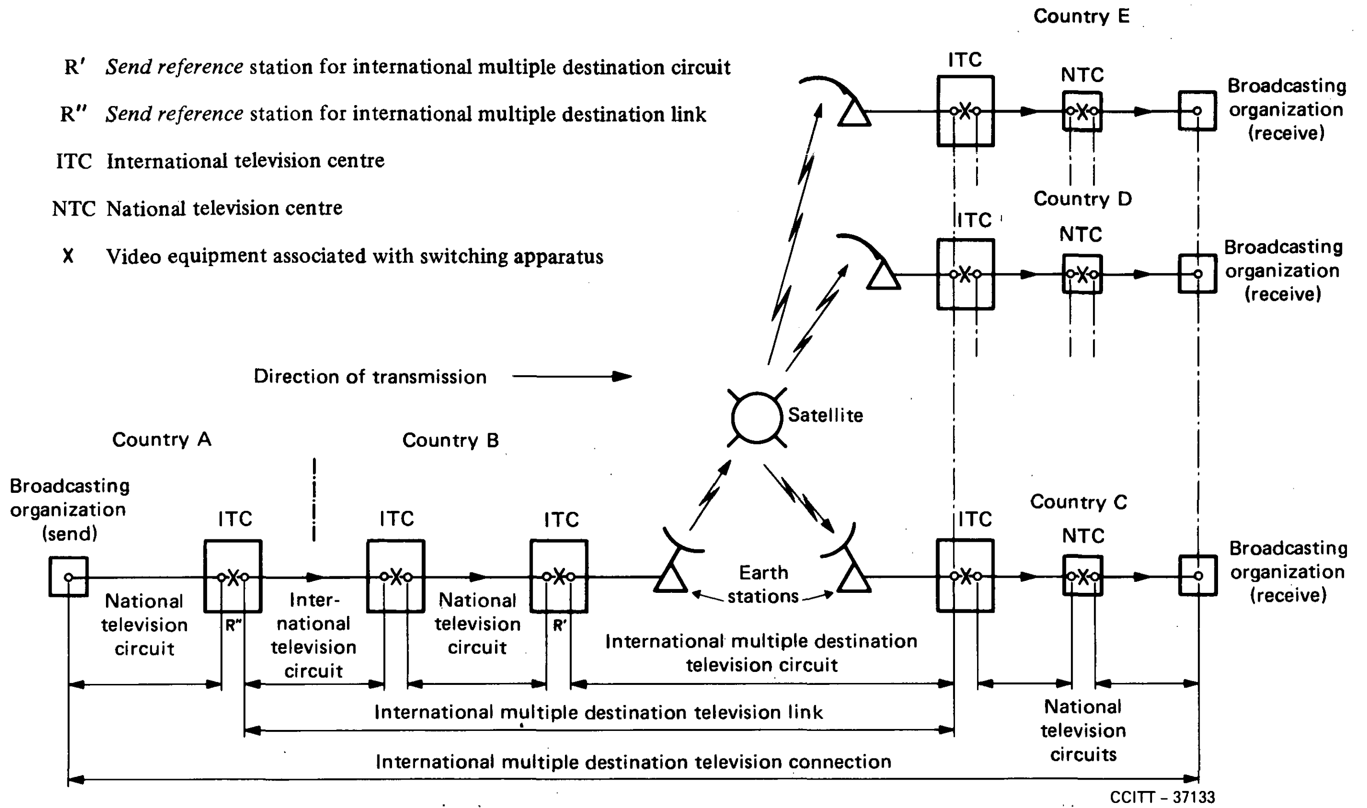


FIGURE 5/N.51

An international multiple destination television link composed of an international multiple destination television circuit and national and international television circuits extended on national circuits at each end to form an international multiple destination television connection

Recommendation N.52

MULTIPLE TELEVISION TRANSMISSIONS AND COORDINATING CENTRES

A multiple television transmission occurs when the same programme is transmitted to several broadcasting organizations, for broadcasting by their transmitting stations or for making recordings.

If the branching point of the television transmission is at the originating point of the programme each unidirectional path to a receiving broadcasting organization is considered to be an individual international television connection.

Otherwise, the term *derived television transmission* is used. The telecommunication Administrations concerned should agree on the choice of a control station. The branching points will be sub-control stations. To meet the needs of the telecommunication Administrations, the control station should have the necessary staff and appropriate control circuits to the sub-control stations for the different sections.

The broadcasting organization will designate a coordinating centre to perform the following functions:

– to coordinate the requests made by the broadcasting organizations participating in the transmission concerned;

– to make all necessary enquiries as to the availability of television circuits;

– to draw up the plan of the network of telephone circuits, sound-programme circuits and television circuits, required for the transmission in question;
– to ensure that the television transmission proceeds normally once the international television connections are handed over to the broadcasting organization;
– immediately to call in the control station and sub-control station concerned, in the event of breakdown or complaints concerning the technical performance of the connections.

Recommendation N.54

DEFINITION AND DURATION OF THE LINE-UP PERIOD AND THE PREPARATORY PERIOD

1 Definition

For each international television transmission a distinction is made between:

– **line-up period**

The period during which the telecommunication Administrations line up the international television link before handing it over to the broadcasting organizations; and

– **preparatory period**

The period during which the broadcasting organizations carry out their own adjustments, tests, etc., before the television transmission itself commences.

The exact time at which the preparatory period begins (point *H* on Figure 1/N.54) is determined by the broadcasting organizations.

2 Line-up period

It is provisionally recommended that, in principle, the duration of the line-up period should nominally be 30 minutes, subdivided into two periods, for the operations described below (see Figure 1/N.54).

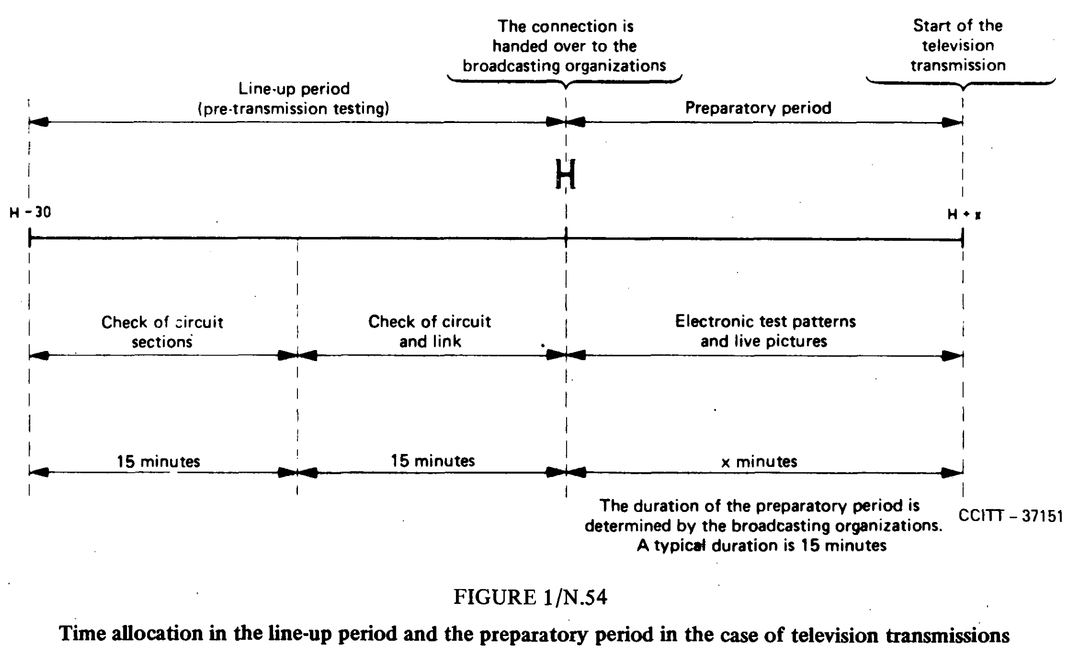


FIGURE 1/N.54

Time allocation in the line-up period and the preparatory period in the case of television transmissions

H −30 to H −15: Concurrent lining-up of the national and international circuit sections that will be used to constitute the international television circuit. The international circuit sections may or may not include a communications satellite. The tests to be made are those given in Recommendation N.62. Tests between the earth stations of a communications satellite circuit section are not the responsibility of the CCITT but these tests also should be completed by time *H −15.*

H − 15 to H: Interconnection of the circuit sections to be used, confirmation that the international television circuit is continuous between the terminal ITCs and overall tests between the control ITC and the sub-control ITC. The tests to be made are those given in Recommendation N.62 [1].

The above periods *H − 30 to H − 15* and *H − 15 to H* are indicated for guidance only. Their duration is based on an estimate of the time necessary to perform the tests in Recommendation N.62 with a reasonable allowance for adjustments. No allowance is included for the removal of fault conditions on the circuit sections or on the complete circuit link.

These periods also assume a configuration of the international television circuit [2] consisting of one international circuit section extended at each end by one national circuit section. In the case of television transmissions involving more than two countries, either or both of the nominal periods *H − 30 to H − 15* and *H − 15 to H* may have to be increased. On the other hand, in particular cases, either or both of these nominal periods may be reduced, by agreement between the Administrations concerned, provided the line-up is properly carried out. This may be possible, for example, when there are two successive international television transmissions on the same route, and the second involves extending the international television circuit or link already lined-up for the first.

During the last few minutes of the nominal period *H − 15 to H*, when the above tests have been completed, the control and sub-control ITCs [3] should put the link through to the broadcasting organization at each end and should confirm that the complete connection is continuous. It should be verified that the link [2] is satisfactory for transmitting the programme, and that the quality and level are acceptable.

By agreement between the telecommunication Administration and the sending broadcasting organization, it might be desirable, during these last few minutes before the end of the line-up period, to transmit live pictures. This would be of particular use when adjusting standards converters. The transmission of live pictures during the line-up period does not, however, alter the telecommunication Administrations' responsibility with regard to the quality of transmission required. This responsibility begins only at time *H*, when the line-up period ends and the preparatory (service) period begins, and when the link is handed over to the broadcasting organizations.

3 Preparatory period

No definite duration is recommended by the CCITT for the preparatory period. This duration is determined by the broadcasting organizations, but a typical duration is 15 minutes. During this period, the tests to be made are also left to the discretion of the broadcasting organizations, but they must not be such as to depart from CCITT recommendations in respect of signal level (see Recommendations N.60 and N.63). The broadcasting organizations may, on occasion, omit the preparatory period and begin the actual transmission at time *H*.

Recommendation N.55

ORGANIZATION, RESPONSIBILITIES AND FUNCTIONS OF CONTROL AND SUB-CONTROL ITCs AND CONTROL AND SUB-CONTROL STATIONS FOR INTERNATIONAL TELEVISION CONNECTIONS, LINKS, CIRCUITS AND CIRCUIT SECTIONS

1 Organization

1.1 The international television link is in all cases the sole responsibility of the telecommunication Administrations involved.

1.2 The national television circuits at the ends of the link may be the responsibility of either the telecommunication Administration or the broadcasting organization or the two together, depending on local arrangements in each particular country.

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[1] See the comment in Recommendation N.62 concerning the difficulties involved in making overall tests on circuits that include a standards converter.

[2] According to the Study Group IV definition, in this particular case, the international television circuit is also an international television link.

[3] See Recommendation N.55 for definition of control and sub-control ITCs.

1.3 The ITC at the receiving end (country C in Figure 2/N.51) is normally the control station for both the international television link and the international television connection and is referred to as the control ITC. The choice of the station which is to have this function is left to the discretion of the Administration concerned.

1.4 The intermediate ITCs, where the international circuit appears at video frequencies, are sub-control stations for the international television link and are referred to as intermediate sub-control ITCs.

1.5 Circuit sections, including satellite sections, also have control and sub-control stations. From the standpoint of overall control arrangements for an international television link, a station controlling a circuit section is referred to herein as an intermediate sub-control station.

1.6 The ITC at the sending end (country A in Figure 2/N.51) is normally the sub-control station for both the international television link and the international television connection. It is also referred to as the terminal sub-control ITC. However, the choice of the station which is to have this function is left to the discretion of the Administration concerned.

2 Responsibilities

2.1 The control ITC is responsible to the broadcasting organization (receive) for the satisfactory performance of the overall international television connection. When an international television connection does not include a satellite section, the control ITC should exert control through intermediate sub-control ITCs, and stations, on that portion of the international television connection extending from the terminal sub-control ITC to the broadcasting organization (receive). When an international television connection does include a satellite section, the control ITC should exert control through intermediate sub-control ITCs, and stations, on that portion of the international television connection extending from the transmitting earth station to the broadcasting organization (receive).

2.2 When an international television connection does not include a satellite section, control of that portion of the international television connection extending from the broadcasting organization (send) to the terminal sub-control ITC should be exerted through the terminal sub-control ITC. When an international television connection does include a satellite section, control of that portion of the international television connection extending from the broadcasting organization (send) to the transmitting earth station should be exerted through the terminal sub-control ITC. In each case, the terminal sub-control ITC is, in turn, responsible for the satisfactory performance of that portion of the connection over which the terminal sub-control ITC has control responsibility; the terminal sub-control ITC should coordinate the activities of any intermediate sub-control ITCs, and stations, both prior to and during the transmission, thus assisting the control ITC and keeping that office informed of developments.

2.3 The receive earth station is the control station for the satellite circuit section. Reference to the control station for the satellite circuit section is intended to apply to the station, or portion of the station, manned by personnel of the satellite operator.

2.4 Any intermediate sub-control ITCs, and other intermediate sub-control stations, are responsible for the satisfactory performance of their respective circuits and circuit sections. In the operation of an international television connection, any sub-control ITCs and stations which are intermediate are responsible to either the terminal sub-control ITC or the control ITC, depending upon their location in the overall connection.

3 Functions

3.1 All stations which are designated as control and sub-control stations on an international television connection should perform the following functions:

- ensure that sections under each respective control are conditioned for service and connected into the international television connection at the appropriate time;
- time the start and conclusion of the transmission in accordance with § 5 below;
- keep complete and accurate records of all station activities pertaining to the international television transmission. This should include timing and recording service impairment observed or reported, and taking corrective action under the direction of the control or terminal sub-control ITC;
- prepare and forward prescribed reports.

3.2 Control and terminal sub-control ITCs on an international television connection should perform the following additional functions:

- verify the scheduling of the television transmission and the availability of information necessary to furnish it;
- perform and coordinate, as required, prescribed pre-transmission line-up tests;
- check the satisfactory receipt, by the broadcasting organization (receive), of the test programme originated by the broadcasting organization (send);
- ensure that the international television connection is handed over to the broadcasting organizations at the scheduled time.

3.3 In order to perform the above functions satisfactorily it is essential that adequate and direct communications be available between terminal ITCs during the line-up and service periods. It is preferable that such communications be provided by direct service circuits (as those specified in Recommendation M.100 [1]), the requirement for television being analogous to the requirements for the service circuits of the telephone and telex networks. In those instances where permanent direct service circuits are not provided and the television service is of an infrequent nature, it will be the responsibility of the control ITC to initiate action for the provision of an adequate means of communications. Use of the public telephone network or telex network should be encouraged in such instances.

4 Pre-transmission procedures

4.1 At some time prior to the scheduled start of television transmission, preferably the day before but not less than two hours prior to the start of service, the control ITC should contact the terminal sub-control ITC and the appropriate intermediate sub-control ITCs or stations, over which it exercises control and confirm that they have the transmission schedule and sufficient information to furnish the service. Similarly, the terminal sub-control ITC should contact the intermediate sub-control ITCs or stations over which it exercises control to verify their readiness.

4.2 The control and sub-control ITCs should initiate circuit section line-up tests for which they are directly responsible. The tests should be completed far enough in advance of the scheduled time at which the connection is to be handed over to the broadcasting organization (point *H* in Figure 1/N.54) to assure completion by that time of the operations given in § 4.3. During this same period the control station for any satellite circuit section should perform line-up tests as prescribed by the responsible authority. The tests recommended for terrestrial circuit sections and ITC-to-ITC links are those detailed in Recommendation N.62.

4.3 Immediately upon conclusion of the circuit section tests, the control ITC, with the cooperation of the terminal sub-control ITC, should verify that the international television link is continuous between these terminal ITCs and should then proceed to perform overall line-up tests as detailed in Recommendation N.62.

4.4 Upon completion of the overall tests, and if possible 2 or 3 minutes prior to the scheduled start of the transmission from the broadcasting organization (send), the control and sub-control ITCs should establish the connection to the broadcasting organizations and check the test programme between them. Checking the test programme consists of verifying the satisfactory receipt, from the standpoints of quality and level, by the broadcasting organization (receive) of test material originated by the broadcasting organization (send). The sub-control ITC should request this transmission of test material from the broadcasting organization (send), as necessary, and should verify that the material is of suitable quality and level at its location. The control ITC should also check for suitable quality and level at its location. After it is determined that the test programme check is satisfactory, the connection should be handed over to the broadcasting organizations.

5 Timing the international television transmission

5.1 The control ITC and terminal sub-control ITC of the international television connection should record the times of start and conclusion of the transmission, in Greenwich Mean Time (GMT).

5.2 The starting time-of-day of the service may be the scheduled time shown on the service order, or the time at which the broadcasting organizations commence to use the service, whichever is earlier. If the connection is not ready for use on schedule, and is handed over to the broadcasting organizations after the scheduled time of start shown on the service order, then the start of service is the time-of-day at which the connection is handed over to the broadcasting organizations.

5.3 The concluding time of the service is the time at which the connection is released by the broadcasting organization (receive) (end of chargeable duration – sometimes called the *Good-night time*).

The conditions for the provision and lease of circuits for television transmissions are given in Recommendation D.180 [2].

6 Monitoring

6.1 The control ITC should monitor in connection with the pre-transmission check of test television programmes and continuously thereafter until the conclusion of the transmission. Continuous monitoring at other stations is not required, except as directed by their respective Administrations, and as required to discharge their responsibilities with regard to fault location.

7 Fault location and handling

7.1 The control and sub-control ITCs and stations are responsible for recording times-of-day and details of service impairments observed and/or reported to them and for initiating corrective actions. However, except when the impairment has rendered the programme unusable, no action which would interrupt the transmission path should be taken except at the direction of the control ITC.

7.2 Although composed of a variety of national and/or international circuits and circuit sections, an overall international television connection without a satellite section may be divided into two segments:

a) the terrestrial facilities between the broadcasting organization (send) and the terminal sub-control ITC;

b) the terrestrial facilities between the terminal sub-control ITC and the broadcasting organization (receive).

When an overall international television connection includes a satellite section the connection may be divided into three major segments:

i) the terrestrial facilities between the broadcasting organization (send) and the transmitting earth station;

ii) the satellite circuit section between earth stations;

iii) the terrestrial facilities between the receiving earth station and the broadcasting organization (receive).

7.3 Faults encountered during service will be observed by the broadcasting organization (receive) and reported to the control ITC or observed by the control ITC, or both.

7.4 Normal fault sectionalization for an overall connection without a satellite section, should be as follows:

- The control ITC shall immediately check the television signal at its location to determine if the fault lies between the broadcasting organization (receive) and the control ITC. If the signal is satisfactory at the control ITC, further sectionalization is carried out by the control ITC, directly or via sub-control stations should they exist, between the control ITC and the broadcasting organization (receive).

- If the signal is unsatisfactory as it appears incoming to the control ITC, the control ITC shall determine from the terminal sub-control ITC whether the signal is satisfactory as it arrives at the terminal sub-control ITC. If the signal incoming to the terminal sub-control ITC is unsatisfactory, the terminal sub-control ITC shall further sectionalize the fault between the broadcasting organization (send) and the terminal sub-control ITC. Such sectionalization shall begin by checking the television signal at its source.

- If the signal incoming to the terminal sub-control ITC is satisfactory, the control ITC should further sectionalize the fault via the appropriate intermediate sub-control ITCs, or stations, and take whatever corrective action is indicated.

7.5 Normal fault sectionalization for an overall international connection containing a satellite section, should be as follows:

- The control ITC shall immediately check the television signal at its location to determine if the fault lies between the broadcasting organization (receive) and the control ITC. If the signal is satisfactory at the control ITC, further sectionalization is carried out by the control ITC, directly or via sub-control stations should they exist, between the control ITC and the broadcasting organization (receive).

- If the signal is unsatisfactory as it appears incoming to the control ITC, the control ITC shall determine from the terminal sub-control ITC whether the signal is satisfactory as it arrives at the terminal sub-control ITC. If the signal incoming to the terminal sub-control ITC is unsatisfactory, the terminal sub-control ITC shall further sectionalize the fault between the broadcasting organization (send) and the terminal sub-control ITC. Such sectionalization shall begin by checking the television signal at its source.

- If the signal incoming to the terminal sub-control ITC is satisfactory, the terminal sub-control ITC should contact the transmitting earth station to determine if the signal is unsatisfactory incoming to that station; simultaneously, the control ITC should contact the receiving earth station to determine if the signal is satisfactory incoming to the receiving earth station.

- If the fault is located between the terminal sub-control ITC and the transmitting earth station, the terminal sub-control ITC shall contact the appropriate intermediate sub-control ITCs or stations, to further sectionalize the fault and take whatever corrective action is indicated.

- If the fault is located in the satellite circuit section, the control ITC should request the receiving earth station (satellite section control) to take corrective action.

- If the fault is located between the receiving earth station and the control ITC, the control ITC should contact the appropriate intermediate sub-control ITCs or stations, to further sectionalize the fault and take whatever corrective action is indicated.

7.6 Intermediate sub-control ITCs and stations should keep the ITCs, to which they are subordinate in the provision of the television service, informed of the status of the fault investigation. Similarly, the control ITC should keep the broadcasting organization (receive) informed. In so doing these stations and ITCs should exchange times-of-day at which faults are encountered, and should attempt to reconcile any differences.

8 Record keeping and monitoring for charging purposes

8.1 The several telecommunication Administrations will prescribe the reports required from their respective stations and the distribution to be made of these reports. To a considerable extent, however, the subject content of these reports will be essentially the same. The following paragraphs will suggest the records of television transmissions to be kept by the stations, and to some extent the information from which the prescribed reports can be prepared.

8.2 The reports prepared by the control ITC normally will provide the information from which bills rendered to the broadcasting organizations will be prepared, including any credit allowances for any transmission interruptions or other serious impairments experienced. Usually a carefully kept and detailed log record in itself will constitute a satisfactory source for this purpose.

8.3 The terminal sub-control ITC and the intermediate sub-control ITCs and stations should also keep detailed log records of their activities in connection with each television transmission. Thus, whether or not these stations are required by their Administrations to submit reports, any needed information will be available to satisfy inquiries or investigations which may arise subsequent to transmissions.

8.4 The following paragraphs suggest the nature and extent of the log record detail. Times-of-day should be shown to the second, in GMT; the record should be kept chronologically from the beginning of service preparations to the final exchange of times-of-day and comments. Abbreviations and condensations should be used carefully and discreetly; initials or names should identify the recorder.

8.5 Record exchanges and discussions with other stations and with broadcasting organizations. These records should include initials, names or other identification of the individuals contacted.

8.6 Record the results of pre-transmission tests, including the test programme check.

8.7 The technical staff of the designated ITC should come to an agreement among themselves so that at the end of the television transmission they have accurate knowledge of:

a) the time of handing over the television link to the broadcasting organization (beginning of chargeable duration);

b) the time at which the television link is released by the broadcasting organization (end of chargeable duration);

c) where appropriate, the times and duration of every interruption or incident which may have occurred (in order that the operating services can determine whether a rebate is due and, if so, its amount).

The times of the beginning and of the end of the chargeable duration, as well as the time of occurrence and duration of any breakdowns which may occur, are entered on a daily report. This daily report is sent on the same day to the service responsible for coordinating all the details necessary for the establishment of the international accounts.

8.8 In recording the times of programme start and conclusion, indicate when agreement is reached with other stations or with broadcasting organizations with respect to these times. Where discrepancies cannot be reconciled, record the differing times with suitable identification of each.

8.9 For any period of impairment, record the time it began, its duration, the time it was reported, and the nature and degree of the impairment, and note whether in the opinion of the broadcasting organization the programme was rendered unusable.

8.10 Record the quality assessment of the overall transmission given by the broadcasting organization (receive), using the quality assessment scale (see Recommendation N.64 for Impairment and Quality Scales).

8.11 The log record of each station at which the transmission was monitored continuously should include the assessment of the overall transmission by the attendant at that station using the quality assessment scale.

9 Responsibilities of control and sub-control stations for multiple destination transmissions

9.1 International multiple destination transmissions on communications satellite systems differ in a number of respects from those routed on terrestrial systems. A common transmitting path extends from the terminal ITC sub-control station through the transmitting earth station to a satellite repeater and separate receiving paths extend from the satellite repeater through the applicable receiving earth station to a number of terminal ITC control stations (Figure 5/N.51). Operations on the common path will affect transmission to all the receiving stations whereas operations on any receiving path will only affect transmission to the terminal ITC control station on the particular path concerned. To coordinate the setting-up, lining-up and maintenance of a multiple destination transmission on a communications satellite system, it is recommended that a send reference station be designated for each multiple destination circuit section, circuit and link.

The responsibilities of a send reference station are given in § 9.2 below. The additional responsibilities and functions of control stations for a multiple destination television transmission are contained in § 9.3 below.

9.2 *Send reference stations*

i) The send reference station for a multiple destination television circuit section is the intermediate circuit sub-control station, at the transmitting earth station (R in Figure 4/N.51).

ii) The send reference station for a multiple destination television circuit and link is the terminal sub-control station for the circuit and link respectively (R′ and R″ in Figure 5/N.51).

In addition to the normal control and sub-control station responsibilities specified in this Recommendation, stations designated as send reference stations are required to perform the following functions:

a) coordinate the setting-up, and lining-up, of the multiple destination circuit section, circuit or link;

b) coordinate maintenance action on the multiple destination circuit section, circuit or link when requested by the control stations;

c) keep records of measurements made during the initial line-up of the multiple destination circuit section, circuit or link and incidents reported by the control stations during transmissions.

9.3 *Additional responsibilities of control stations*

In addition to the control station responsibilties in §§ 1 to 8 above, the control stations of multiple destination circuit sections, circuits or links, having a designated send reference station should perform the following functions:

a) report to the appropriate send reference station the results of line-up measurements made on the multiple destination circuit section, circuit or link;

b) report any incidents observed during transmissions to the appropriate send reference station.

c) cooperate with the appropriate send reference station in locating fault conditions.

References

[1] CCITT Recommendation *Service circuits*, Vol. IV, Fascicle IV.1, Rec. M.100.

[2] CCITT Recommendation *International sound- and television-programme transmissions*, Vol. II, Fascicle II.1, Rec. D.180.

2.2 Lining-up and monitoring of an international television connection

It is assumed that the international television connection is as shown in Figures 2/N.51 and 5/N.51, and that such a connection is provided by the interconnection of permanently and/or occasionally established television circuits.

Recommendation N.60

NOMINAL AMPLITUDE OF VIDEO SIGNALS AT VIDEO INTERCONNECTION POINTS

At video interconnection points, the nominal amplitude of the picture signal, measured from the blanking level to the white level should be 0.7 V (0.714 V for system M signals), while the nominal amplitude of the synchronizing pulses should be 0.3 V (0.286 V for system M signals), so that the nominal peak-to-peak amplitude of a monochrome video signal should be 1.0 V. The addition of colour information results in an increase in the overall amplitude of the video signal. The magnitude of this increase depends upon the colour system employed, but should not exceed 25% (i.e. nominal amplitude of composite colour video signal $\leq$ 1.25 V). Figure 1/N.60 shows the waveform of a video signal.

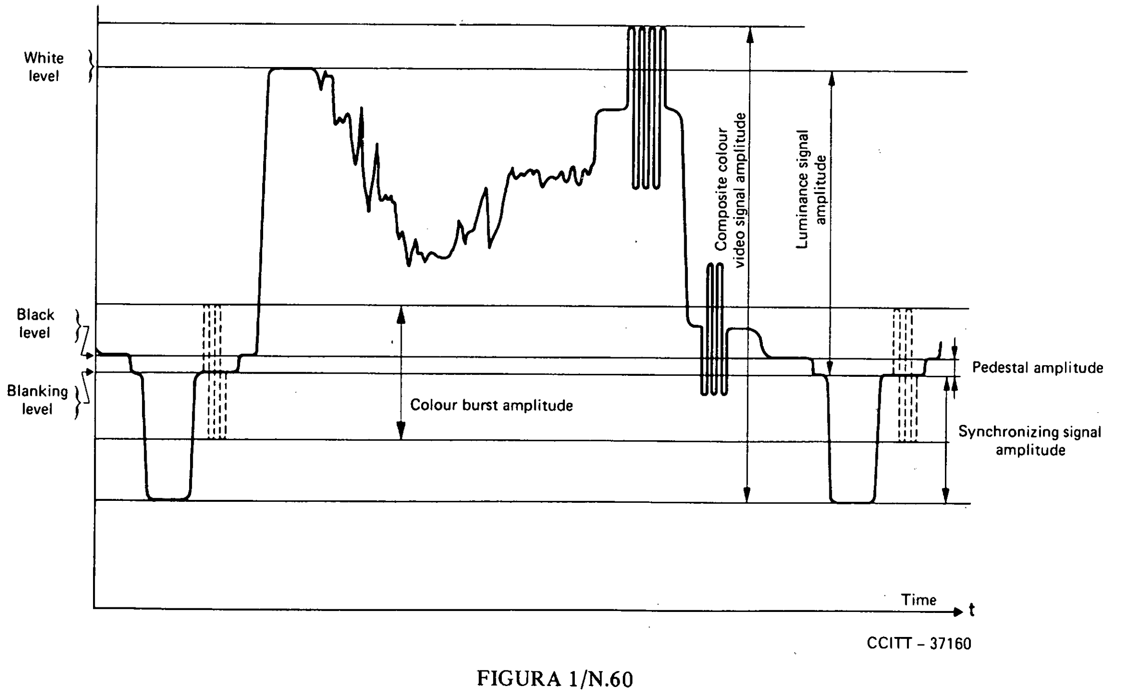


FIGURA 1/N.60

Waveform of one line of video signal

Recommendation N.61

MEASUREMENTS TO BE MADE BEFORE THE LINE-UP PERIOD THAT PRECEDES A TELEVISION TRANSMISSION

The national television circuits should be so adjusted that, when they are connected to the international television link, the amplitude of the video signals at the video interconnection points is in accordance with Recommendation N.60.

Recommendation N.62

TESTS TO BE MADE DURING THE LINE-UP PERIOD THAT PRECEDES A TELEVISION TRANSMISSION

1 General

Tests during the line-up period are carried out by telecommunication Administrations.

In principle, they comprise tests (with correcting adjustments if necessary) using special test signals for the different parameters tested.

The tests to be carried out during the line-up period are given in the following Tables for 525-line and 625-line standards (in the absence of intermediate standards converters). These tables give the details of tests for colour transmission purposes. The individual test signals specified are those defined by the CCIR.

2 Test limits for international circuits

In Tables 1/N.62 and 2/N.62:

a) The test values given are target values.

b) X signifies that the test concerned should be required for line-up. **0** signifies that the test concerned is not foreseen as a necessary line-up test but that it may be performed for confirmation.

c) All the video waveform tests described below should be made at normal level (see Recommendation N.60).

d) Insertion test signals may be made available during the line-up period and may be used during the preparatory period and subsequent transmission for monitoring and fault location purposes.

e) The test values for ITC – ITC (terrestrial + satellite) circuits were derived from a summation of the ITC – ITC terrestrial circuit figures (given in Tables 1/N.62 and 2/N.62) and the earth station-to-earth station (INTELSAT single transmission per transponder) parameters given in Tables A-1/N.62 and A-2/N.62 for 525-line and 625-line systems respectively.

f) For details of the equivalent dB values of the IRE units mentioned in the tables, see Table A-3/N.62.

TABLE 1/N.62
(Previously Table A/N.62)

525-line standard

Item	Parameter	Test waveform	ITC-to-ITC tests for circuits having terrestrial sections only (cable and/or radio)		ITC-to-ITC tests for circuits having terrestrial sections (cable and/or radio) and a satellite section	
			Testing during line-up period	Test values	Testing during line-up period	Test values
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Insertion gain Note 1	No. 2 or equivalent Notes 1, 13	X	± 1 dB 100 ± 11 IRE units	X	± 1 dB 100 ± 11 IRE units
2a	Variation of insertion gain (short period, e.g. 1 sec.) Note 1	No. 2 or equivalent Notes 1, 13	X	± 0.3 dB 100 ± 3 IRE units	X	± 0.4 dB or 100 ± 4 IRE units
2b	Variation of insertion gain (medium period, e.g. 1 hour) Notes 1, 3, 13	No. 2 or equivalent Notes 1, 13	0	± 1 dB 100 ± 11 IRE units	0	± 1 dB 100 ± 11 IRE units
3	Signal-to-continuous random noise ratio (weighted) Notes 1, 18	No input signal	X	Better than 56 dB Note 5	X	Better than 50 dB Note 4
4a	Signal-to-periodic noise ratio Power supply hum (0-1 kHz) Note 2	No input signal	0	Better than 50 dB after clamp 35 dB unclamped	0	Better than 47 dB after clamp 32 dB unclamped
4b	Signal-to-periodic noise ratio (1 kHz to 4.2 MHz) Note 2	No input signal	0	Better than 55 dB	0	Better than 52 dB
5	Signal-to-impulsive noise ratio Notes 2, 9	No input signal	0	Better than 25 dB	0	
6	Luminance nonlinearity Notes 1, 2	5-riser staircase or No. 3	0	3 %	0	6 %
7	Chrominance nonlinearity Note 10					
8a	Luminance-chrominance intermodulation Differential gain Note 2	5-riser staircase Note 15	X Note 7	± 1 dB or ± 10 % (Note 17)	X Note 7	± 1.5 dB or ± 15 % (Note 17)
8b[a)]	Luminance-chrominance intermodulation Differential phase Note 2	5-riser staircase Note 15	X Note 7	± 3.0° Note 17	X Note 7	± 6.0° Note 17
9	Chrominance-luminance intermodulation Note 10					
10	Nonlinear distortion synchronizing signal Note 2	5-riser staircase Note 15	0	± 10 % (40 ± 4 IRE units)	0	± 10 % (40 ± 4 IRE units)

TABLE 1/N.62 *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
11a[a)]	Linear waveform distortion Field time Note 1	No. 1 or equivalent Note 1	As required	± 2 % Note 8	As required	± 4 % Note 8
11b[a)]	Linear waveform distortion Line time Note 1	No. 2 or equivalent Note 1	X	± 1 % Note 8	X	± 2 % Note 8
11c	Linear waveform distortion Short time (overshoot) Note 1	No. 2 or equivalent Notes 1, 14	X	1st adjacent lobe ⩽ 6 % 2nd adjacent lobe ⩽ 3 %	X	1st adjacent lobe ⩽ 10% 2nd adjacent lobe ⩽ 5 %
11d	Linear waveform distortion Short time (2 T pulse-to-bar ratio)	No. 2 or equivalent Notes 1, 14	X	0.94 to 1.06	X	0.88 to 1.12
12	Steady state attenuation frequency characteristic	Multiburst Notes 11, 16	X	+1 dB to −0.7 dB	X	+2 dB to −1 dB
13a	Chrominance-luminance gain inequality Note 2	Composite sine-squared pulse Note 12	X	+8 % to −11 %	X	+12 % to −20 %
13b	Chrominance-luminance delay inequality Note 2	Composite sine-squared pulse Note 12	X	± 80 nanoseconds	X	± 100 nanoseconds

a) The values specified in columns (5) and (7) for parameters 8b, 11a and 11b, might not be met by some Administrations.

Notes to Table 1/N.62

1. See CCIR Recommendation 421-3 [1], for definition.
2. See CCIR Recommendation 451-2 [2], for definition.
3. The test limits are indicated as a guide for critical observation during video transmissions.
4. This objective should be relaxed in accordance with Table A-4/N.62 when one of the earth stations is separated from its ITC by more than 2500 kilometres.
5. These objectives should be relaxed in accordance with Table A-4/N.62 when the terrestrial facilities exceed 2500 kilometres.
7. If test time is short, a test of 50% APL is sufficient with suitable notation of the results. Poor results at normal level may indicate the need to make additional tests over the dynamic range of 10% to 90% APL. These additional tests should be carried out during trouble-shooting procedures on the indicated circuit section(s).
8. The variation in amplitude of the top of the bar (window) signal, relative to its mid-point amplitude, should not exceed the values indicated. In the case of field-time distortion, the first and last 250 microseconds of the bar top should be ignored. For line-time distortion the first and last 1 microsecond should be ignored.
9. The requirement for impulsive noise shall be equal to or less than one impulse per minute of a sporadic or infrequently occurring nature.
10. This item is under study for future use.
11. Test waveform as shown in Figure A-1/N.62 to be used for this item.
12. Test waveform to be used for this test is shown in Figure A-2/N.62. The composite pulse will fall somewhere between 10 T and 20 T. The exact pulse width is still under study.
13. The bar portion of the test waveform is used for this test.
14. For this test, the 2 T sine-squared pulse is added in position A of the waveform.
15. The test waveform of the five-riser staircase with a superimposed subcarrier of 3.58 MHz at 40 IRE units amplitude is shown in Figure A-3/N.62. An alternative test waveform for this test is the ten-riser staircase with a superimposed subcarrier of 3.58 MHz at 20 IRE units amplitude as shown in Figure A-4/N.62.
16. The frequency response within the passband of the circuit should not fall outside the tolerances given, relative to the nominal values.
17. The CCIR expresses the limit, in this way, as ±X. The CCITT has copied this, but is of the opinion that for an expression of this nature it would be better to put the sign for *is equal to or less than.*
18. Values using the noise weighting network for System M (Canada and USA). See CCIR Recommendation 421-3 [1].

TABLE 2/N.62
(Previously Table B/N.62)

625-line standard

Item	Parameter	Test waveform	ITC-to-ITC tests for circuits having terrestrial (cable and/or radio) sections only		ITC-to-ITC tests for circuits having terrestrial sections (cable and/or radio) and a satellite section	
			Testing during line-up period	Test values	Testing during line-up period	Test values
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Insertion gain	Test signal No. 2 Note 1	X	0 dB ± 1 dB	X	0 dB ± 1 dB
2a	Variation of insertion gain, short period (e.g. 1 sec.)	Test signal No. 2 Note 1	X	± 0.2 dB	X	± 0.3 dB
2b	Variation of insertion gain, medium period (e.g. 1 hour)	Test signal No. 2 Note 1	0	± 1 dB Note 15	0	± 1 dB Note 15
3	Signal-to-continuous random noise ratio (CCIR Recs. 421-3 [1], 451-2 [2])	No input signal Note 3	X	Better than 55 dB Note 2	X	Better than 50 dB Note 2
4a	Signal-to-periodic noise ratio, Power supply hum (0-1 kHz) Note 4	No input signal	0	Better than 35 dB		Better than 35 dB
4b	Signal-to-periodic noise ratio, (1 kHz – f_c) (f_c top freq. of TV system) Note 4	No input signal	0	Better than 52 dB		Better than 52 dB
5	Signal-to-impulsive noise ratio Note 4	No input signal	0	Better than 25 dB		Better than 25 dB
6	Luminance nonlinearity (normal level)	5-riser staircase Note 5	0	⩽ 12 %	0	
7	Chrominance nonlinearity Note 6	FF/G2	0		0	
8a	Luminance-chrominance intermodulation Differential gain	As in CCIR Rec. 451-2 [2] or 421-3 [1]	X	± 8%	X	± 15%
8b	Luminance-chrominance intermodulation Differential phase	No. 3a and 3b Note 7	X	± 5°	X	± 8°
9	Chrominance-luminance Note 8	Note 8	0		0	
10	Nonlinear distortion synchronizing signal Note 9	Note 9	0	± 10%	0	+12 % −15 %
11a	Linear waveform distortion, Field time Note 11	Note 10	0	± 6 % Note 10	0	± 6 % Note 10
11b	Linear waveform distortion, Line time	Note 10	X	± 3% Note 10	X	± 4 % Note 10

TABLE 2/N.62 *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
11c	Linear waveform distortion Short time (step response) Note 12	Note 12	X		X	
11d	Linear waveform distortion Short time (2 T pulse-to-bar ratio)	Note 16	0	0.92 to 1.08	X	0.90 to 1.10
12	Steady state attenuation-frequency characteristic Note 13	Note 13	X	+1.5 dB to −1.0 dB	X	+2.0 dB to −1.5 dB
13a	Chrominance-luminance gain inequality	Note 14	X	± 10%	X	± 15%
13b	Chrominance-luminance delay inequality	Note 14	X	± 100 nanoseconds	X	± 150 nanoseconds

Notes to Table 2/N.62

1. T.S. No. 2 – test signal number 2 as described in CCIR Recommendation 421-3 [1]. Other bar signals may be used by bilateral agreement.
2. The figures given assume the use of the 625-line weighting network for system D, K, L, described in CCIR Recommendation 421-3 [1].
3. There are several methods of measuring noise in the presence of video signals which may be employed by bilateral agreement between the Administrations concerned.
4. For further details on these noise parameters refer to CCIR Recommendations 421-3 [1], 451-2 [2].
5. The test signal should be a five-riser staircase as described in the CCIR Recommendation cited in [3].
6. This test may be performed subject to the availability of test signal G2 (CCIR Recommendation 473-1 [4]) as a full-frame signal.
7. The test signals are those described in CCIR Recommendation 451-2 [2] (five-riser staircase with APL range of 12.5 to 87.5%) or, alternatively, test signals 3*a* and 3*b* described in CCIR Recommendation 421-3 [1]. If test time is short, a test at 50% APL is sufficient with suitable notation on the results. In addition, tests of the overload characteristics (+3 dB reference 1 volt) may be indicated by poor results at normal level. These should be carried out during trouble-shooting procedures on the indicated circuit section(s). The test limits apply to a normal level only.
8. This test may be performed subject to the availability of a suitable test signal. Test signal G2 (CCIR Recommendation 473-1 [4]) is considered suitable if available in full-frame form.
9. The signal described in Note 5 may be used for this test. Records of this parameter may be considered optional according to the Administrations' wishes on pre-transmission tests.
10. The test signals defined in CCIR Recommendation 421-3 [1] or 451-2 [2] should be used. The variation in amplitude of the top of the bar (window) signal, relative to its mid-point amplitude, should not exceed the values indicated. In the case of field-time distortion, the first and last 250 microseconds of the bar top should be ignored. For line-time distortion, the first and last microsecond should be ignored.
11. This parameter is not necessarily measured on pre-transmission tests but may be recorded when a signal combining several functions (window or electronic test-pattern) is available from the broadcasting organization.
12. No limits have been given for this parameter in view of the differing methods of measurements in use in a) North America, b) the United Kingdom, and c) the rest of Europe. These are respectively:
    a) the amplitude of the 1st and 2nd adjacent lobes following a 2 T pulse,
    b) *k* rating of a 2 T pulse,
    c) the amplitude of overshoots of a 1 T or 2 T rise time bar.
13. The test signal should be a full-frame version of C3 and C1 or C2 given in CCIR Recommendation 473-1 [4]. This test is an *option* to be used as required by Administrations in place of transient tests. The frequency response within the passband of the circuit should not fall outside the tolerances given, relative to the nominal value.
14. The test signal should be that shown in the CCIR Recommendation cited in [5] (but with the pulse having a half amplitude duration of 20 T) or the composite signal shown in CCIR Recommendation 473-1 [4], line 17, as a full-frame test signal.
15. The test limits are indicated as a guide for critical observations during video transmissions.
16. Test signal No. 2 (CCIR Recommendation 421-3 [1]) with a 2 T sine-squared pulse added in position A of the waveform.

ANNEX A

(to Recommendation N.62)

Provisional test values for 525-line and 625-line satellite circuit-sections and 525-line terrestrial circuit-section developed from information provided by AT&T and COMSAT

TABLE A-1/N.62

525-line standard

Item	Parameter	Test wave-form	International satellite circuit-section					Terminal ITC to adjacent earth station circuit section
			Setting up test	Test[1] values	Testing during line-up period	Test[a)] values	Notes (see the following list)	Test values 0 dB
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Insertion gain	T.S. No. 2	X	0 dB ± 0.25 dB / 0 dB ± 0.25 dB	X	0 dB ± 0.25 dB / 0 dB ± 0.25 dB	1 2	± 0.5 dB or 100 ± 5 IRE units
2a	Variations insertion gain – short period (e.g. 1 sec.)	T.S. No. 2	X	± 0.1 dB / ± 0.1 dB	X	± 0.1 dB / ± 0.1 dB	1 2	± 0.3 dB or 100 ± 3 IRE units
2b	Variations insertion gain – medium period (e.g. 1 hour)	T.S. No. 2	X	± 0.25 dB / ± 0.25 dB		± 0.25 dB / ± 0.25 dB	1 2	± 0.5 dB or 100 ± 5 IRE units
3	Signal-to-continuous random noise ratio	No input signal	X	54 dB / 49 dB	X	54 dB / 49 dB	3 4	56 dB (see Note 4 to Table 1/N.62)
4a	Signal-to-periodic noise ratio Power supply hum (0 to 1 kHz)	No input signal	X	50 dB / 50 dB	0	50 dB / 50 dB	5	50 dB after clamp 35 dB unclamped

a) The values shown on the upper line are for INTELSAT single transmission (30 MHz bandwidth) per transponder and the values shown on the lower line are for INTELSAT dual transmission (2 × 17.5 MHz bandwidth) per transponder, satellite circuit sections.

TABLE A-1/N.62 *(continued)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
4b	Signal-to-periodic noise ratio (1 kHz to f_c) (f_c = max. frequency of the TV system)	No input signal	X	55 dB / 55 dB	0	55 dB / 55 dB	6	55 dB
5	Signal-to-impulsive noise ratio	No input signal	X	25 dB / 25 dB	0	25 dB / 25 dB		25 dB
6	Luminance nonlinearity	5-riser staircase or T.S. No. 3	X	Not yet specified / Not specified		Not yet specified / Not specified	7	3 %
7	Chrominance nonlinearity	Not yet speci-fied		Not yet specified / Not specified		Not yet specified / Not specified		Not yet specified
8a	Luminance-chrominance intermodulation (differential gain)	5-riser stair-case	X	± 10 % / ± 10 %	X	± 10 % / ± 10 %	7 8 9	± 10 %
8b	Luminance-chrominance intermodulation (differential phase)	5-riser stair-case	X	± 3° / ± 4°	X	± 3° / ± 4°	7 8 9	± 3.0°
9	Chrominance-luminance intermodulation	Not yet speci-fied		Not yet specified / Not specified		Not yet specified / Not specified		Not yet specified
10	Nonlinear distortion synchronizing signal	5-riser stair-case	X	+ 5 % −10 % / + 5 % −10 %	0	+ 5 % −10 % / + 5 % −10 %	7 8 9	± 10% or (40 ± 4 IRE units)

TABLE A-1/N.62 *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
11a	Linear waveform distortion – field time	T.S. No. 1	X	± 1% ± 2%	0	± 1% ± 2%	1	± 2.0% (see Note 8 to Table 2/N.62)
11b	Linear waveform distortion – line time	T.S. No. 2	X	± 1% ± 1.5%	X	± 1% ± 1.5%	1 2	± 1.0% (see Note 8 to Table 1/N.62)
11c	Linear waveform distortion – short time (step response)	T.S. No. 2	X	Not yet specified Not specified		Not yet specified Not specified	1 10	1st adjacent lobe ⩽ 6% 2nd adjacent lobe ⩽ 3.0%
11d	Linear waveform distortion – short time (2 T P/B ratio)	T.S. No. 2	X	0.94 to 1.06 0.94 to 1.06	X	0.94 to 1.06 0.94 to 1.06	1 11	0.94 to 1.06
12	Steady state response attenuation-frequency characteristic	Multi-burst	X	+1 dB to −0.5 dB +1 dB to −0.5 dB	0	+1 dB to −0.5 dB +1 dB to −0.5 dB	12 14	+1 dB to −0.7 dB
13a	Chrominance-luminance gain inequality	Composite sine-squared pulse	X	± 10% ± 10%	X	± 10% ± 10%	13	+9% to −11%
13b	Chrominance-luminance delay inequality	Composite sine-squared pulse	X	± 50 ns ± 50 ns	X	± 50 ns ± 50 ns	13	± 80 ns
14	Signal crosstalk ratio	Composite sine-squared pulse	X	58 dB	X	58 dB	13 15	

TABLE A-2/N.62

625-line standard

Item	Parameter	Test wave-form	International satellite circuit section				
			Setting up test	Test[a] values	Testing during line-up period	Test[a] values	Notes (see the following list)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Insertion gain	T.S. No. 2	X	0 dB ± 0.25 dB / 0 dB ± 0.25 dB	X	0 dB ± 0.25 dB / 0 dB ± 0.25 dB	1
2a	Variations insertion gain – short period (e.g. 1 sec.)	T.S. No. 2	X	± 0.1 dB / ± 0.1 dB	X	± 0.1 dB / ± 0.1 dB	1
2b	Variations insertion gain – medium period (e.g. 1 hour)	T.S. No. 2	X	± 0.25 dB / ± 0.25 dB		± 0.25 dB / ± 0.25 dB	1
3	Signal-to-continuous random noise ratio	No input signal	X	54 dB / 49 dB	X	54 dB / 49 dB	3 4
4a	Signal-to-periodic noise ratio Power supply hum (0-1 kHz)	No input signal	X	50 dB after clamp / 50 dB after clamp	0	50 dB after clamp / 50 dB after clamp	5

[a] The values shown on the upper line are for INTELSAT single transmission (30 MHz bandwidth) per transponder and the values shown on the lower line are for INTELSAT dual transmission (2 × 17.5 MHz bandwidth) per transponder, satellite circuit sections.

TABLE A-2/N.62 *(continued)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
4b	Signal-to-periodic noise ratio (1 kHz – f_c)	No input signal	X	55 dB / 55 dB	0	55 dB / 55 dB	6
5	Signal-to-impulsive noise ratio	No input signal	X	25 dB / 25 dB	0	25 dB / 25 dB	
6	Luminance nonlinearity	5-riser stair-case	X	Not yet specified / Not specified		Not yet specified / Not specified	7
7	Chrominance nonlinearity	Full field G2	X	Not yet specified / Not specified		Not yet specified / Not specified	8
8a	Luminance-chrominance intermodulation (differential gain)	5-riser stair-case	X	± 10% / ± 10%	X	± 10% / ± 10%	7
8b	Luminance-chrominance intermodulation (differential phase)	5-riser stair-case	X	± 3° / ± 4°	X	± 3° / ± 4°	7
9	Chrominance-luminance intermodulation	Full field G2	X	Not yet specified / Not specified		Not yet specified / Not specified	8
10	Nonlinear distortion synchronizing signal	5-riser stair-case	X	+ 5% –10% / + 5% –10%		+ 5% –10% / + 5% –10%	7

TABLE A-2/N.62 *(end)*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
11a	Linear waveform distortion – field time	T.S. No. 1	X	± 1% / ± 2%		± 1% / ± 2%	1
11b	Linear waveform distortion – line time	T.S. No. 2	X	± 1% / ± 1.5%	X	± 1% / ± 1.5%	1
11c	Linear waveform distortion (short time step response)	T.S. No. 2	X	Not yet specified / Not specified		Not yet specified / Not specified	1 9
11d	Linear waveform distortion – short time (2 T P/B ratio)	T.S. No. 2	X	0.94 to 1.06 / 0.94 to 1.06	X	0.94 to 1.06 / 0.94 to 1.06	1 2
12	Steady state attenuation frequency characteristic	Full field G3	X	+1 dB to −0.5 dB Note 10 / + 1 dB to −0.5 dB Note 10	X	+1 dB to −0.5 dB Note 10 / +1.0 dB to −0.5 dB Note 10	6 8
13a	Chrominance-luminance gain inequality	Full field F	X	± 10% / ± 10%	X	± 10% / ± 10%	8
13b	Chrominance-luminance delay inequality	Full field F	X	± 50 ns / ± 50 ns	X	± 50 ns / ± 50 ns	8
14	Signal crosstalk ratio	Full field F	X	/ 58 dB	X	/ 58 dB	8 11

Notes to Table A-1/N.62

525-line satellite circuit sections and terrestrial circuit sections

1. This test signal is described in CCIR Recommendation 421-3 [1].
2. While T.S. No. 2 is preferred, other line bar signals can be used for this test.
3. Noise weighting per CCIR Recommendation 421-3 [1], system M (USA and Canada) is used in this test.
4. There are several methods for measuring noise in the presence of video signals which may be employed by bilateral agreement between the Administrations concerned.
5. This parameter is measured after clamping to ensure the removal of the low-frequency energy dispersal signal.
6. For a 525-line satellite circuit section, f_c = 4.2 MHz.
7. This test, while not specified as yet, would be similar to that shown in CCIR Recommendation 451-2 [2] for the 625-line systems.
8. For this test the 5-riser staircase signal should be switchable through the range 10 to 90% APL.
9. The ramp or 10-riser staircase signal may be used in this test.
10. Test limits for this parameter must await agreement on the step rise time.
11. A sine-squared pulse of half-amplitude duration HAD = 250 nanoseconds is inserted on T.S. No. 2 for this test.
12. Details of the multiburst test signal for the 525-line system have not as yet been agreed upon. It is expected, however, that it will contain a reference white flag, followed by six frequency bursts of 0.5 MHz, 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.6 MHz and 4.2 MHz. These bursts would have a maximum peak-to-peak amplitude of 0.42 volts and would be centred on a mid-grey pedestal.
13. Details of the composite pulse have not been agreed upon as yet. However, it is expected that it will have a half-amplitude duration of between 10 T and 20 T. The exact pulse width is still under study.
14. The frequency response within the passband of the circuit should not fall outside the tolerances given relative to the nominal value.
15. This parameter is described in Recommendation J.62 [6] and CCIR Report 486-1 [7].

Notes to Table A-2/N.62

625-line satellite circuit-sections

1. This test signal is described in CCIR Recommendation 421-3 [1].
2. A sine-squared pulse of half-amplitude duration HAD = 200 nanoseconds is inserted on T.S. No. 2 for this test.
3. Noise weighting per CCIR Recommendation 421-3 [1], systems D, K and L is used in this test.
4. There are several methods for measuring noise in the presence of video signals which may be employed by bilateral agreement between the Administrations concerned.
5. This parameter is measured after clamping to ensure the removal of the low-frequency energy dispersal signal.
6. For a 625-line satellite circuit section, f_c = 6 MHz.
7. The five-riser staircase waveform is described in CCIR Recommendation 451-2 [2].
8. This test waveform is described in CCIR Recommendation 473-1 [4]. If it is available on a full frame basis, it should be so used for this test.
9. Test values for this parameter must await agreement on the step rise-time.
10. The frequency response within the passband of the circuit should not fall outside the tolerances given relative to the nominal value.
11. This parameter is described in Recommendation J.62 [6] and CCIR Report 486-1 [7].

TABLE A-3/N.62

Conversion for video test signals

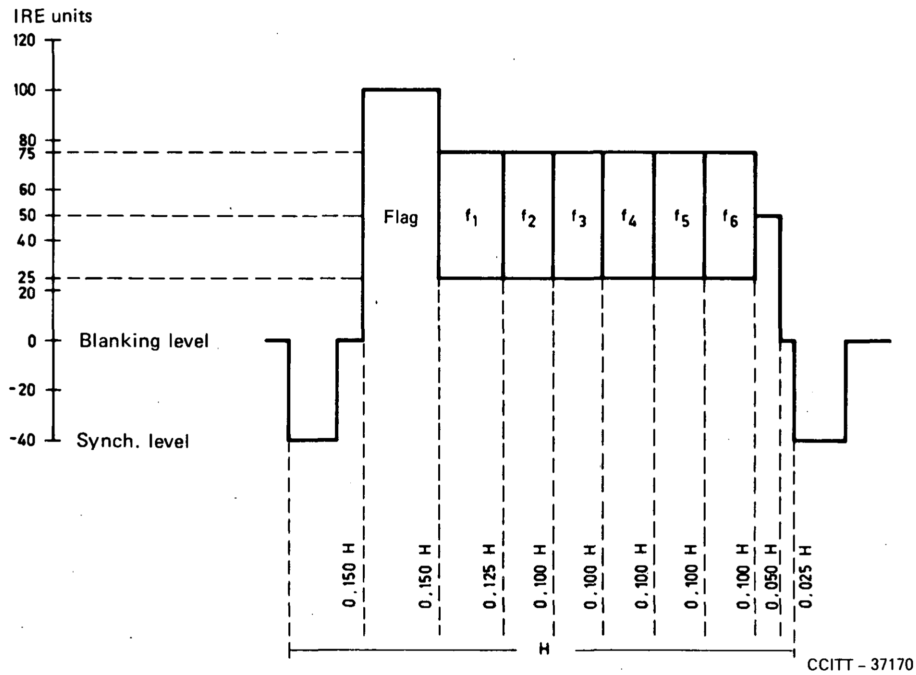
Loss conversion scale			*Gain conversion scale*		
Volt	IRE Units	dB	Volt	IRE Units	dB
0.7	100	0.0	0.7	100	0.0
0.69	99	0.1	0.71	101	0.1
0.69	98	0.2	0.72	102	0.2
0.68	97	0.3	0.73	103	0.3
0.67	96	0.4	0.73	104	0.3
0.67	95	0.4	0.74	105	0.4
0.66	94	0.5	0.75	106	0.5
0.65	93	0.6	0.76	107	0.6
0.64	92	0.7	0.76	108	0.7
0.64	91	0.8	0.77	109	0.7
0.63	90	0.9	0.78	110	0.8
0.62	89	1.0	0.78	111	0.9
0.62	88	1.1	0.79	112	1.0
0.61	87	1.2	0.8	113	1.1
0.6	86	1.3	0.8	114	1.1
0.6	85	1.4	0.81	115	1.2
0.59	84	1.5	0.82	116	1.3
0.58	83	1.6	0.83	117	1.4
0.57	82	1.7	0.83	118	1.4
0.57	81	1.8	0.84	119	1.5
0.56	80	1.9	0.85	120	1.6
0.53	75	2.5	0.88	125	1.7
0.49	70	3.1	0.92	130	2.3
0.46	65	3.7	0.95	135	2.6
0.42	60	4.4	0.99	140	2.9
0.39	55	5.2	1.02	145	3.2
0.35	50	6.0	1.06	150	3.5
			1.41	200	6.0

TABLE A-4/N.62

Continuous random noise (weighted) for 525-line systems

Objectives for signal-to-noise ratios on circuits with a terrestrial circuit section component exceeding 2500 kilometres in length

Terrestrial distance (km)	*Terrestrial circuits* S/N ratio (dB)	*Terrestrial plus satellite circuits* S/N ratio (dB)
3500	54.6	49.5
4500	53.4	48.5
5500	52.6	48.0
6500	51.8	47.5



Signal characteristics	H	Burst frequencies in MHz					
		f_1	f_2	f_3	f_4	f_5	f_6
525-line	63.5 μs	0.5	1.5	2.0	3.0	3.6	4.2

FIGURE A-1/N.62

525-line multiburst signal

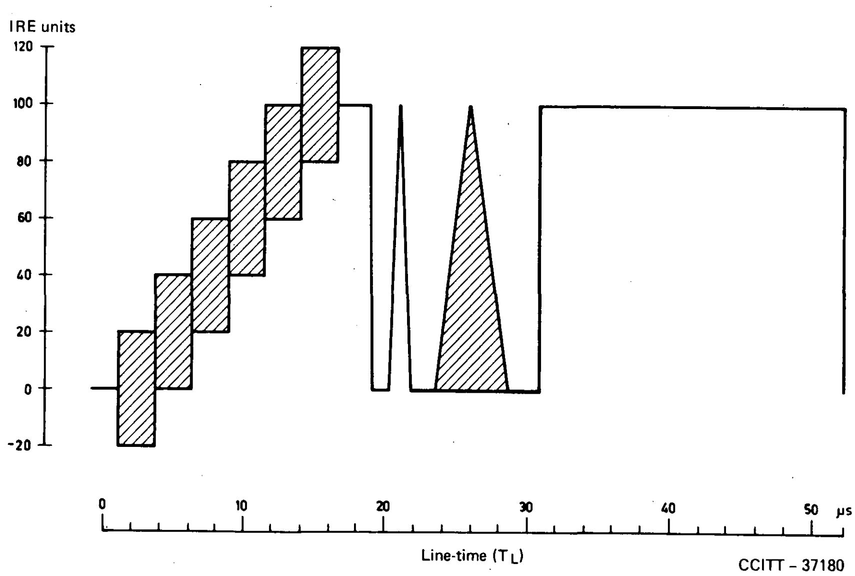
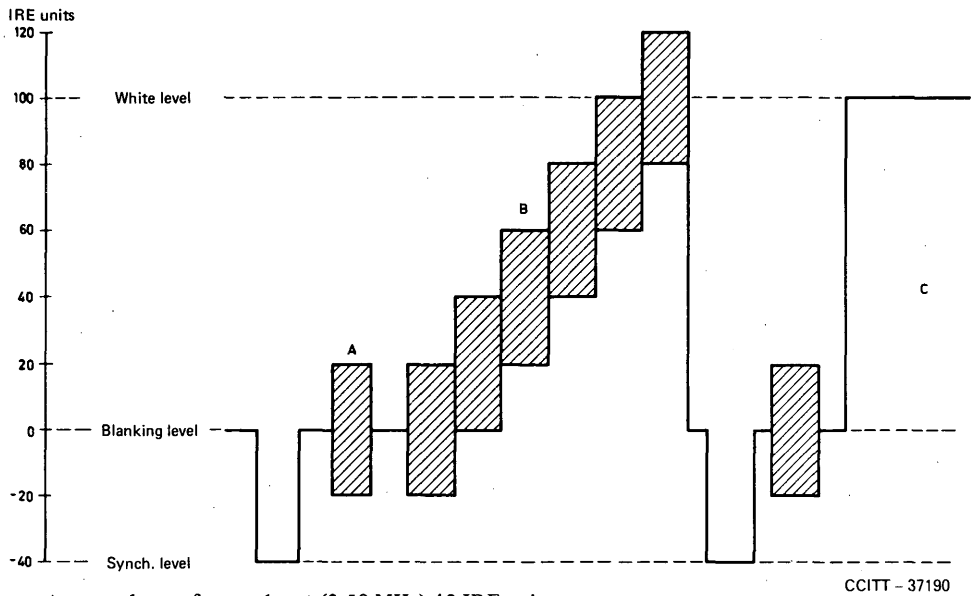


FIGURE A-2/N.62

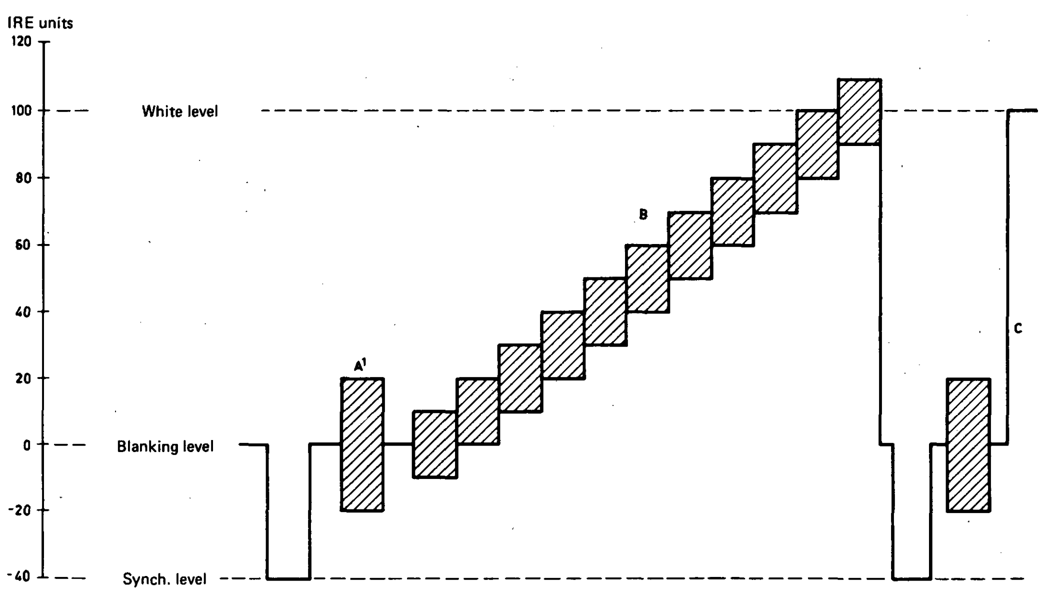
525-line combined single-line test signal with composite pulse (specific component signal spacing under study)



A = colour reference burst (3.58 MHz) 40 IRE units
B = superimposed sub-carrier (3.58 MHz) 40 IRE units
C = three intermediate lines with switchable white level or blanking level

FIGURE A-3/N.62

525-line 5-riser staircase test signal



A = colour reference (3.58 MHz) 40 IRE units
B = superimposed sub-carrier (3.58 MHz) 20 IRE units
C = four intermediate lines with switchable white level or blanking level

[1] On some generators, the amplitude of the reference burst may only be 20 IRE units peak-to-peak.

FIGURE A-4/N.62

10-riser staircase test signal (525 lines)

References

[1] CCIR Recommendation *Requirements for the transmission of television signals over long distances (System I excepted)*, Vol. XII, Rec. 421-3, ITU Geneva, 1975.

[2] CCIR Recommendation *Requirements for the transmission of television signals over long distances (System I only)*, Vol. XII, Rec. 451-2, ITU, Geneva, 1975.

[3] *Ibid.*, Figure 3.

[4] CCIR Recommendation *Insertion of special signals in the field-blanking interval of monochrome and colour television signals*, Vol. XII, Rec. 473-1, ITU, Geneva, 1975.

[5] CCIR Recommendation *Requirements for the transmission of television signals over long distances (System I only)*, Vol. XII, Rec. 451-2, Figure 5, ITU, Geneva, 1975.

[6] CCITT Recommendation *Specification for a long-distance television transmission (System I only)*, Orange Book, Vol. III-2, Rec. J.62, ITU, Geneva, 1977.

[7] CCIR Report *Transmission performance of television circuits designed for use in international connections*, Vol. XII, Report 486-1, ITU, Geneva, 1975.

Recommendation N.63

TEST SIGNALS TO BE USED BY THE BROADCASTING ORGANIZATIONS DURING THE PREPARATORY PERIOD

After the broadcasting organizations have taken over the international television connection, they may decide to make measurements on the complete connection from the point where the television programme is produced to the point or points where it is to be received.

The broadcasting organizations often use live pictures for testing during the preparatory period, especially when a standards convertor is involved. If for any reason they should need to send test signals then it is desirable that the telecommunication Administrations should recommend the broadcasting organizations in their countries to send signals that are in accordance with those recommended in Recommendation N.67 (at levels in accordance with Recommendation N.60), so that the staff at intermediate video interconnection points can, if necessary, compare the results of the measurements made by the broadcasting organizations with those obtained by the telecommunication Administrations during the line-up period. There is no occasion to readjust the output levels of the station equipment since these have already been set during the line-up period.

Recommendation N.64

QUALITY AND IMPAIRMENT ASSESSMENT

1 5-grade scale for quality and impairment assessment

The 5-grade scale, applicable to both quality and impairment assessments in Table 1/N.64 should be used.

TABLE 1/N.64

Grade	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very annoying

Although the scale is intended, in connection with television, to apply to *overall* picture assessment, it should be noted that the same scale could be used for a critical assessment of particular picture characteristics. Moreover, the number of the grade can be taken as either a quality assessment or an impairment assessment. Depending on the context, for example, a Grade 3 picture is of *fair* quality, having *slightly annoying* impairments. The same scale can be used in the case of types of transmission other than television.

Note 1 – It is implicit that before a circuit is handed over to a broadcasting organization all reasonable steps will have been taken to ensure that the circuit quality from the point of view of transmission is the best that can be achieved at the beginning of the preparatory period.

Note 2 – Grade 1 should be applied only to a transmission considered to be unusable by the broadcasting organization concerned. If, under exceptional circumstances, the broadcasting organization decides to use a transmission so graded, because of the interest in the information to be transmitted, this should not constitute a precedent for changing the grade or for changing the significance of Grade 1.

Note 3 – This Recommendation does not apply to the assessment of speech transmission quality in telephony.

Recommendation N.67

MONITORING TELEVISION TRANSMISSIONS. USE OF THE FIELD BLANKING INTERVAL

1 Monitoring points

Technical control by the telecommunication Administrations of a television transmission in progress should be possible at any time:

- at national and international television centres in the connection;
- at the last staffed-station immediately preceding the frontier of each country and at a point in the station which will include as much as possible of the station equipment in the direction of transmission concerned (by providing monitoring-demodulators if necessary).

These centres and stations should be equipped with an oscilloscope (the horizontal sweep frequency of which is synchronized to the line frequency) for monitoring the electrical signal and a picture-monitor for monitoring the complete picture.

2 Numbering of lines in a television field

For 625-line systems the numbering of the lines is as follows:

Line 1 starts at the instant indicated by 0_v in Figure 2-1 of CCIR Report 624-1 [1]; at this instant, the leading edge of the line synchronization pulse coincides with the beginning of the sequence of field synchronization pulses. The lines are numbered according to their sequence in time, so that the first field comprises lines 1 to 312 as well as the first half of line 313, whereas the second field comprises the second half of line 313 and lines 314 to 625.

For 525-line systems the numbering of the lines is as follows:

Line 1 of field 1 is the line starting with the first equalizing pulse at the instant indicated by 0_{E1} in Figure 2-3a of CCIR Report 624-1 [2], line 1 of field 2 is the line starting with the second equalizing pulse at one half-line period after the instant indicated by 0_{E2} in Figure 2-3b of this report [3].

3 625-line insertion test signals (ITS)

The advent of colour has caused the CCIR to recommend a comprehensive set of test signals which may be inserted on lines 17, 18, 330 and 331 for international monochrome or colour transmissions [1]. This signal is illustrated in Figure 1/N.67 [2] and is made up as follows:

Line 17

A 10 μs white bar (B_2), a 2 T sine-squared pulse (B_1), a 20 T composite pulse (F) and a 5-riser staircase (D_1).

Line 18

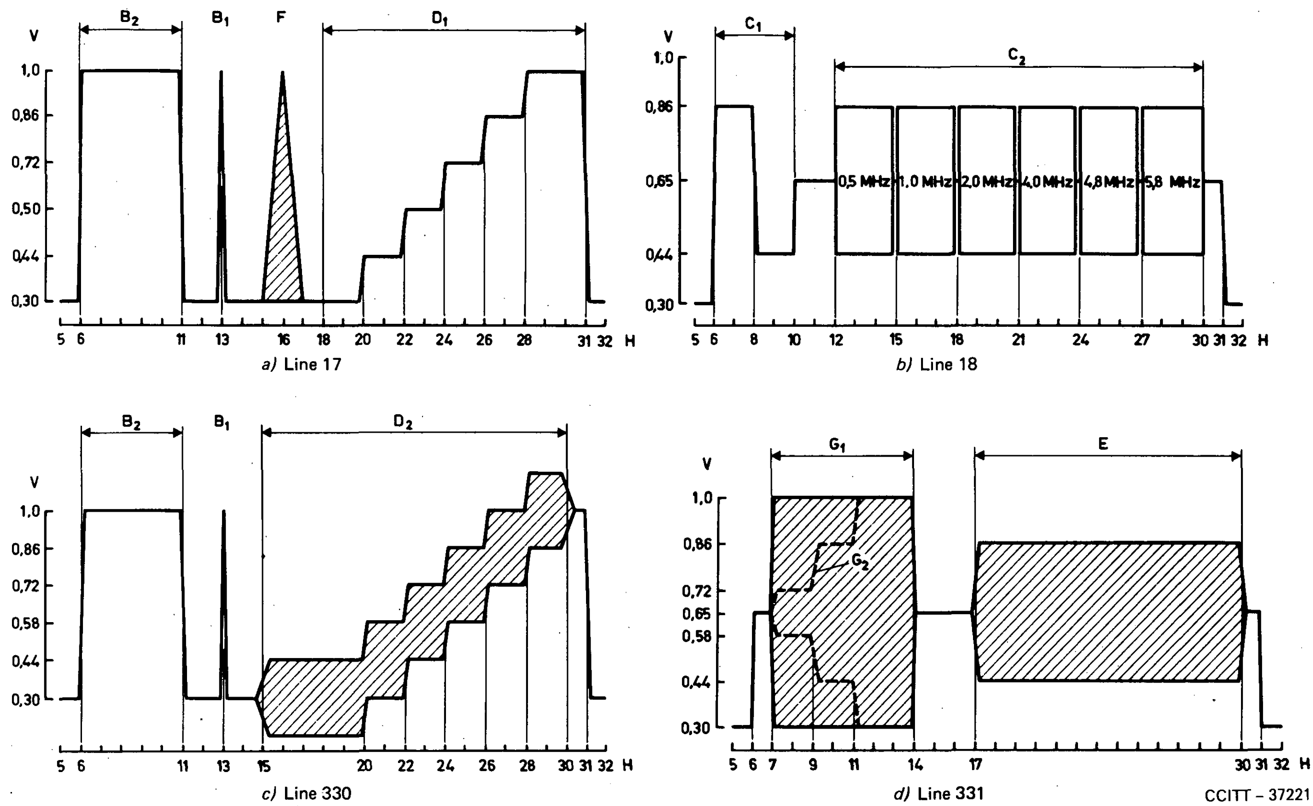
A multiburst (C_2) preceded by a reference bar signal (C_1).

Line 330

A 10 μs white bar (B_2), a 2 T sine-squared pulse (B_1) and a 5-riser staircase with superimposed colour subcarrier (D_2).

Line 331

A chrominance bar signal (G_1) or a three-level chrominance signal (G_2), followed by a sub-carrier reference bar (E).



Note – A detailed description of these signals is given in CCIR Recommendation 473-2 [4].

FIGURE 1/N.67

Test signal for insertion in field blanking intervals of a 625-line colour (or monochrome) television signal

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1) As an interim measure some organizations may decide to omit some of the waveforms, but in this case care must be taken not to alter the mean values appreciably.

2) A colour burst is present in the line blanking period during colour transmissions. In the case of PAL colour transmissions the chrominance subcarrier of the insertion signals is locked at 60° from the (B-Y) axis.

For colour the CCIR has recommended a comprehensive set of test signals which may be inserted on lines 17 of both fields (lines 17 and 280 if numbered consecutively) for international monochrome or colour transmissions. These signals are illustrated in Figure 2/N.67, c) and d) and are made up as follows:

Figure 2/N.67, c): a luminance bar (reference white level) (B_2), a 2 T sine-squared pulse (B_1), a modulated 12.5 T sine-squared pulse (F) and a superimposed 5-riser staircase (D_2);

Figure 2/N.67, d): a reference bar signal (C_1), a luminance pedestal, a multiburst signal superimposed on the pedestal (C_2) and a superimposed 3-level chrominance signal (G).

A detailed description of these signals is given in CCIR Recommendation 473-2 [4].

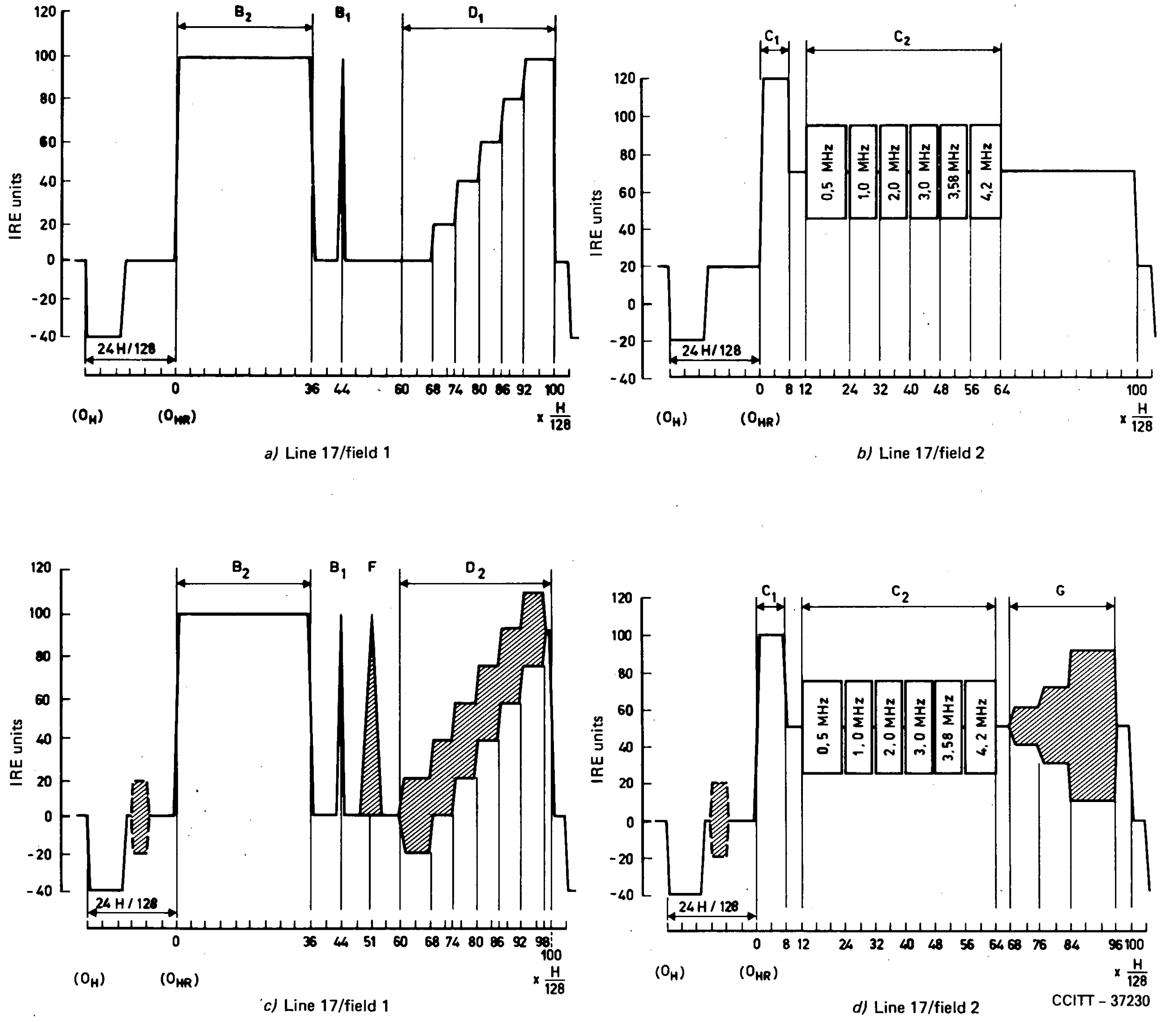

FIGURE 2/N.67

Test signal for insertion in field blanking intervals of a 525-line colour (or monochrome) television signal

5 Measurements on insertion test signals (ITS)

In order to carry out measurements on an insertion test signal, stations and centres should also be equipped with a line selector which enables only the test signal line (or lines) to be displayed on the oscilloscope.

Measurements which can be made with the above signals are given in Tables 1/N.67 and 2/N.67.

TABLE 1/N.67

625-line monochrome or colour signal (Figure 1/N.67)
(CCIR Recommendation 473-2) [4]

Characteristics measured	Waveform used	Line number
Linear distortions		
Insertion gain	B_2	17 and 330
Amplitude/frequency response	C_2 and C_1	18
Line-time waveform distortion	B_2	17 and 330
Short-time waveform distortion		
– step response	B_2	17 and 330
– pulse response	B_1	17 and 330
Chrominance luminance gain inequality	B_2 and G_1 or G_2 B_2 and F	17 and 330, 331 17
Chrominance luminance delay inequality	F	17
Nonlinear distortions		
Luminance line-time nonlinearity	D_1	17
Chrominance nonlinearity	G_2	331
Luminance chrominance intermodulation		
– differential gain	D_2	330
– differential phase	D_2 and E	330, 331
Chrominance luminance intermodulation	B_2 and G_1 or G_2	17, 331

TABLE 2/N.67

525-line monochromne or colour signal (Figure 2/N.67)

Characteristics measured	Waveform used	Line number
Linear distortion		
Insertion gain	B_2	17/field 1
Amplitude/frequency response	B_2 [a] and C_2	17/fields 1 and 2
Line-time waveform distortion	B_2	17/field 1
Short-time waveform distortion:		
– step response	B_2	17/field 1
– pulse response	B_1	17/field 1
Chrominance/luminance gain inequality	B_2 and F	17/field 1
Chrominance/luminance delay inequality	F	17/field 1
Nonlinear distortion		
Line-time luminance nonlinearity	D_1 [b]	17/field 1
Chrominance nonlinearity	G	17/field 2
Luminance/chrominance intermodulation:		
– differential gain	D_2	17/field 1
– differential phase	D_2	17/field 1
Chrominance/luminance intermodulation	G	17/field 2

a) C_1 (line 17/field 2) may be used in place of B_2, when line-time distortion is suitably small.
b) D_2 may be used when the chrominance/luminance intermodulation is suitably small.

6 Insertion and removal of test signals in the field blanking period

6.1 *International signals*

The appropriate international signals inserted by the originating broadcasting organization should be transmitted to the point of destination of the television connection. Exceptionally, if the connection includes a standards or colour systems convertor which does not pass signals occurring during the field blanking period, then the signals should be monitored at the upstream video point nearest to the convertor and new international signals, to the appropriate standard, should be inserted at the downstream point nearest to the convertor. The test signals should be available at any video connection point in order to facilitate assessment of performance. They may also be of use in carrying out any necessary readjustment of correctors at the final destination.

6.2 *National signals*

Any test signals inserted in lines 18 to 20 (525-line systems), or 19 to 21 (625-line systems) and the corresponding lines in the second field in either standard, should be regarded as national signals and should be removed at a suitable video point within the national frontier so that downstream countries on the circuit may use these lines for their own needs. Exceptionally, and subject to agreement between all the countries concerned, national signals may be transmitted across international frontiers.

7 General implementation

It is requested that Administrations of countries where national broadcasting organizations have the sole right of transmitting television signals should approach those organizations in order that the principles of this Recommendation may be applied as widely as possible.

References

[1] CCIR Report *Characteristics of television systems*, Vol. XI, Report 624-1, p. 5, Figure 2-1, ITU, Geneva, 1978.

[2] *Ibid.*, p. 7, Figure 2-3a.

[3] *Ibid.*, p. 7, Figure 2-3b.

[4] CCIR Recommendation *Insertion of test signals in the field-blanking interval of monochrome and colour television*, Vol. XII, Rec. 473-2, ITU, Geneva, 1978.

2.3 Maintenance of leased circuits for television transmissions

Recommendation N.73

ROUTINE MAINTENANCE MEASUREMENTS

(Under study)

PART II

SUPPLEMENTS TO SERIES M AND N RECOMMENDATIONS

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1 Technical information

Supplement No. 1.1

PREFIXES USED IN THE DECIMAL SYSTEM

(For this Supplement, see page 409, Volume IV.2 of the *Green Book*)

Supplement No. 1.2

TRANSMISSION MEASUREMENT CONVERSION TABLES

(For this Supplement, see page 409, Volume IV.2 of the *Green Book*)

Supplement No. 1.3

THE NORMAL (OR LAPLACE-GAUSS) DISTRIBUTION

(For this Supplement, see page 416, Volume IV.2 of the *Green Book*)

Supplement No. 1.4

METHODS OF QUALITY CONTROL

(For this Supplement, see page 422, Volume IV.2 of the *Green Book*)

Supplement No. 1.5

MATHEMATICAL PROCESSING OF THE MEASUREMENT RESULTS OF THE VARIATIONS OF THE OVERALL LOSS OF TELEPHONE CIRCUITS

(For this Supplement, see page 451, Volume IV.2 of the *Green Book*)

Supplement No. 1.6

STATISTICAL THEORY REQUIREMENTS

(For this Supplement, see page 459, Volume IV.2 of the *Green Book*)

2 Measuring techniques

Supplement No. 2.1

SOME GENERAL OBSERVATIONS CONCERNING MEASURING INSTRUMENTS AND MEASURING TECHNIQUES

(For this Supplement, see page 463, Volume IV.2 of the *Green Book*)

Supplement No. 2.2

MEASUREMENTS OF LOSS

(For this Supplement, see page 471, Volume IV.2 of the *Green Book*)

Supplement No. 2.3

LEVEL MEASUREMENTS

(For this Supplement, see page 475, Volume IV.2 of the *Green Book*)

Supplement No. 2.4

MEASUREMENT OF CROSSTALK

(For this Supplement, see page 480, Volume IV.2 of the *Green Book*)

Supplement No. 2.5

MEASURING ERRORS AND DIFFERENCES DUE TO IMPEDANCE INACCURACIES OF INSTRUMENTS AND APPARATUS. USE OF DECOUPLED MEASURING POINTS

(For this Supplement, see page 482, Volume IV.2 of the *Green Book*)

Supplement No. 2.6

ERRORS IN THE INDICATIONS GIVEN BY LEVEL-MEASURING INSTRUMENTS DUE TO INTERFERING SIGNALS

(For this Supplement, see page 489, Volume IV.2 of the *Green Book*)

Supplement No. 2.7

MEASUREMENT OF GROUP DELAY AND GROUP-DELAY DISTORTION

(For this Supplement, see page 492, Volume IV.2 of the *Green Book*)

Supplement No. 2.8

MEASUREMENTS OF SUDDEN PHASE CHANGES ON CIRCUITS

(For this Supplement, see page 508, Volume IV.2 of the *Green Book*)

Supplement No. 2.9

VIBRATION TESTING

(For this Supplement, see page 511, Volume IV.2 of the *Green Book*)

Supplement No. 2.10

METHOD FOR MEASURING THE FREQUENCY SHIFT INTRODUCED BY A CARRIER CHANNEL

(For this Supplement, see page 522, Volume IV.2 of the *Green Book*)

Supplement No. 2.11

RAPID VERIFICATION TEST FOR ECHO CONTROL

(For this Supplement, see page 524, Volume IV.2 of the *Green Book*)

Supplement No. 2.12

AN AUTOMATIC DATA ACQUISITION AND EFFECTIVE PROCESSING PROCEDURE FOR GROUP AND SUPERGROUP PILOT LEVELS

(For this Supplement, see page 524, Volume IV.2 of the *Green Book*)

Supplement No. 2.13

LOOP METHOD FOR THE MAINTENANCE OF 4-WIRE TELEPHONE-TYPE LEASED CIRCUITS

(For this Supplement, see page 267, Volume IV.1 of the *Orange Book*)

Supplement No. 2.14

AUTOMATIC MEASURING DEVICE FOR CARRIER SYSTEMS WITH A LARGE NUMBER OF CHANNELS

(For this Supplement, see page 268, Volume IV.1 of the *Orange Book*)

Supplement No. 2.15

DETECTION OF CIRCUIT FAULTS

(For this Supplement, see page 275, Volume IV.1 of the *Orange Book*)

3 Supplements to the Series O Recommendation

(see Fascicle IV.4)

4 Transmission performance of the international network

Supplement No. 4.1

STABILITY OF OVERALL LOSS AND PSOPHOMETRIC NOISE: RESULTS OF ROUTINE MAINTENANCE MEASUREMENTS MADE ON THE INTERNATIONAL NETWORK DURING THE FIRST HALF OF 1978

(Analysis carried out by the French Administration)

1 General

Continuing the useful practice begun in previous study periods, Study Group IV requested the Special Rapporteur responsible for the study of Question 1/IV to present in this supplement the results of analyses carried out on the basis of observations made on the stability of the network from 1977 to 1980.

In order to make comparisons, it may be useful to refer to Supplements No. 4.1 of the *Green Book* [1], and No. 4.1 of the *Orange Book* [2].

While during previous periods these analyses related to data collected year by year from routine maintenance measurements, Study Group IV decided that for the 1977-1980 period it would obtain equally valid information at lower cost by asking for measurements to be made over a shorter period, of six months only. The first half of 1978 was chosen for this period.

The measurements forming the basis of the analysis related to international circuits, groups and supergroups, in accordance with Recommendations M.520 [3], M.610 [4] and M.620 [5]. It is noted that, for the first time, circuit noise measurements have been collected and analyzed.

2 Contributions received and analyzed

Table 1 shows the countries which have submitted contributions to the Special Rapporteur and the types of measurement involved.

TABLE 1

Contributions received and analyzed

Type of measurement / Country	Supergroup pilots	Group pilots	Circuits measured manually for overall loss	Circuits measured automatically for overall loss	Circuits measured manually for noise	Circuits measured automatically for noise
F.R. of Germany			×	×	×	×
AT&T (United States)			×	×	×	×
Spain			×		×	
France			×	×	×	×
United Kingdom				×		×
Hungary	×	×	×	×		
Norway	×	×	×	×	×	×
Netherlands	×	×	×	×		
Japan (KDD)	×	×	×	×	×	×
Australia			×	×	×	×

3 Results of the analyses

3.1 *Level measurements at reception*

Symbols used

N is the number of results used to calculate M and S;

M is the deviation of the mean value of the results of level measurements from the nominal value, in decibels,

S is the standard deviation in decibels,

HL is the number of results differing by more than X from the nominal value and which have not been taken into account,

X is +5.5 dB or −6.0 dB for results marked in decibels,

X is +55 cNp or −60 cNp for results marked in nepers.

3.1.1 *Supergroup and group pilots*

3.1.1.1 *Classification*

The results analyzed were classified according to whether or not the groups were fitted with automatic level regulators:

– Class 1: measurements made at the regulator input,

– Class 2: measurements made at the regulator output,

– Class 3: measurements on groups without regulators.

3.1.1.2 *Number of relations*

The analyses were made according to the direction of transmission. It should be noted that the Special Rapporteur did not receive any data concerning both transmission directions for any of the country-to-country relations. This is partly due to the way in which the collection of data was organized, i.e. the fact that it was submitted by the country where the group or supergroup control station was situated. In addition, since very few countries sent contributions for all of the classes (1, 2 or 3), the data available were finally divided as shown in Table 2.

TABLE 2

Groups and supergroups—Number of transmission directions per class

Type	Total number of relations	Transmission direction		
		Class 1	Class 2	Class 3
Supergroups	33	15	15	9
Groups	81	75	26	4

3.1.1.3 *Standards given by Recommendation M.160* [6]

In order to give an idea of the present state of the international network with respect to the aims outlined in Recommendation M.160 [6], the number of country-to-country relations satisfying the specifications in Table 3 on the basis of the results analyzed is given in Table 4.

TABLE 3

Standards of Recommendation M.160 [6] for pilots

	Maximum value of $\|M\|$	Maximum value of S
Group pilot	0.3 dB	0.6 dB
Supergroup pilot	0.3 dB	0.5 dB

3.1.1.4 *Results*

These are summarized in Table 4.

TABLE 4

Stability of pilots

	Class 1	Class 2	Class 3
Supergroup pilots	N : 2464 M : + 2.51 S : 10.92 HL+: 0 HL—: 2	N : 1826 M : + 3.13 S : 5.37 HL+: 0 HL—: 1	N : 4457 M : + 0.14 S : 4.48 HL+: 0 HL—: 0
Relations satisfying Recommendation M.160 [6]		5 out of 15	3 out of 9
Groups pilots	N : 19129 M : — 0.89 S : 9.80 HL+: 3 HL—: 47	N : 4872 M : — 0.03 S : 5.07 HL+: 0 HL—: 1	N : 7384 M : — 0.03 S : 3.35 HL+: 0 HL—: 2
Relations satisfying Recommendations M.160 [6]		19 out of 26	3 out of 4

Note – M and S are expressed in centibels.

The analysis in Table 5 classifies the relations according to whether they are unable to satisfy Recommendation M.160 [6] for:

i) too high a value for the mean only (in absolute value),

ii) a standard deviation which is too high,

iii) both causes simultaneously.

TABLE 5

Groups and supergroups—Relations failing to satisfy Recommendation M.160

	i)	ii)	iii)	Total of relations failing to satisfy Rec. M.160 [6]	Total number of relations
Supergroup pilot class 2	7	0	3	10	15
Supergroup pilot classe 3	0	6	0	6	9
Group pilot class 2	1	3	3	7	26
Group pilot class 3	0	0	1	1	4

3.1.1.5 *Conclusions*

The data to be analyzed proved very few, especially when compared to the quantity available during previous surveys (see references [1] and [2] given in § 1).

The results should be therefore assessed with the greatest caution.

The reduction in the available data base is particularly marked for class 2 measurements, i.e. those made at the output of automatic level regulators, particularly in the case of the groups.

It should be noted that this situation was not entirely unexpected; the methods employed in applying Recommendation M.520 [3] can differ greatly from one Administration to another.

3.1.2 *Overall loss of circuits*

3.1.2.1 *Classification*

Two separate analyses of the results were carried out according to whether they were obtained by manual or automatic measurements (ATME No. 2).

3.1.2.2 *Number of relations*

– *Circuits measured manually*

These measurements covered 241 country-to-country relations, broken down into 444 transmission directions; for 38 of the relations, measurements were furnished and analyzed for a single transmission direction only.

– *Circuits measured automatically*

These measurements covered 28 country-to-country relations, broken down into 50 transmission directions; for six of the relations measurements were furnished and analysed for a single transmission direction only.

– *Breakdown*

  – Measurements carried out manually: 69.6%

  – Measurements carried out automatically: 30.4%

3.1.2.3 *Standards given in Recommendation M.160* [6]

To give an idea of the present state of the international network with respect to the aims outlined in Recommendation M.160 [6], § 3.1.2.4 below indicates, on the basis of the results analyzed, the number of transmission directions that satisfy the following specifications:

Maximum value of |M|: 0.5 dB

Maximum value of S : 1.0 dB

3.1.2.4 *Results*

– *Circuits measured manually*

47 transmission directions, i.e. 10.6%, are such that $\left[\begin{array}{l}|M| > 0.5\ \text{dB}\\ S < 1\ \text{dB}\end{array}\right.$

110 transmission directions, i.e. 24.8% are such that $\left[\begin{array}{l}|M| < 0.5\ \text{dB}\\ S > 1\ \text{dB}\end{array}\right.$

30 transmission directions, i.e. 6.7%, are such that $\left[\begin{array}{l}|M| > 0.5\ \text{dB}\\ S > 1\ \text{dB}\end{array}\right.$

Thus a total of 187 transmission directions, i.e. 42.1%, fail to satisfy Recommendation M.160. Conversely, 257 transmission directions, i.e. 57.9%, satisfy Recommendation M.160.

For these measurements the results are (in centibels):

N = 71 959
M = +0.08
S = 9.96
HL+ : 150
HL– : 169

– *Circuits measured automatically*

6 transmission directions, i.e. 12%, are such that $\left[\begin{array}{l}|M| > 0.5\ \text{dB}\\ S < 1\ \text{dB}\end{array}\right.$

18 transmission directions, i.e. 36%, are such that $\left[\begin{array}{l}|M| < 0.5\ \text{dB}\\ S > 1\ \text{dB}\end{array}\right.$

11 transmission directions, i.e. 22%, are such that $\left[\begin{array}{l}|M| > 0.5\ \text{dB}\\ S > 1\ \text{dB}\end{array}\right.$

Thus, a total of 35 transmission directions, i.e. 70%, fail to satisfy Recommendation M.160. Conversely, 15 transmission directions, i.e. 30%, satisfy Recommendation M.160.

For these measurements, the results are (in centibels):

N = 31 375
M = –0.93
S = 14.23
HL+ : 21
HL– : 266

3.1.2.5 *Conclusions*

The results obtained automatically show a percentage of relations satisfying the specifications of Recommendation M.160 [6] which is markedly lower than the percentage shown for manual measurements. This situation is much the same as that revealed in previous analyses (see references [1] and [2] to § 1).

Study Group IV concluded that the measurements made automatically conveyed a truer and more accurate picture of the network; the usual practice is for manual measurements to be made in repeater stations and, therefore, do not take certain equipment such as signalling devices, etc., into account.

3.2 *Circuit measurements of psophometric noise*

3.2.1 *Classification*

As in the case of overall loss, the results obtained for psophometric noise were analyzed separately according to whether they were obtained by manual or automatic measurements.

In addition, seven classes of length were used in accordance with the Recommendation cited in [7].

TABLE 6

Classes of circuit length for noise

Class	Length (kilometres)
1	Below 320
2	from 321 to 640
3	from 641 to 1 600
4	from 1 601 to 2 500
5	from 2 501 to 5 000
6	from 5 001 to 10 000
7	from 10 001 to 20 000

In the case of circuits routed via satellite, the noise length is 2500 km, plus the total length of the terminal routings [8].

3.2.2 *Number of measurements*

The number of noise measurements analyzed is given in Table 7.

TABLE 7

Number of noise measurements per class

Class	Manual measurements No.	%	Automatic measurements No.	%
1	3 419	9.8	0	0
2	3 183	9.1	3 641	12.7
3	7 221	20.6	9 121	31.7
4	2 561	7.3	158	0.6
5	9 440	27.0	4 417	15.4
6	7 035	20.1	8 749	30.4
7	2 125	6.1	2 686	9.3
TOTAL	34 984	100	28 772	100

Breakdown

55% of the noise measurements were carried out manually

45% of the noise measurements were carried out automatically

3.2.3 *Standards given by Recommendation M.580* [9]

Recommendation M.580 [9] contains maintenance objectives for noise, according to the length of each circuit measured. These objectives are the essential criterion applied to the presentation of the results. Their values, given as A, are listed in Table 8.

TABLE 8

Noise objectives per class

Class of length	1	2	3	4	5	6	7
A: noise objective (dBm0p)	—55	—53	—51	—49	—46	—43	—40

3.2.4 *Results*

For each method of measurement (manual or automatic) and each class of length, the percentage is shown of the number of measurements for which the value obtained is less than or equal to:

$$A + x \quad \text{(dBm0p)}$$

where

A is the objective as indicated in § 3.2.3 above,

x has the integral values of the interval (-4, $+4$), including the extreme values.

These percentages are given in Tables 9 and 10.

TABLE 9

Percentages of the number of noise measurements for which the value obtained is less than or equal to A + x (dBm0p)

Measurements made manually

Class	Number	≤ A—4 (%)	≤ A—3 (%)	≤ A—2 (%)	≤ A—1 (%)	≤ A (%)	≤ A+1 (%)	≤ A+2 (%)	≤ A+3 (%)	≤ A+4 (%)
1	3419	72.53	78.35	82.86	87.89	92.27	94.96	95.96	98.01	98.74
2	3183	71.78	79.29	84.57	89.60	94.09	97.67	98.17	98.64	99.24
3	7221	68.74	76.56	83.45	89.94	92.93	95.00	95.84	96.60	96.89
4	2561	65.75	77.46	84.10	89.73	91.48	93.28	94.76	95.78	96.68
5	9440	42.27	53.91	64.42	72.35	80.42	86.03	89.80	93.12	95.49
6	7035	65.88	75.65	83.39	88.45	92.53	95.94	97.65	98.52	99.01
7	2125	87.62	91.34	93.83	96.14	97.27	98.21	98.63	99.05	—

TABLE 10

Percentages of number of noise measurements for which the value obtained is less than or equal to A + x (dBm0p)

Measurements made automatically

Class	Number	≤ A—4 (%)	≤ A—3 (%)	≤ A—2 (%)	≤ A—1 (%)	≤ A (%)	≤ A+1 (%)	≤ A+2 (%)	≤ A+3 (%)	≤ A+4 (%)
1	0	—	—	—	—	—	—	—	—	—
2	3641	88.16	91.34	94.25	96.15	96.84	97.19	97.74	98.18	98.51
3	9121	88.98	93.39	95.72	96.82	98.07	98.72	99.01	99.37	99.51
4	158	94.30	96.20	96.20	99.36	99.36	100	100	100	100
5	4417	38.17	54.42	68.21	80.19	86.82	91.91	95.33	97.77	99.13
6	8749	74.95	81.60	88.04	92.66	95.56	97.31	98.49	99.53	99.70
7	2686	83.73	89.87	94.75	96.53	98.02	98.99	99.36	99.70	—

These two tables may be used to plot the histograms (Figures 1 to 7) and distribution functions (Figures 8 and 9) of noise measurements for each length class. It is important to remember that the objective is a value which is assigned to each length class.

3.2.5 *Conclusions*

The curves exhibit similar shapes for length classes 1, 2, 3, 4, 6 and 7, while class 5 (2501-5000 km) is appreciably different. The set of classes 1, 2, 3, 4, 6 and 7 is represented by a single pair of curves (manual and automatic) in Figure 10, along with the curve-pair relating to class 5.

There is a difference of 3 dB between length class 5 and the other classes taken as a whole, for both manual and automatic measurements. In other words, class 5 would join the group of the other classes if the objective assigned to it were set 3 dB above its present value. A number of reasons have been put forward to explain this fact, but in the opinion of Study Group IV, none of them is conclusive.

Moreover, there is a difference of 2 dB between the automatic and manual measurement results, the automatic measurements giving a lower noise level than the manual ones. This difference does not remain constant from one class to another. Although additional factors are involved in the automatic measurements, the improved results may be due to the difference in traffic density at the time of measurement. Automatic measurements are usually made during the network's off-peak hours, thus the noise level is lower than at peak hours, when manual measurements are generally carried out. It is also possible that this difference is the result of the different lengths of time over which noise measurements are made: 375 ms for the automatic method, a few seconds for the manual method.

Finally, in considering the mean value of all the classes, it is noted that for each class the objective is attained for:

- 89.66% of the manual measurements,
- 95.43% of the automatic measurements.

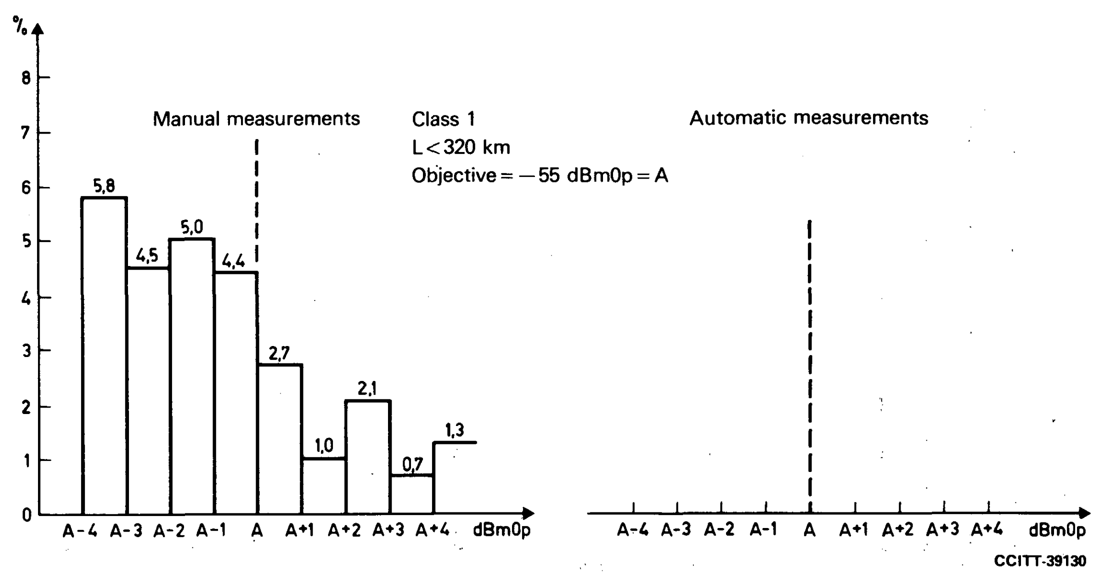

FIGURE 1

Histograms of noise measurement results, by class and by measuring method – Class 1

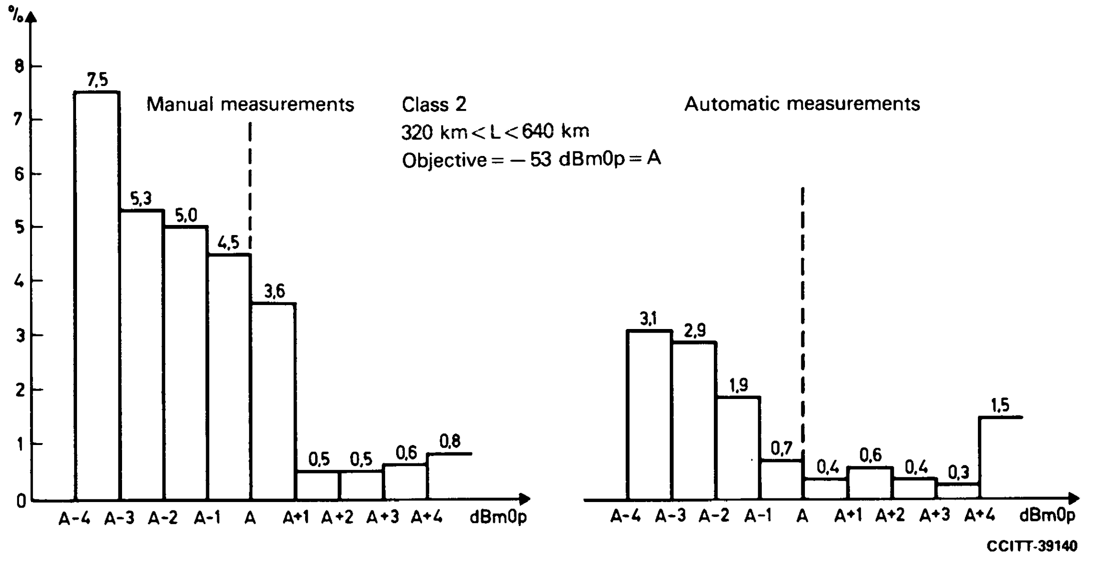

FIGURE 2

Histograms of noise measurement results, by class and by measuring method – Class 2

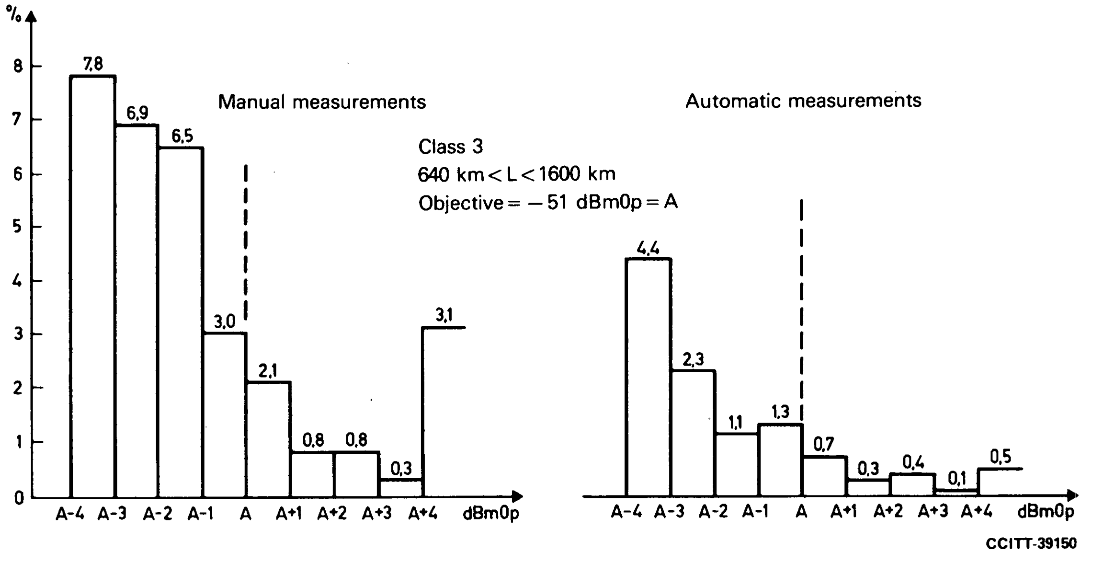

FIGURE 3

Histograms of noise measurement results, by class and by measuring method – Class 3

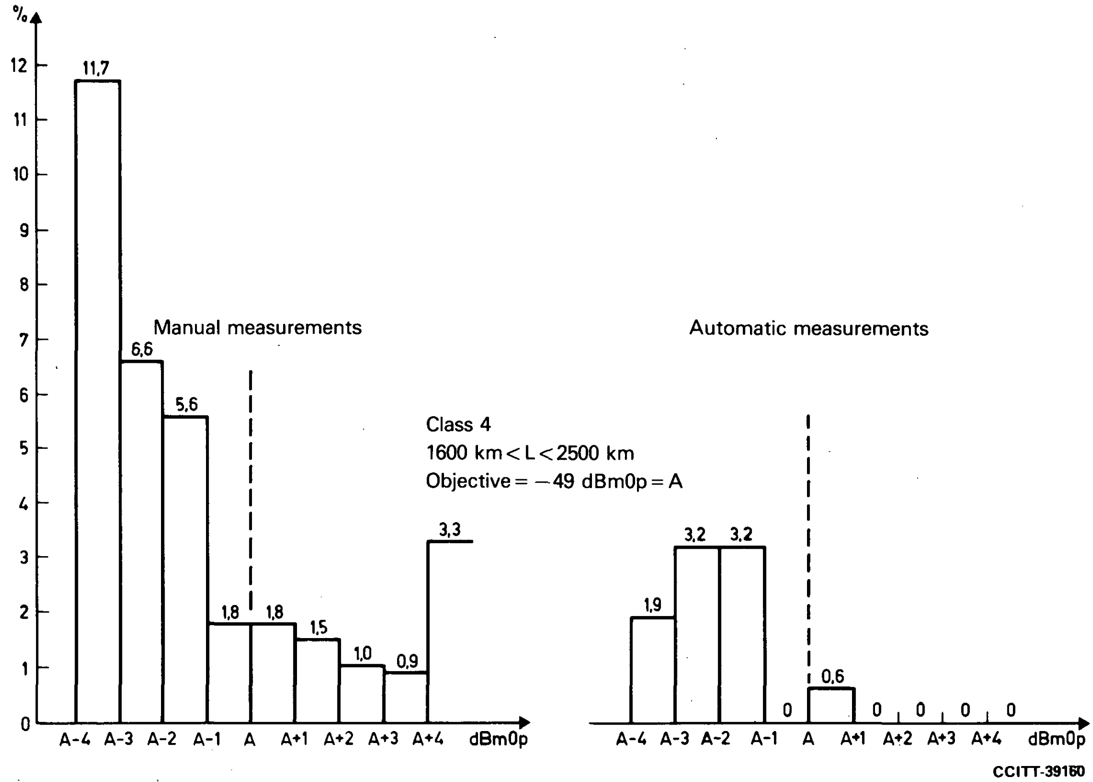

FIGURE 4

Histograms of noise measurement results, by class and by measuring method – Class 4

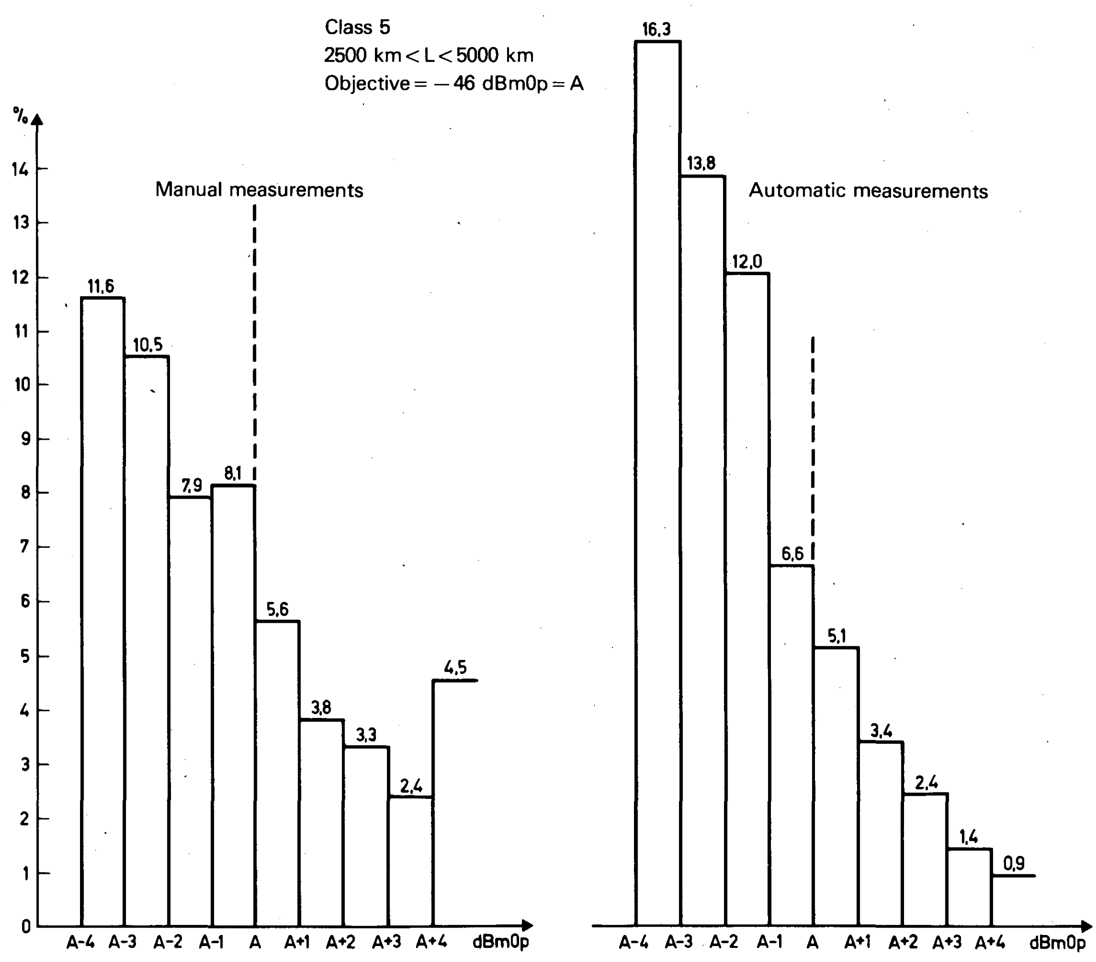

FIGURE 5

Histograms of noise measurement results, by class and by measuring method – Class 5

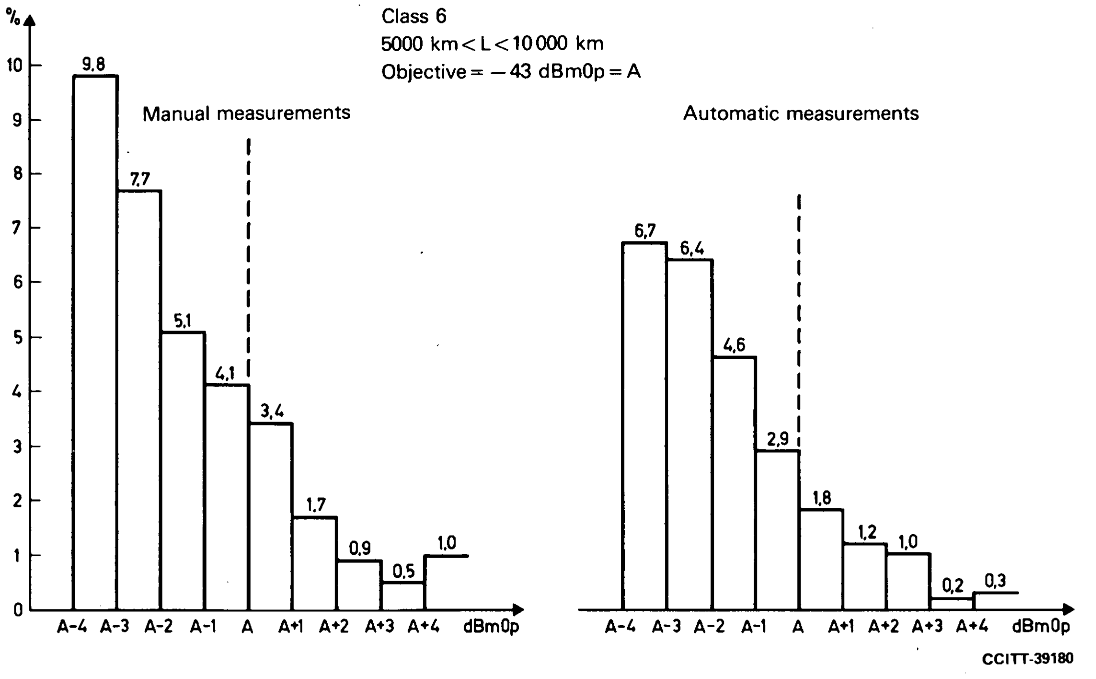

FIGURE 6

Histograms of noise measurement results, by class and by measuring method – Class 6

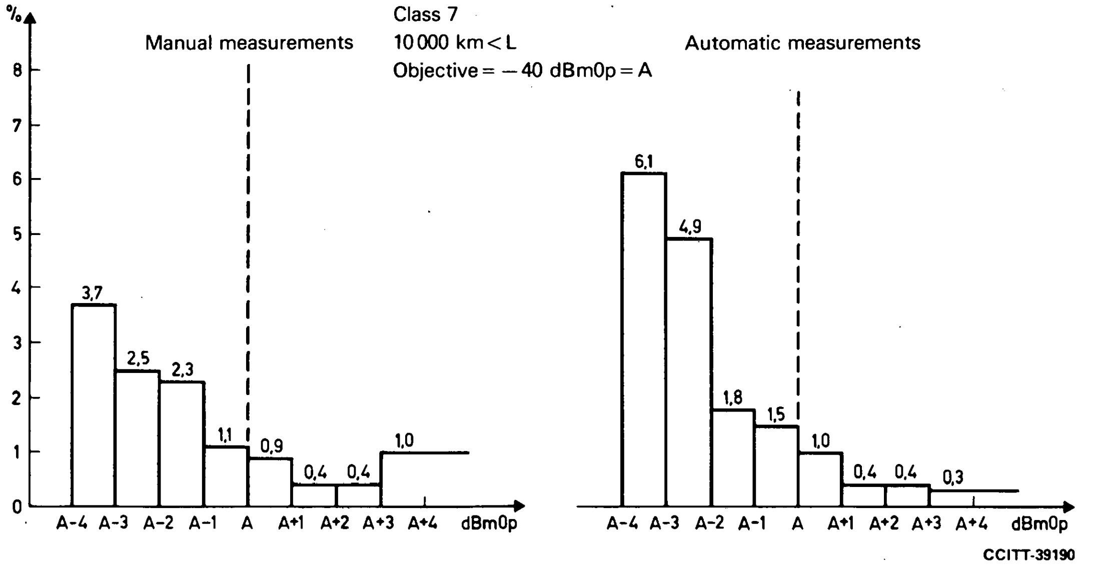

FIGURE 7

Histograms of noise measurement results, by class and by measuring method – Class 7

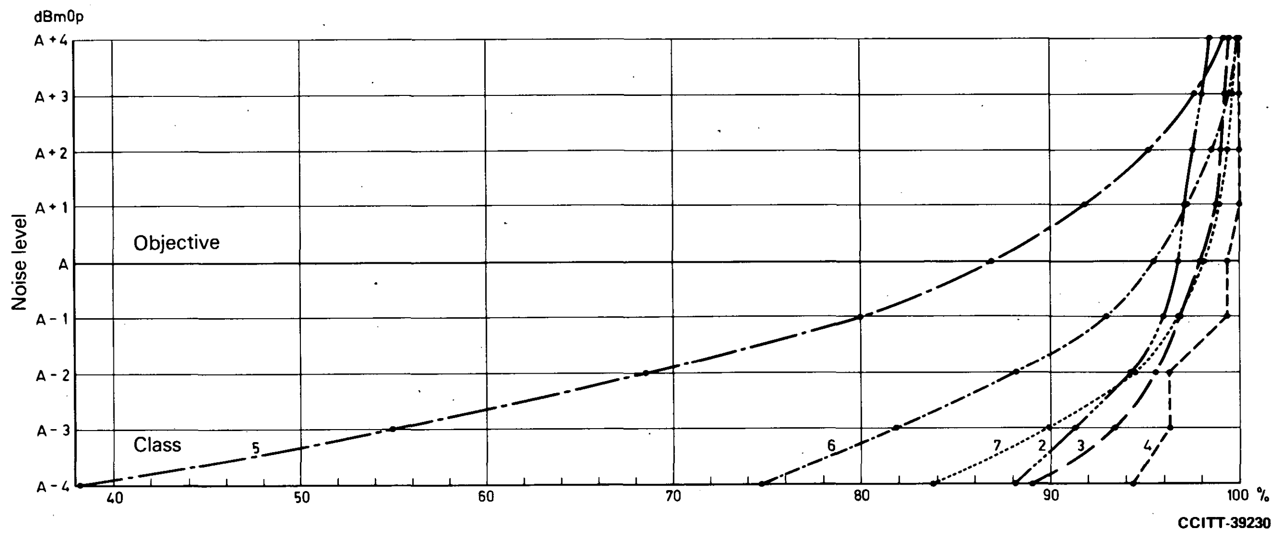

FIGURE 8

Distribution functions of automatic measurements by length class

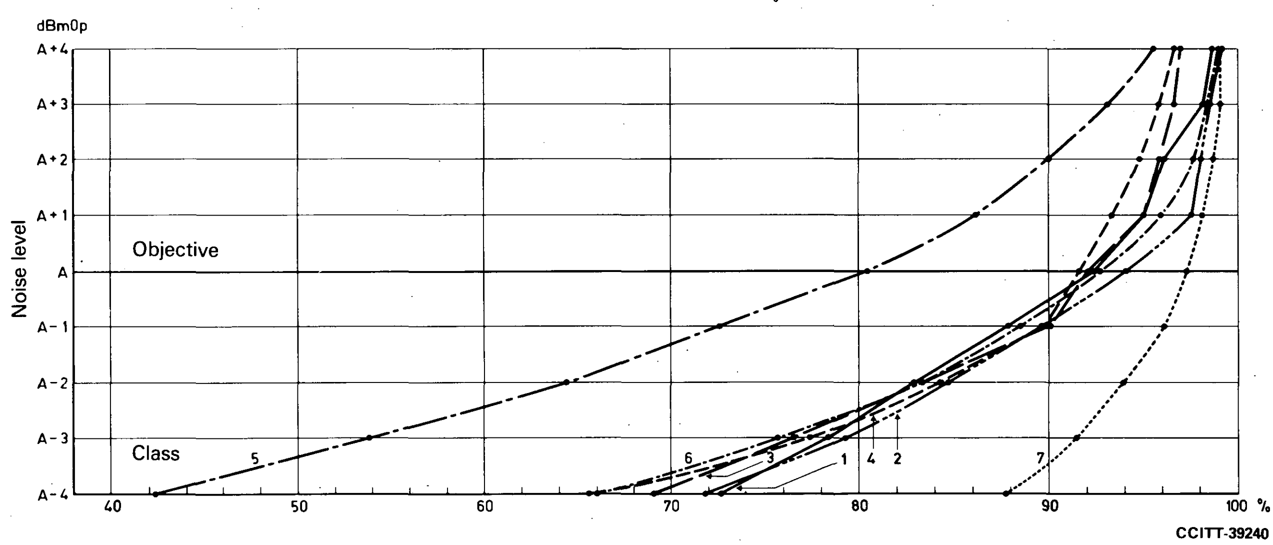

FIGURE 9

Distribution functions of automatic measurements by length class

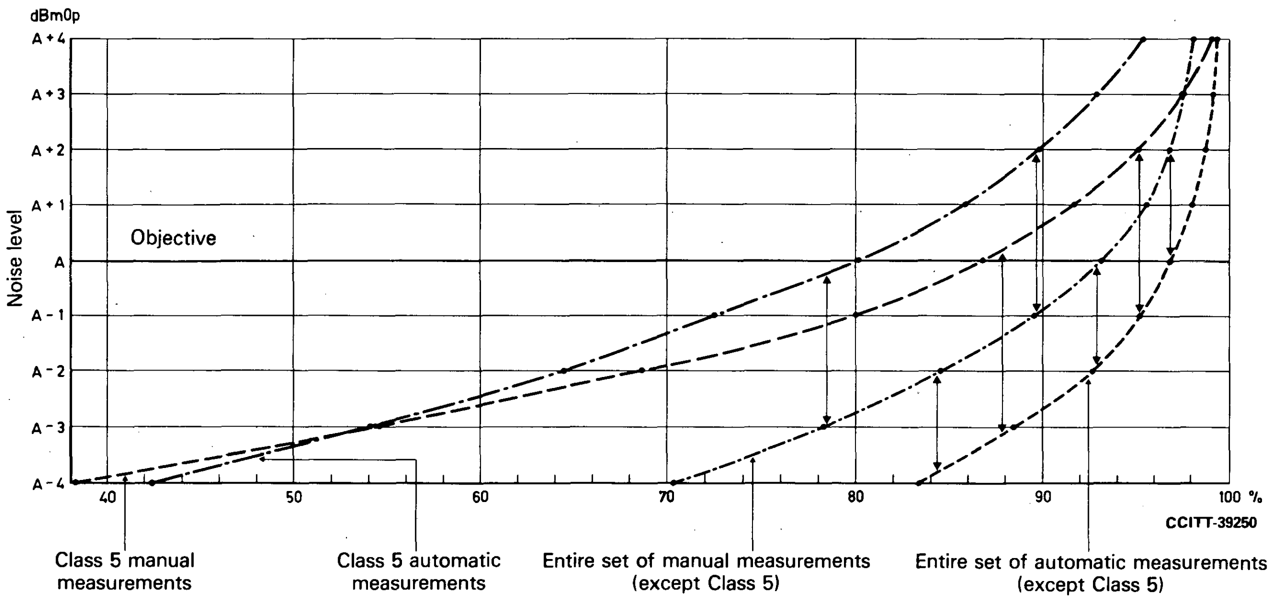

FIGURE 10

Distribution functions of measurements – Class 5 and the other classes taken together

References

[1] *Results of measurements and observations on the stability of the overall loss of circuits in the international network*, Green Book, Vol. IV.2, Supplement No. 4.1, ITU, Geneva, 1973.

[2] *Results of measurements and observations on the stability of the overall loss of circuits in the international network*, Orange Book, Vol. IV.1, Supplement No. 4.1, ITU, Geneva, 1977.

[3] CCITT Recommendation *Routine maintenance on international group, supergroup, etc., links*, Orange Book, Vol. IV.1, Rec. M.520, ITU, Geneva, 1977.

[4] CCITT Recommendation *Periodicity of maintenance measurements on circuits*, Orange Book, Vol. IV.1, Rec. M.610, ITU, Geneva, 1977.

[5] CCITT Recommendation *Methods for carrying out routine measurements on circuits*, Orange Book, Vol. IV.1, Rec. M.620, ITU, Geneva 1977.

[6] CCITT Recommendation *Stability of transmission*, Orange Book, Vol. IV.1, Rec. M.160, ITU, Geneva, 1977.

[7] CCITT Recommendation *Setting-up and lining-up an international circuit for public telephony*, Orange Book, Vol. IV.1, Rec. M.580, § 6 and Table D/M.580, ITU, Geneva, 1977.

[8] *Ibid.*, Note to Table D/M.580.

[9] CCITT Recommendation *Setting-up and lining-up an international circuit for public telephony*, Orange Book, Vol. IV.1, Rec. M.580, ITU, Geneva, 1977.

Supplement No. 4.2

RESULTS AND ANALYSIS OF THE 10th SERIES OF TESTS OF SHORT BREAKS IN TRANSMISSION

1 Introduction

This supplement reproduces the main results of the 10th series (1977-1980) of measurements of short breaks in transmission on the international network. The detailed report from the Special Rapporteur for this subject can be found in the Contribution COM IV-No. 83 and No. 84 (Study Period 1977-1980).

1.1 Tables 1 and 2 at the end of this Supplement summarize the results obtained in the course of this series of tests which are classified as follows:

- For each circuit and for each direction of transmission Table 1 shows the distribution of isolated short breaks on a time-interval basis, and also gives information about series of breaks, together with some routing details for each circuit. Furthermore some information about longer breaks and periods of nonregistration is given.
- For each circuit, Table 2 gives the distribution of single breaks during periods of coincidence of breaks in the two directions of transmission as registered at each of the receiving ends.

1.2 Results were obtained for 16 circuits, viz. 13 circuits in the European network and 3 very long circuits (1 with a satellite section and 2 with long submarine cable sections).

2 General remarks

2.1 The tests were carried out during the second half of 1977. The duration of the test for each circuit was nominally 4 weeks. The observations were made using interruption analyzers meeting the specifications of Recommendation O.62 [1], with the threshold level set at 10 dB and the instrument dead time set at 125 ms.

2.2 It should be noted that information about the causes of the observed breaks cannot be given, as fault localization during the tests was considered only incidentally.

2.3 The following definitions were used for the purpose of this series of tests:

a) Any period during which the interruption rate is 3 or more breaks per minute is called a "3-break per minute" series of breaks.

b) Any period during which the interruption rate is 7 or more breaks per 10 minutes is called a "7-break per 10 minutes" series of breaks. The end of such a period may be some distance from the beginning; it occurs only when the interruption rate falls below 7 interruptions per 10 minutes.

Separate recording is not made of periods at the "3-break per minute" rate if these periods occur within a period during which the interruption rate is 7 or more per 10 minutes.

For the practical treatment of the registered data the definitions and rules mentioned above regarding series of breaks have been interpreted as follows:

A series of "7-break per 10 minutes" begins when a 10-minute interval with at least 7 breaks is found. Such a series ends when it is no longer possible to find an overlapping interval of 10-minute length with at least 7 breaks, and with at least 1 break within the overlapping period.

Within the limits just mentioned the beginning of a series is the first 1-minute interval in which a break occurs, and the series extends to the last 1-minute interval in which a break occurs.

For purposes of illustration, for the examples given in Figures 1, 2 and 3, a time axis with an indication of the number of breaks within 1-minute intervals is used.

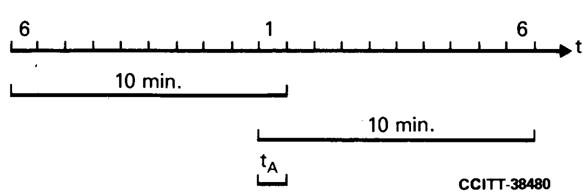

FIGURE 1

Example of a series of "7-break per 10 minutes" that extends beyond the time interval t_A

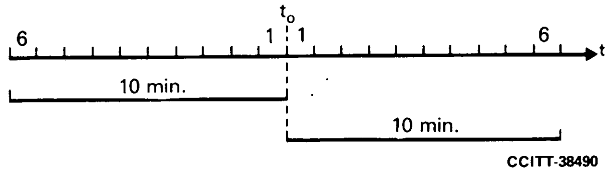

FIGURE 2

Example of two series of "7-break per 10 minutes" adjacent at time $t = t_0$

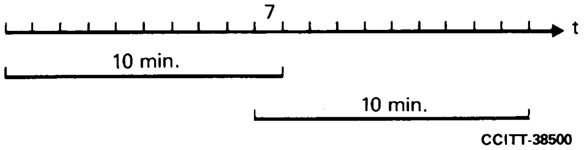

FIGURE 3

Example of 1 series of "7-break per 10 minutes" of duration 1 min.

A series of "3-break per minute" of duration 2 minutes never occurred. Such a series is, however, possible but very unlikely. It would occur only if breaks during a 20-minute period were distributed as illustrated in Figure 4.

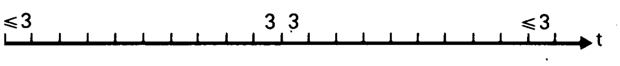

FIGURE 4

Number of breaks within 1 min-intervals; occurrence of a series of "3-break per minute" of duration 2 min.

2.4 Coincidence of breaks in the two directions of transmission has been considered only when the breaks occur at the same time, i.e. in principle within the same 1-minute interval. As the two clocks usually would not change their minute reading at the same time, it has been necessary to some extent also to take neighbouring 1-minute intervals into consideration. Furthermore, in cases where it has been found that the two clocks most likely differ by 1 or 2 minutes, this has been taken into consideration in the determination of the times for coincidence of breaks.

3 Comments on the Tables

The two longest intervals (0.5 s-60 s and > 1 min) have, due to some practical difficulties, been put together in one interval (> 500 ms).

When counting breaks during periods of coincidence of breaks in the two directions of transmission, the distinction between individual breaks and series of breaks could not be applied. Thus, Table 2 shows the number of single breaks, irrespective of that distinction.

TABLE 1

Isolated breaks, number and duration of series of breaks; information about circuits and registration periods

Circuit terminals	Length (m)	Isolated breaks – Time interval (ms) 0.5-3	3-30	30-100	100-300	300-512	> 500	Number of 3-break per minute periods	Duration (minutes) of 3-break per minute periods	Number of 7-break per 10 minutes periods	Duration (minutes) of 7-break per 10 minutes periods	Duration (minutes) of breaks over 1 minute	Missing time in the full 4 week-registration period
Amsterdam – Bruxelles	255	12	6	4	2	1	12	1	1	2	25	141	
Bruxelles – Amsterdam		11	2	6	1	0	12	5	5	2	19	168	
Bruxelles – Paris	382	45	16	5	1	0	21	8	8	5	22	528	72 h.
Paris – Bruxelles		15	1	2	2	4	0	3	3	0	0	0	
Oslo – Stockholm	515	26	3	0	0	0	8	1	1	2	5	0	66 h.
Stockholm – Oslo		31	1	2	0	0	32	5	5	1	1	13	66 h.
Bern – Paris	550	83	3	1	0	0	3	1	1	1	3	8	
Paris – Bern		18	0	1	0	0	5	2	2	2	4	2	
Amsterdam – Paris	≈630	36	0	1	0	0	4	2	2	4	54	39	
Paris – Amsterdam		4	2	0	2	0	11	0	0	2	10	99	
Amsterdam – København	774[a]	20	1	1	0	0	1	0	0	0	0	0	
København – Amsterdam		14	0	0	0	0	1	2	2	2	2	0	
Amsterdam – Bern	860	115	87	7	7	0	20	5	5	5	15	12	6 h.
Bern – Amsterdam		30	5	7	0	1	19	5	5	4	7	378	
København – Oslo	894[b]	16	3	0	0	0	5	4	4	4	7	0	
Oslo – København		10	10	0	2	0	4	1	1	2	2	0	
Bruxelles – København	1063[a]	17	5	2	0	0	12	3	3	5	83	106	
København – Bruxelles		6	3	5	3	0	7	1	1	0	0	31	
Roma – Bern	1100	534	12	50	20	2	163	9	9	38	337	0	
Kobenhavn – Paris	≈1400	69	5	4	1	3	18	6	6	20	376	62	96 h.
Paris-Kobenhavn		168	7	1	2	0	43	10	10	18	198	125	
Budapest – Paris	≈1500	202	10	4	5	0	25	8	8	13	70	0	74 h.
Madrid – Paris	≈1770	401	33	6	2	4	30	9	9	15	247	58	
Paris – Madrid		277	35	3	1	0	39	9	9	42	340	66	155 h.
Paris – Pittsburgh	7043[c]	110	36	13	7	1	11	24	24	19	157	40	72 h.
Madrid – Pittsburgh	7419[d]	61	6	3	5	0	25	8	8	10	91	95	101 h.
Pittsburgh – Madrid		54	14	7	2	2	19	12	12	15	77	42	45 h.
Bern – Tokyo	4382[e]	114	14	4	7	11		17	17	10	69	0	
Tokyo – Bern		119	12	9	5	6	13	5	5	3	21	17	144 h.

a) Submarine cable section 264 km.
b) Submarine cable section 149 km.
c) Submarine cable section 6414 km.
d) Submarine cable section 6290 km.
e) Satellite section regarded as 2500 km.

TABLE 2

Number of single breaks during periods of coincidence of breaks in the two directions of transmission

	Time interval (ms)					
Circuit terminals	0,5-3	3-30	30-100	100-300	300-512	> 0.5 s
Amsterdam – Bruxelles	3	0	0	1	0	5
Bruxelles – Amsterdam	5	0	1	1	0	5
Bruxelles – Paris	1	1	0	0	0	2
Paris – Bruxelles	1	0	1	0	0	0
Oslo – Stockholm	24	13	0	0	0	6
Stockholm – Oslo	15	12	0	0	0	7
Bern – Paris	0	0	0	0	0	0
Paris – Bern	0	0	0	0	0	0
Amsterdam – Paris	2	0	0	0	0	0
Paris-Amsterdam	1	0	0	0	0	0
Amsterdam – København	1	0	1	0	0	0
København – Amsterdam	3	0	0	0	0	1
Amsterdam – Bern	22	13	5	7	0	18
Bern – Amsterdam	66	3	11	10	2	17
København – Oslo	473	281	0	0	0	2
Oslo – København	20	13	0	0	0	2
Bruxelles – København	1	0	0	0	0	2
København – Bruxelles	1	0	0	0	0	1
København – Paris	40	0	0	0	0	0
Paris – København	22	0	0	0	0	0
Madrid – Paris	28	2	0	0	0	0
Paris – Madrid	28	4	10	1	0	6
Madrid – Pittsburgh	13	3	2	0	0	12
Pittsburgh – Madrid	37	27	7	5	2	14
Bern – Tokyo	75	8	1	5	14	
Tokyo – Bern	76	9	6	1	0	7

Reference

[1] CCITT Recommendation *Essential clauses for a sophisticated instrument to measure interruptions on telephone circuits*, Vol. IV, Fascicle IV.4, Rec. O.62.

Supplement No. 4.3

CHARACTERISTICS OF LEASED INTERNATIONAL TELEPHONE-TYPE CIRCUITS

(For this Supplement, see page 564, Volume IV.2 of the *Green Book*)

Supplement No. 4.5

INSTRUCTIONS FOR MAKING FUTURE MEASUREMENTS OF THE TRANSMISSION QUALITY OF COMPLETE CONNECTIONS FOR RECORDING THE RESULTS OF THE MEASUREMENTS

(For this Supplement, see page 569, Volume IV.2 of the *Green Book*)

Supplement No. 4.6

INSTRUCTIONS FOR MAKING FUTURE MEASUREMENTS OF THE TRANSMISSION QUALITY OF NATIONAL EXTENSIONS (EXCLUDING SUBSCRIBER'S LOCAL LINES) AND FOR RECORDING THE RESULTS OF THE MEASUREMENTS

(For this Supplement, see page 580, Volume IV.2 of the *Green Book*)

Supplement No. 4.7

INSTRUCTIONS FOR MAKING FUTURE MEASUREMENTS OF THE TRANSMISSION QUALITY OF INTERNATIONAL CIRCUITS AND INTERNATIONAL CENTRES AND FOR RECORDING THE RESULTS OF THE MEASUREMENTS

(For this Supplement, see page 587, Volume IV.2 of the *Green Book*)

Supplement No. 4.8

RESULTS AND ANALYSIS OF TESTS OF IMPULSIVE NOISE

(For this Supplement, see page 593, Volume IV.2 of the *Green Book*)

Supplement No. 4.9

WEIGHTING OF MEASUREMENTS RELATING TO THE STABILITY OF CIRCUITS IN THE INTERNATIONAL NETWORK ACCORDING TO THE SIZE OF CIRCUIT GROUPS

(For this Supplement, see page 283, Volume IV.1 of the *Orange Book*)

TRANSIENT ANALOGUE CIRCUIT IMPAIRMENTS AND THEIR EFFECT ON DATA TRANSMISSION

(Information submitted by CTCA – Canada)

1 Purpose

The purpose of this Supplement is to highlight the experience of the Canadian carriers with regard to transient analogue circuit impairments and their effect on data. This Supplement will also describe test instrumentation and techniques used by operations forces to monitor and sectionalize those impairments when data transmission performance has been adversely affected.

2 General

With the introduction of data services came an awareness of transient phenomena, which are characterized by abrupt momentary changes in various transmission parameters that, while generally not voice affecting, do significantly impact data information transfer. The transient parameters most commonly encountered are:

1) impulsive noise,

2) phase hits,

3) amplitude hits (gain hits),

4) dropouts (short breaks in transmission).

These phenomena are caused by events in the networks which, with suitable expertise, instrumentation and procedures, can be identified, sectionalized and eliminated or controlled. Measurement of these parameters is usually performed on a corrective maintenance as opposed to routine maintenance basis.

3 Descriptions

3.1 *Impulsive noise*

Impulsive noise appears as a large peak or excursion in the total noise waveform. It is the most commonly encountered transient phenomena and consequently has been studied quite extensively. This impairment is extremely destructive to data and can appear in any form of transmission medium, from voice frequency cable pairs to long-haul microwave systems.

Impulsive noise is distinct from message circuit noise and, in most cases, is generated from sources independent of those causing message circuit noise. To a large degree impulsive noise is caused by customers making regular use of the network, i.e. originating and terminating calls that in turn cause switches and relays to be operated and released, resulting in electrical transients that generate impulsive noise. This phenomenon, however, is also caused by system overload conditions, inadequate grounding, power filtering difficulties, equipment defects and other sources. It can usually be isolated and cleared through perseverance and methodical maintenance procedures.

To ensure satisfactory performance levels, Canadian carriers use a maximum of 15 counts in 15 minutes at a threshold of 71 dBrnc0 (about −20 dBm0p) as an overall maintenance limit.

3.2 *Phase hits*

Phase hits are short-term changes in phase of the transmitted signal and are caused by an extraneous, undesired signal. A phase hit may consist of a momentary rise and fall of phase jitter, or it may consist of a one-way phase step. Phase hits are caused by the manual or automatic switching of carrier supplies not in phase; by noise transients modulating the carrier supply, by facility "patching" operations and by manual or automatic switching to alternate transmission facilities having different propagation times. This latter cause can be minimized by the application of differential absolute delay equalization (DADE), which renders the various transmission paths of equal electrical length.

Many apparent phase hits are actually caused by impulsive noise peaks. It is therefore necessary to verify that impulsive noise is within limits before performing phase hit measurements. To further differentiate between actual versus apparent phase hits, a guard interval (e.g. 4 ms) is designed into the test instrumentation thus preventing the false operation of hit detectors due to the uncorrelated noise.

The maintenance limits or phase hits used by one Canadian carrier are shown in Table 1.

TABLE 1

Maximum allowable number of phase hits in a 15-minute period

Phase hit threshold	Allowable hits
10°	15
20°	4
30°	1

3.3 *Amplitude hits* (gain hits)

A gradual level change of a few dB will not usually create a problem for data users. However, amplitude hits, which are characterized by sudden level changes of 2 dB or greater will generally have a significant impact on bit-error-rate performance. As was the case with phase hits, many apparent amplitude hits are actually caused by impulsive noise and, for this reason, it is necessary to first ensure that impulsive noise is within requirements. Amplitude hits, however, are usually of longer duration than impulsive noise peaks. A typical 4-ms guard interval is again designed into the measuring equipment in order to prevent the false operation of the hit detector circuitry due to uncorrelated noise.

Amplitude hits can be caused by patching facilities as part of regular maintenance activity (e.g. momentary double termination), by manual or automatic switching to alternate carrier supplies or transmission facilities and also by microwave fading conditions, etc.

At this time a standard maintenance limit for this phenomenon has not been implemented by the Canadian carriers. A number of companies, however, have adopted limits such as those shown in Table 2.

TABLE 2

The number of amplitude hits greater than 2 dB in any 8-hour normal business day period which should not be exceeded

Circuit length (km)	Maintenance objective	Immediate action objective
0- 500	2 events	4 events
501-1500	3	6
1501-6500	4	8

3.4 *Dropouts* (short breaks in transmission)

A dropout is an instantaneous reduction in signal level exceeding a specified threshold for a specified period of time (see COM IV-No. 55, page 26, 1977-1980). This form of transient impairment can have a great impact on data transmission and, once again, is commonly associated with manual or automatic facility protection switching activities. Extremely short dropouts frequently encountered in radio path switching can be due to relay contact travel. Parallel patching in carrier terminals which results in signal phase changes can, in addition to causing amplitude hits, also cause dropouts (when complete signal cancellation occurs). Intermittent equipment faults can also cause this phenomenon.

The carriers are still experimenting both with what constitutes a dropout and also with the actual maintenance limit itself. A number of companies are classifying a dropout as a negative amplitude hit of 12 dB or greater with a minimum duration of 4 ms. These companies are also using the maintenance and immediate action limits (for the respective circuit lengths) as shown in Table 2 covering amplitude hits.

Note – Phase hits, amplitude hits and dropouts, to a large degree are caused by regular maintenance activity. For this reason, any preventive maintenance activity that would involve patching or switching facilities, or switching carrier supplies, etc., is restricted during the normal business day. This work is performed during periods of reduced data traffic.

4 Variables within the phenomena

Each transient phenomenon will vary with different sources and, in fact, often from the same source. The significant variables are:

1) magnitude,

2) duration,

3) frequency of occurrence,

4) mode of occurrence.

Item 4), mode of occurrence, refers to the manner in which the impairment may be affected by time of day or day of week, and also indicates whether the disturbances occur randomly, individually, in bunches or in some other discernible *pattern.*

5 Coincidence of transient phenomena

An event which results in data errors usually causes more than one transient phenomenon. Rarely does one phenomenon exist in isolation. Data modems are often sensitive to a combination of both transient impairments and continuous impairments (e.g. noise and phase jitter). Before this was realized, it was not understood why a phase hit of "X" degrees would sometimes cause data errors and sometimes not. With increasing experience came the realization that an error threshold was a complex function of all impairments present.

Transient phenomena, then, are not independent of each other either in cause or effect; they are related to specific events which of course may have random occurrence. They are reproducible in the sense that a repeated event will tend to cause the same transient phenomena each time, within close limits. This knowledge of transient phenomena led to the development of more sophisticated surveillance and testing systems; systems that could monitor a facility and identify these phenomena; systems that could correlate these phenomena with a given event; systems that led to positive and rapid trouble sectionalization capability and improved network data performance.

6 Data impairment correlation equipment (DICE)

6.1 *General*

Based upon the knowledge gained with regard to data affecting transient impairments, a number of test system configurations were developed for use by operations personnel. One of these test systems was labelled DICE (Data Impairment Correlation Equipment) and will be described here as an illustration. This "DICE" system is a logically arranged package of standardized test equipment mounted in a mobile cart to permit rapid changes of location without having to disassemble the test set-up. The system provides technicians with a capability of performing long-term monitoring to detect trouble trends. DICE also permits the correlation and rapid trouble sectionalization of the various data transmission impairments. The fault detection and isolation capability of this system stems from its ability to simultaneously monitor and correlate data error causing impairments at any number of different voice frequency and high frequency test points in the same facility. Identified impairments are also automatically recorded and correlated with any originated facility alarms. Time of occurrence is also indicated.

6.2 *DICE system configuration*

Figure 1 provides a basic layout of the DICE system configuration. The principal equipment is as follows:

Frequency selective voltmeter (FSVM)

Used to demodulate any channel from any high frequency point in the multiplex for purposes of performing analogue parameter measurements. An audio panel is also provided to facilitate aural impairment identification.

Phase jitter set

A multipurpose test set capable of measuring phase jitter and phase hits.

Impulsive noise measuring set

The set is equipped with four registers, each of which is activated at different threshold levels.

Digital recorder

A four channel digital totalizer that accepts the inputs from the four counters on the impulsive noise set and prints the time and number of impulses occurring in consecutive 15-minute intervals. This digital recorder also has an alarm feature that will provide a pulse output every time a channel has been incremented more than a preset number in continuous 1-minute periods during the 15-minute test interval. This feature is provided to assist in the identification and sectionalization of impulsive noise bursts.

Multitrack tape/oscillographic recorder

The multitrack magnetic tape and oscillographic recorder arrangement is optional for use with complex problems requiring an actual waveform or "signature" presentation, i.e. transient phenomena are caused by specific "events" (e.g. carrier supply switching, radio protection switching, etc.), and each event has a characteristic *signature.* Knowledge and recognition of these signatures can assist greatly in the sectionalization of difficult trouble conditions.

Data test set

The use of this equipment is optional. Its purpose is to monitor bit error-rate performance over an adjacent channel within the multiplexed group and to associate errors with the transient phenomena.

Level meter

This test set monitors gradual level changes, amplitude hits and dropouts.

Event recorder

This is the main instrument of the DICE package as it is this 12-channel recorder which performs the final time correlation and identification of all parameters and alarms being monitored.

6.3 *DICE system operation*

With reference to Figure 1, the input panel serves as a centralized point of access to the DICE system. The basic operation is as follows.

The input signal to the system must be a voice frequency (or demodulated equivalent) signal containing a 1-kHz tone. This signal is amplified (Amp 1) and applied to a split pad. The amplifier is adjusted for unity gain between the level of the input signal and the level at any one of the output ports of the split pad. Similarly amplifier 2 is adjusted to ensure unity gain between the input and output of the 1-kHz rejection filter module/split pad arrangement.

To facilitate the identification of transmission impairments causing service failures on high-speed data channels, loss of sync and bit-error-rate alarms are relayed to the event recorder which in turn *correlates* these alarms with the offending analogue parameter(s).

In summary, the DICE system has three major roles:

1) to monitor any given channel and detect parameter degradation before service is affected;

2) to correlate transmission parameter impairments with system alarms to determine which parameter(s) is/are out of requirement;

3) to provide a rapid trouble sectionalization capability.

Fault sectionalization requires a logical and systematic approach towards the identification of the ultimate cause of an impairment. *Experience* with the DICE or equivalent form of system is a most definite asset for purposes of proper printout analysis and rapid fault sectionalization.

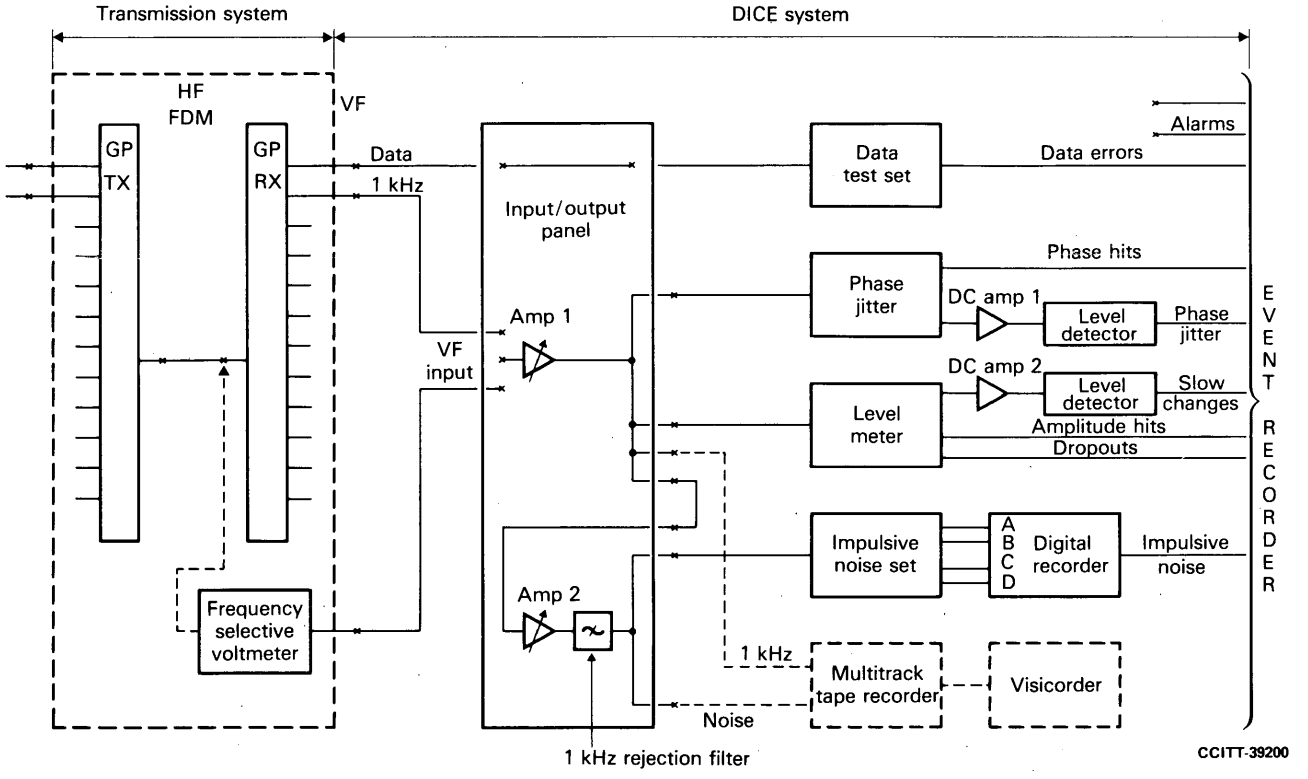

FIGURE 1
DICE system configuration

7 Conclusions

This Supplement has addressed the subject of transient analogue circuit impairments as related to data performance. Worst offenders were reviewed with regard to typical causes and cures. A test system package for the detection and sectionalization of these phenomena was also described.

Some general conclusions are:

1) Once basic remedial action is taken to rectify and control certain *steady* impairments such as noise and phase jitter, these parameters are no longer a major source of problems.

2) Transient or short duration impairments can have a drastic effect on data performance.

3) Transient phenomena are related to specific events which may have random occurrence; they are not independent of each other either in cause or effect; they are reproducible in the sense that a repeated event tends to cause the same transient phenomena each time, within close limits.

4) Each transient phenomenon will vary with different sources and, at times, also from the same source. The significant variables are magnitude, duration, frequency of occurrence and mode of occurrence.

5) Transient phenomena are caused by an event in the network. Once the cause has been determined mitigative measures can be applied, e.g. modification to equipment, replacement of older equipment, improved maintenance techniques, etc.

6) Awareness of and experience with transient phenomena has led to the development of sophisticated test system configurations that afford rapid detection and sectionalization of data affecting impairments. This capability is primarily derived through the ability to correlate system alarms with any out-of-limit analogue transmission parameter(s); these in turn can be correlated with high bit-error-rate indications.

7) Impulsive noise is generally the main offending transient phenomenon. It is necessary to first ensure that other transient impairments are not actually caused by impulsive noise peaks.

8) Phase hits, amplitude hits and dropouts, to a large degree, are generated by maintenance activity such as switching carrier supplies, switching microwave channels and patching transmission facilities. This form of activity is curtailed during periods of heavy data traffic.

In summary, the data transmission improvement programme has led to the identification and resolution of many problems affecting the data service. Engineering knowledge of transient phenomena resulted in the development of sophisticated data transmission surveillance and fault sectionalization test instrumentation. Experience with this equipment has developed data expertise amongst maintenance forces; improved transmission bit-error-rate performance has removed certain former assignment restrictions on special services data circuit facilities and finally, as a result of this programme, it has been possible to make a significant improvement in the quality of service provided to the customer.

5 Maintenance of television circuits

Supplement No. 5.1

REQUIREMENTS FOR THE TRANSMISSION OF TELEVISION SIGNALS OVER LONG DISTANCES

(For this Supplement, see page 598, Volume IV.2 of the *Green Book*)

6 Miscellaneous

Supplement No. 6.1

EFFECT ON MAINTENANCE OF THE INTRODUCTION OF NEW COMPONENTS AND OF MODERN EQUIPMENT DESIGN

(For this Supplement, see page 620, Volume IV.2 of the *Green Book*)

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