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INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

(C. C. I. F.)

XVIIth PLENARY ASSEMBLY

GENEVA, 4-12 OCTOBER 1954

VOLUME V

Signalling and Switching

Part 1 — Signalling in the manual service.

Part 2 — General recommendations relating to signalling in the semi-automatic service.

Part 3 — Guiding principles for the maintenance of semi-automatic circuits.

Part 4 — Specifications for standard international signalling and switching equipment.

PUBLISHED BY THE INTERNATIONAL TELECOMMUNICATION UNION
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MODIFICATIONS TO VOLUME V OF THE GREEN BOOK

(Signalling and Switching)

2nd Amendment

On page 20 of Volume V, replace paragraph 2 by the following:

Power of signals transmitted on national circuits

The C.C.I.F. hopes that Administrations and Private Operating Agencies will, as far as possible, take into consideration for their national signalling systems the following limits:

a) 36 000 microwatts seconds for the signalling currents (*electric signals* and *tones*) which must not be exceeded during the busy hour for one direction of transmission of a circuit (with the assumption that in a multichannel carrier system, the energy for one way transmission is half the signal energy for transmission in both directions);

b) the values in Table 1 on page 94, giving the absolute level of power (at the point of zero relative level) of a signalling pulse at a given frequency.

3rd Amendment

In the " Specifications ", replace paragraph 2.9, page 55, by the following new text:

2.9. *Connection of the signal transmitter and signal receiver to the circuit.*

The signal receiver should be protected against disturbing currents (voice currents or possibly noise), coming from the near-end of the circuit, by a buffer amplifier or other arrangement. The arrangement used should introduce an appropriate supplementary attenuation in such a manner that, at the point where the signal receiver is connected, these distrubing currents are of such a level that they cannot:

— operate the signal receiver,

— or interfere with the reception of signals by operating the guard circuit of the signal receiver.

The supplementary attenuation introduced should in consequence take account:

a) of relative level n of the point where the signal receiver is connected (this relative level is obtained by taking as the zero relative level the origin of the circuit situated at the extreme end);

b) of the lowest signal level at the entry to the signal receiver, that is:

— $18+n$ db in the case of the 2 frequency system (see page 75 of Volume V of the Green Book);

— $15+n$ db in the case of the 1 frequency system (see page 65 of Volume V of the Green Book);

c) of the maximum admissible level for disturbing currents (voice currents and switching noise) coming from the near-end of the circuit. For the maximum level of voice currents, an assumption could be made which might be, for example, +10 db at the point of zero relative level in the direction *opposite* to that of the signals. The characteristics of the switching noises depend on the national systems used;

d) of the equivalent with which the international circuit is operated in terminal service;

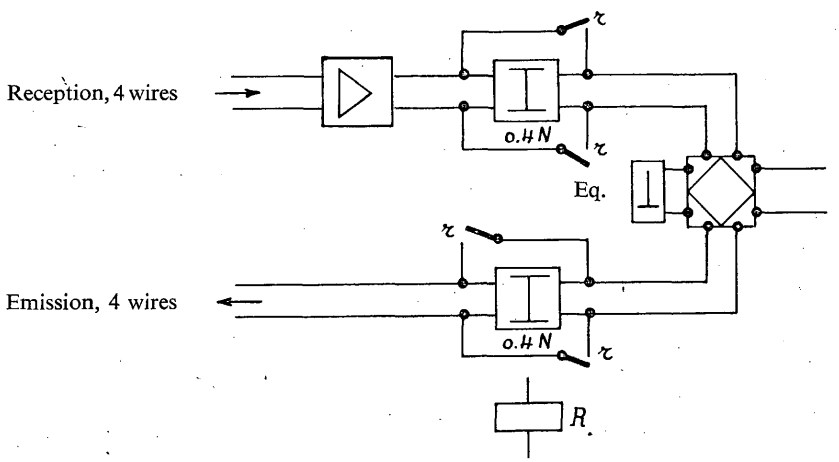
e) of a margin of security *x* corresponding to an appreciable reduction of the level of disturbing currents coming from the near-end as defined, with reference to the minimum level of the signal as defined in paragraph *b)*.

4th Amendment

It would be useful, on the occasion of a reissue of Volume V of the Green Book, to introduce in the Appendix to the Specifications, diagrams illustrating the 3 methods indicated in the paragraph 2.4 previously mentioned. These diagrams could be as follows:

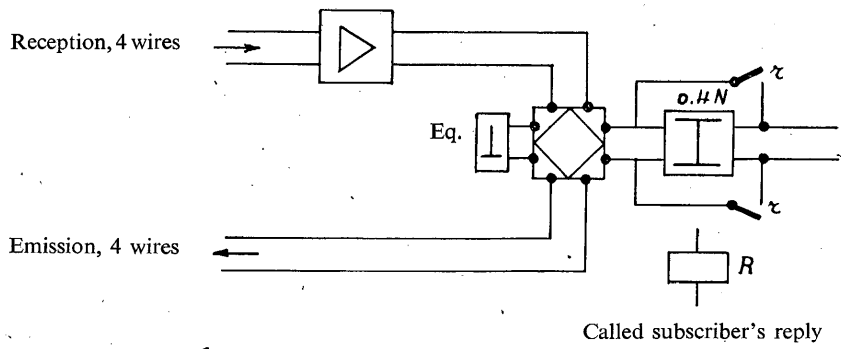
Diagrams

a) Insertion of a line attenuation on each of the channels of the 4-wire part of the connection.

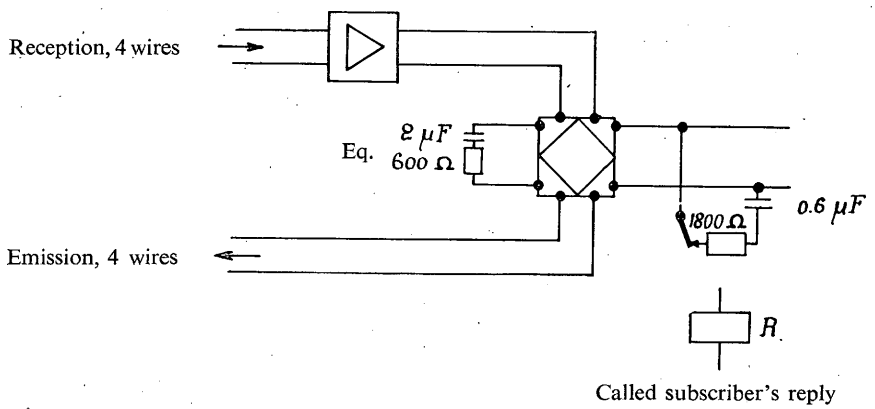


Called subscriber's reply

b) Insertion of a line attenuation in the 2-wire part of the connection.



c) Insertion of a terminating impedance in parallel with the 2-wire part of the connection.



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PART I

SIGNALLING IN THE MANUAL SERVICE

CHAPTER I

USE OF SIGNAL RECEIVERS PROPER TO MANUAL OPERATION

A signalling current of a frequency of 500 c/s ± 2%, interrupted at a frequency of 20 c/s ± 2%, was provisionally chosen in 1934 for manually-operated circuits used in international communications. (C.C.I.F. White Book, Volume III, Xth Plenary Assembly, Budapest, 1934).

The frequency of 500 c/s was selected to be transmitted, under normal conditions, by carrier-current terminal equipment and by line repeaters. Further, to avoid false signals due to voice currents, it was considered desirable to interrupt the 500 c/s signalling current at low frequency. The use of a uniform interrupting frequency of 20 c/s allows, in particular, a high degree of selectivity to be obtained in signal receivers.

The effective power of the current, non-interrupted, is fixed at 1 milliwatt at the point of zero relative level or an absolute power level of zero (with a tolerance of ± 1 decibel or ± 0.1 nepers) which corresponds to an average power of interrupted signalling current of 0.5 milliwatts, with a tolerance of ± 1 decibel or ± 0.1 nepers.

The power levels specified above were determined in 1954 (XVIIth Plenary Assembly, Geneva, 1954) on the basis of the limit imposed for the maximum energy which can be transmitted by signals during the busy hour and which must not exceed 2.5 microwatt hours or 9000 microwatt seconds at the point of zero relative level. To this effect a reasonable value for the number of calls, or attempts to establish calls, on a circuit during the busy hour has been assumed and 2 seconds has been admitted as the sending duration of the signalling current to line when the operator actuates her ringing key.

In the case where, outgoing from an international terminal centre, the 500/20 c/s signals are liable to be sent over wide-band carrier-current systems (coaxial carrier current systems) it is desirable, to avoid the overloading of repeaters, that the duration of the 500/20 c/s signals sent to line shall not exceed 2 seconds and possibly be limited automatically to this value.

Considering that, as a general rule, the " Instructions for Operators of the International Telephone Service " (Article 11) require the signalling current sent over the international circuit to have a duration of a least two seconds to avoid the risk of signals being undetected at the incoming end, the means for limiting the sending duration of the signalling current will generally consist of an arrangement which controls the sending duration independently of the time the ringing key is operated and which fixes that duration automatically to a value of 2 seconds.

Note. — In the case of two-wire circuits of short length, it may be economical to use a low-frequency signalling current (between 16 and 25 c/s or 50 c/s) by agreement between the Administrations and private operating Companies concerned.

APPENDIX

Essential technical clauses of a specification for the supply of 500/20 c/s voice frequency signalling sets (signal senders and receivers) intended for manually-operated circuits

(a) *Sending of signals*

Power. — The signal sender shall supply a sinusoidal current at a frequency of 500 c/s ± 2% interrupted at a frequency of 20 c/s ± 2%.

The effective mean power of the 500/20 c/s current is fixed at 0.5 milliwatt or an absolute level of power of −3 decibels or −0.35 nepers (with a tolerance of ± 1 decibel or 0.1 nepers) at the point of zero relative level.

Every precaution should be taken to avoid unbalance effects in the circuit during the transmission of a 500/20 c/s signalling current.

(b) *Reception of signals*

Sensitivity. — The signal receiver shall operate correctly when the current at 500/20 c/s at the entry to the signal receiver is within the limits :—

$$-0.95 + n \ll N \ll +0.25 + n \text{ nepers}$$

$$-8.5 + n \ll N \ll +2.5 + n \text{ decibels}$$

where n represents the relative level of power at the point of the circuit at which the signal receiver is connected.

The limits take account of the tolerances indicated above for the level of power transmitted and a margin of ± 0.5 nepers (± 4.5 decibels) with reference to the nominal absolute level of power of the 500/20 c/s current received at the entry to the signal receiver. This margin is planned to take account of the variations in transmission conditions on international circuits.

Tuning. — Tuning should be such that the signal receiver operates only at a frequency of 500 c/s guaranteed to within ± 2% approximately and at an interrupting frequency of 20 c/s guaranteed to within ± 2% approximately.

Delay. — The delay, i.e., the time which elapses between the application of the signalling voltage and the operation of the signal receiver, must be sufficiently long to allow the signal receiver to remain insensitive to all speech currents which normally flow in the circuit to which it is connected. The duration of this delay

must, however, be less than 1200 milliseconds. (In other words, 1200 milliseconds is the maximum recognition time of a signal, at the end of which a signal must certainly have been recognised).

Selectivity. — (resulting from the tuning of the resonant circuit and the delay mentioned above).

The receipt of a speech (or noise) current circulating in the circuit must not give rise to a current liable to cause the operation of the signalling equipment, and, in consequence, causing a wrong indication to be given on the international positions even if the speech (or noise) voltage reaches its maximum value experienced in practice. In particular, the signal receiver must not operate when a speech power not exceeding 6 milliwatts is applied at the point of zero relative level.

Insertion loss. — The insertion loss introduced by the signal receiver into the circuit with which the signalling set is associated must be less than 0.3 decibel or 0.035 nepers for any frequency effectively transmitted by the circuit.

CHAPTER II

USE FOR MANUAL OPERATION OF TYPES OF SIGNAL RECEIVERS DESIGNED FOR SEMI-AUTOMATIC OPERATION

The directives relating to 500/20 c/s signalling sets are provisional. An Administration or Private Operating Company intending to purchase new signalling sets for use on international circuits which for the time being are to be operated on a manual basis, may find it advantageous, by agreement with the Administrations interested in the operation of the circuits concerned, to use signal receivers and signal senders conforming to the specifications established for the semi-automatic service. This will permit a greater technical uniformity of installations and will avoid having to replace the signal receivers when, ultimately, these circuits are operated on a semi-automatic basis.

The signal receivers must, therefore, conform completely with clauses 4.2 and 5.2 of the Semi-automatic equipment Specifications depending on whether single-frequency or two-frequency signal receivers are concerned. The general clauses of sections 2.8 and 2.9 of these specifications concerning the insertion of signal receivers should also be observed.

Sending of signals

The frequency and power level of the signalling current must be in accordance with the conditions specified in clauses 4.1 or 5.1 of the Semi-automatic equipment Specifications. If two-frequency signal receivers are concerned, the two frequencies (compound signal) must be transmitted simultaneously.

The nominal duration of a signal sent to line is fixed as 2 seconds so as to maintain the same value as that specified for 500/20 c/s signalling.

Reception of signals

At the receiving end, provisions must be made for a splitting arrangement conforming to clauses of sections 4.3 or 5.3 of the Semi-automatic equipment Specifications.

These splitting arrangements can:—

— either form a integral part of the signal receivers
— or be placed at the end of the circuit following the signal receiver.

The signalling equipment which is placed at the output of the signal receiver and which causes the lighting of the calling and clearing lamps will be arranged in such a manner as to have a signal recognition time of between 100 and 1200 milliseconds:—

— the minimum duration of 100 ms has been fixed to avoid the recognition of false signals due to imitation by speech currents;
— the maximum duration of 1200 ms has been fixed to permit the partial use of old type equipment planned for the reception of 500/20 c/s signals.

Note. — The characteristics of signal receivers of the types used for semi-automatic operation could possibly also be used to provide signals and supplementary facilities for operators if the Administrations concerned consider that the operational advantages to be obtained justify the equipment modifications involved at the international terminal centres.

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PART II

GENERAL RECOMMENDATIONS RELATING TO SIGNALLING IN THE SEMI-AUTOMATIC SERVICE

CHAPTER I

CCIF BASIC RECOMMENDATIONS IN RESPECT TO INTERNATIONAL SEMI-AUTOMATIC OPERATION

Recommendation No. 1

Advantages of semi-automatic operation in the International Telephone Service

(XVIIth Plenary Assembly, Geneva, October, 1954.)

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

taking note of the essential conclusions drawn by the " Field Trial Commission for international telephone operation " (C.E.A.) in its final report, particularly:

(a) the large economies in personnel which are secured by the introduction of semi-automatic operation not only at the incoming centre but also at the outgoing centre,

(b) the very small number of faults due to the equipment used for the international semi-automatic service,

(c) the improvement in the efficiency (ratio of chargeable time to total occupation time) of semi-automatic circuits compared with the efficiency of manual circuits operated on a demand basis,

(d) the improvement in the quality of service afforded subscribers due to the reduction in the time of setting-up a call,

(e) the fact that all types of calls can be set up without difficulty over semi-automatic circuits, viz:—

— ordinary
— *preavis*

— requiring an incoming B operator or booking at incoming suspended-call positions.

and that it is, therefore, possible to use only semi-automatic circuits for international calls ;

draws the attention of Administrations and Private Operating Compagnies:

to the advantages which semi-automatic operation affords from the point of view of the economies and the quality of service given to subscribers.

Recommendation No. 2

Signalling Systems to be used for international semi-automatic telephone operation

(XVIIth Plenary Assembly, Geneva, October, 1954.)

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

Considering

that standardisation of the signalling systems to be used for international telephone operation is necessary if in any one international terminal centre it is desired to avoid having a multiplicity of different types of equipment for the various routes exploited,

that the field trials conducted with public traffic in 1953 and 1954 to enable a choice to be made between two different systems proposed for standardization (single-frequency or two frequency-system) indicated that, in the opinion of the operating services, both systems were satisfactory and that no clear evidence was afforded of the superiority of one system over the other,

that the appreciations expressed on the relative importance of the other factors which could favour the choice of one or other of these two systems, depended either on considerations largely based on national experience in signalling matters from which differing conclusions can be drawn according to the techniques employed in each country, or on purely theoretical grounds based on the views held concerning the development of international semi-automatic operation in the more or less distant future ;

desiring

that the C.C.I.F. recommendation concerning the international signalling system for semi-automatic operation can be generally applied by all Administrations and Private Operating Companies interested in adopting this method of operation ;

unanimously issues the recommendation

that Administrations and Private Operating Companies use for international semi-automatic telephone operation, one or other of the two standardized systems specified in Part IV of this work in the following conditions:

Terminal Traffic

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

Considering

that the establishment of the semi-automatic service on an international route used solely for terminal traffic, requires only a bilateral agreement between the Administrations and/or Private Operating Companies of the two countries concerned*;

recommends

that one or other of the two international signalling systems be used on an international route operated in terminal traffic,

that the choice as to which of the two signalling systems is to be used should be determined by mutual agreement,

considering

that where agreement cannot be reached to use the same signalling system for both directions of circuit operation, it would be useful to refer to a simple rule to facilitate the conclusion of an agreement as to the use of a signalling system for each direction of operation,

recommends

reference to the following rule: " The system to be used in each direction on a route operated in terminal traffic will be the system used (or preferred) at the outgoing centre " since such a rule can, in comparison with the inverse rule according to which the choice of the system would depend on the equipment at the incoming centre, have the advantage, in certain centres, of permitting the provision of a single access, common to the equipment of all directions.

Note. — By agreement between Administrations it can be arranged for the transmission of numerical signals to be effected by means of dial-type pulses without having recourse to the special code of numerical signals planned for each of the two standardized systems.*

Transit traffic

THE INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE

Considering

that the establishment of transit operation in the semi-automatic service does not depend on agreements between Administrations and/or Private Operating Companies of only two countries but on agreements between those of several countries,

* The considerations formulated by the Working Party of the 8th C.E. (which was given full powers by the XVIIth Plenary Assembly to establish specifications) serving as a guide in the case where modifications to a standard signalling system were envisaged by bilateral agreement between Administrations to permit the transmission of numerical signals by means of dial-type pulses, form part of the preamble to the Specifications, page 39 of this volume.

that the co-existence of the two signalling systems used together for transit operation would give rise to very great difficulties as was emphasized in the Final Report of the C.E.A. *,

that in 1954 the opinions of the various Administrations and Private Operating Companies differed on the question of the importance likely to be assumed by transit traffic over a period during which it can reasonably be expected that present techniques will be applied,

and in view of the fact

that the majority of the countries which, in 1954, had a preference for the single-frequency system attached only a minor importance to transit routings whilst the majority of countries which considered that, during the above-mentioned period, transit operation will be of importance for the distribution of their traffic and which desired to see a rapid development of transit operation, were in favour of the two-frequency system.

Unanimously recommends

that Administrations and/or Private Operating Companies normally use the two-frequency system for transit operation except when special agreement is reached between three or more countries to use the single-frequency system for transit operation between them.

Note. — In accordance with this recommendation the transit equipment and the circuits used for transit in the semi-automatic service should, therefore, be of the two-frequency type (except in the case of the special agreements mentioned above). In the case of a centre where, for terminal traffic, the outgoing circuits are normally of the single-frequency type, this centre can only serve for switching a transit call automatically on the condition that, in addition to the single-frequency equipment, two-frequency transit equipment is installed and a certain number of two-frequency outgoing circuits are provided on the transit routes.

It would therefore be necessary that the volume of transit traffic to be switched through this centre should be sufficient to justify not only the cost of installing the automatic transit equipment but also to warrant the existence of two different types of outgoing circuits and the possible reduction in the efficiency of the circuits arising from their division into two distinct groups.

If the traffic conditions do not justify such measures it will nevertheless be possible to secure, for the transit traffic to be routed through this centre, an appreciable part of the advantages arising from the use of semi-automatic circuits (elimination of the incoming operator, speedier setting-up of calls). In fact, it will be sufficient for the operator at the outgoing centre to route a transit call via the code 11 or code 12 operator at the transit centre (operator obtained via a single-frequency or two-frequency semi-automatic circuit) and for this latter operator to establish the call over an outgoing single-frequency circuit.

---

* C.E.A. = Field Trial Commission for international telephone operation. This Commission was active from 1949 to 1954. Its conclusions expressed in its " Final Report " here quoted, have been used as the basis of the present Recommendations.

1st Amendment.

Replace Chapter II of Part 2, pages 13 to 17, by the following: 13

CHAPTER II

GUIDING PRINCIPLES ON WHICH THE C.C.I.F. RECOMMENDATIONS RELATIVE TO INTERNATIONAL SIGNALLING AND SWITCHING SYSTEMS HAVE BEEN BASED

1. *Unidirectional operation of the circuits*

To enable the equipment to be as simple as possible and to avoid double connections and lock-ups, the international fully-automatic or semi-automatic telephone circuits should be operated *in one direction only.*

2. *Transmission of signals in the 300/3400 c/s band*

The signals employed on international circuits must be transmitted within the band of frequencies used for speech.

Note 1. — In reaching this decision, account was taken of the following advantages of systems which use separate channels for speech and for signalling:

(1) Freedom from disturbance due to speech currents and echo suppressors and also from disturbances which might arise from connections to other systems;

(2) Possibility of using signals formed by short pulses or continuous transmission and the possibility of transmitting these signals during the actual period of conversation;

(3) Simplicity of terminal equipment.

The following disadvantages of systems using a signalling channel, completely separate from the speech channel, have also been taken into consideration:

(1) The need to transfer all signals from the incoming to the outgoing side of each transit centre;

(2) The additional costs arising from the establishment of a separate signalling channel;

(3) The possibility that a trunk connection may be set up, in which the speech channel (associated with the signalling channel) is faulty;

(4) The distortions of signals due to additional repetitions at transit centres;

(5) The increased difficulties when a defective section of the line has to be replaced.

Note 2. — Signalling systems not using frequencies within the speech band, and not presenting, or not presenting to the same extent, the disadvantages (2), (3) and (5) referred to above, have been developed for modern multi-circuit carrier cable systems.

If Administrations desire, by bilateral agreement, to use such systems for direct routes which would not carry transit traffic, it would be highly desirable, from the transmission aspect, to use one of the types of out-of-band signalling systems defined in the Appendix to this chapter.

3. *Maximum admissible power for signals transmitted over international circuits*

The power of signals for international signalling systems has been defined on the assumption that international circuits would be in accordance with the limits laid down by the C.C.I.F., particularly in respect of the power levels and stability of the transmission and based on the three following recommendations:

(1) The maximum signal energy transmitted in the course of the busy hour should not exceed a value of 9000 microwatts seconds at a point of zero relative level for one direction of transmission on a circuit.

Note. — This recommendation was made by the C.C.I.F. XIVth Plenary Assembly (Montreux 1946) which decided that, for signal constituted by a succession of trains of sinusoidal alternating currents, the mean power (during the busy hour) should not exceed a value corresponding to an absolute level of power of—3.0 nepers or—26 decibels at the point of zero relative level. This absolute level of power is that which should not be exceeded by a sinusoidal current at any voice frequency, continuously applied at the point of zero relative level.

The C.C.I.F. XVIIIth Plenary Assembly (Geneva 1956) specified the maximum limit of energy, not for the signals alone, but for signals and tones *together*. This maximum energy results from considerations relating to the possible overloading of amplifiers in coaxial carrier-current telephone systems and was fixed as 36 000 microwatts seconds during the busy hour for one direction of transmission of a circuit. In a multi-circuit carrier system, in order to obtain the value of the energy for unidirectional transmission, it will be permissible to take half of the energy relative to signal transmission in both directions.

(2) The absolute level of power admissible for each element of a signal of short duration, as a function of its frequency, should not exceed the values indicated in Table 1 which follows. This recommendation results from cross-talk considerations.

Note. — Following the studies made in 1955/1956, the C.C.I.F. XVIIIth Plenary Assembly (Geneva 1956) confirmed that the values in Table 1 were still valid in addition to the information appearing in the note following this Table which indicates how those absolute level values for each frequency have been decided.

TABLE 1

Maximum admissible value (at the point of zero relative level) for the absolute level of power of a signalling pulse

Signalling frequency e/s	Maximum admissible power for a signal at the point of zero relative level (microwatts)	Corresponding absolute level of power	
		Nepers with reference to 1mW	Decibels with reference to 1mW
800	750	—0.11	—1
1200	500	—0.35	—3
1600	400	—0.45	—4
2000	300	—0.57	—5
2400	250	—0.7	—6
2800	150	—0.9	—8
3200	150	—0.9	—8

Note. — If the signals are constituted by two different frequency components, transmitted simultaneously, the maximum admissible values for the absolute power levels are 3 decibels (or 0.35 nepers) below the above figures.

Note. — The values shown in Table 1 above have been obtained taking into consideration the limitation imposed by noise produced in an adjacent channel of a carrier-current system. This limit was determined on the following basis:

a) The psophometric E.M.F. (measured at the point of zero relative level) produced in an adjacent channel by signalling pulses on the signalling channel considered, is assumed to have a " median " admissible value of 0.5 millivolts (or an absolute level of—70 decibels) where the " median " value is defined as being the value in millivolts corresponding to the mean value of the psophometric E.M.F.s expressed in decibels.

b) A value of 62 decibels is assumed as the mean value of the difference of attenuation between the suppressed band and the pass band of a telephone channel filter of a carrier-current system.

c) The curve defined in Volume II of the C.C.I.F. Green Book (Recommendation No. 5, Vol. II) has ben adopted as the characteristic curve of the psophometric filter network for commercial telephone circuits.

(3) In the case of a signal comprising a mixture of two sinusoidal currents at different frequencies, the maximum admissible power of each of these components must be half the admissible power of a signal with sinusoidal wave form in the steady state and of the same duration and transmitted at the same rate.

4. *Choice of frequencies for the signalling systems recommended by the C.C.I.F.*

The results of tests carried out at London, Paris and Zurich, between 1946 and 1948, on the subject of the number of false signals due to speech currents (signal imitation) in relation to different values of signalling frequencies, led to the conclusion that, to obtain a relative immunity from false signals without excessively increasing the length of the signals used, it was desirable to use frequencies of at least 2000 c/s.

At this time and taking into account the conditions of the foreseeable future, a frequency of 2600 c/s seemed, from this point of view, to be the best for signalling over international circuits of modern carrier current types.

A frequency as high as 2600 c/s cannot, however, be used satisfactorily on a number of international circuits planned to remain in service for a long time and on which the rapid increase of attenuation with frequency in the higher range of frequencies prohibits the reliable use of this frequency.

5. *Principles adopted for establishing the list of international signals.*

The principles on which the list of international signals has been based are as follows:

1. It is desirable to reduce the number of distinct signals to be transmitted over an international circuit to a minimum compatible with the essential needs of an international semi-automatic service effected with standard equipment and used for transit operation as well as terminal operation.

2. It is desirable to provide operators at the outgoing international terminal centre with the means:—

a) to obtain connection to any incoming operator at an incoming international terminal centre, who functions as an incoming " B " operator;

b) to obtain connection to any suspended-call operator at an international terminal centre;

c) to obtain connection to a particular suspended-call operator at an international terminal centre;

d) to cause an operator, speaking a particular language (assistance operator) to intervene on an established call.

3. It is desirable to consider the international service with remote selection as having its own characteristics and not to require with this method of operation *in normal service* all the advantages of obtaining the called subscriber directly and at the same time all the advantages resulting in manual service from the presence of an operator at the incoming end of the international circuit.

APPENDIX

Characteristics of out-of-band signalling systems whose use would be desirable from a transmission aspect, where such systems would be used by bilateral agreement for direct circuits, which would not carry transit traffic.

Type 1 (discontinuous).

Frequency: Virtual carrier (zero frequency).

Level: High, for example —3 db (at a point of zero relative level).

Type 2

A (discontinuous).

Frequency: 3825 c/s.

Level: High, for example about —5 db (at a point of zero relative level).

B (semi-continuous).

Frequency: 3825 c/s.

Level: Low, for example —20 db (at a point of zero relative level).

The first type of signalling system is only compatible with group and supergroup reference pilots, where the displacement from the virtual carrier frequency (zero-frequency) is 140 c/s.

Types 2 A and 2 B are only compatible with group and supergroup reference pilots, where the displacement from the virtual carrier frequency (zero-frequency) is 80 c/s.

CHAPTER III

NATIONAL SIGNALLING SYSTEMS

A. C.C.I.F. RECOMMENDATIONS

1. Steps to be taken to ensure the reciprocal protection of international and national signalling systems

To avoid interference with one signalling system arising from another signalling system, it is advisable to limit the length of:—

(1) the fraction of the *international* signal which may be able to pass from the international circuit into the national system (protection of national systems);

(2) the fraction of the *national* signal which may be able to pass:—

(a) from the national signalling system to the international signalling system (protection of the international system);

(b) from one national signalling system to the national signalling system of another country via the international connexion which has been established (protection of national systems).

1.1. *Protection of national systems in respect to the international systems.*

The condition (1) above is satisfied due to the existence in the international signalling systems of a splitting arrangement on each international circuit (see the Specifications for international signalling systems, sections 4.3 and 5.3).

The " splitting times " for international systems (defined as the maximum duration of the fraction of the international signal which can pass into a national system) have the values of:—

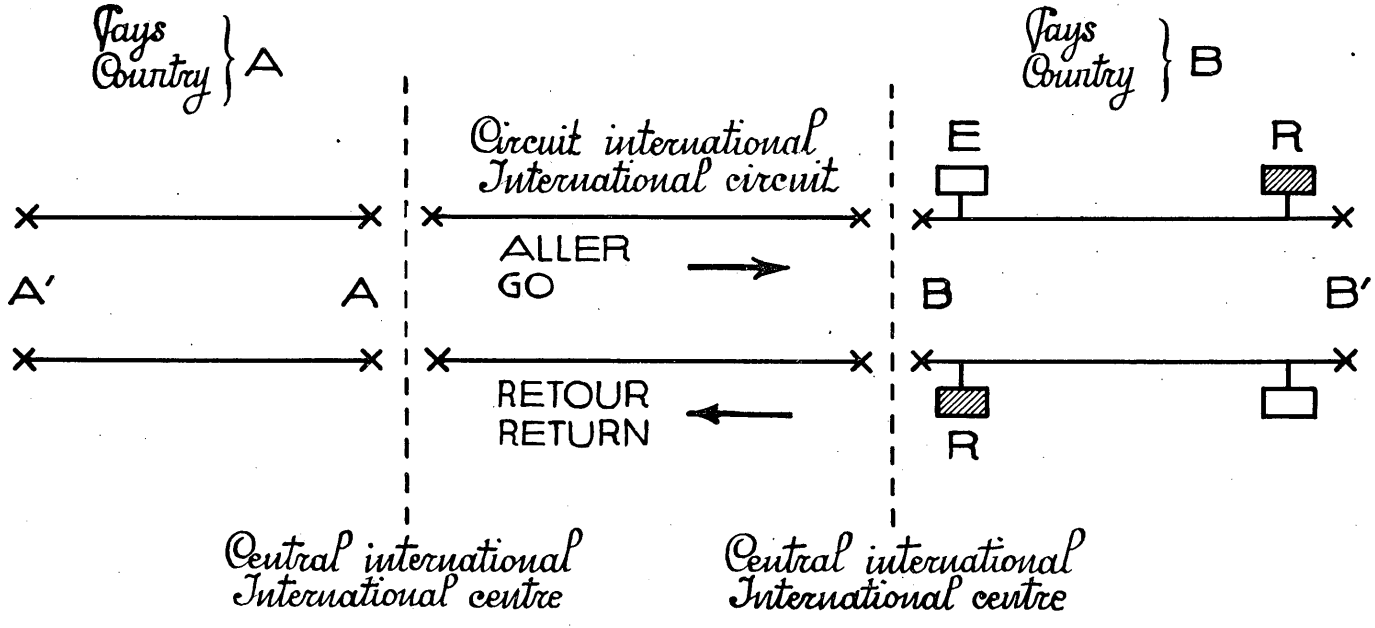
35 milliseconds in the case of the single-frequency system,
55 milliseconds for the compound signal element in the two-frequency system.

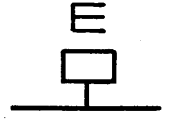
1.2. *Protection of the international system in respect to national systems.*

With regard to condition (2) above:—

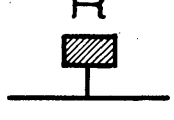
(a) the value of 60 milliseconds adopted by the specifications as the minimum recognition time of a line signal (see sections 4.4.2.3 and 5.4.2.3) is in general greater than the splitting time of national systems (see the tables giving the essential characteristics of national signalling systems on pages 23 and 24).

(b) the signalling frequencies used in the international systems are, in the majority of countries, different from those used in national systems.





= Signal sender of the national system



= Signal receiver of the national system

If the case arises that the splitting time of the national signalling system is greater than 55 milliseconds and the signalling frequencies used in the national system and international system are the same or nearly the same, it might be desirable to insert a device at the international terminal centre which will prevent the fraction of the national signal exceeding a duration of 55 milliseconds from passing into the international circuit.

1.3. *Interference between national signalling systems when two systems are interconnected via an international circuit.*

To ensure the reciprocal protection of national systems (protection which is defined in point (2 *b*) above), the XVIIth Plenary Assembly of the C.C.I.F. (Geneva, 1954) issued the two following recommendations *(a)* and *(b)*.

As from 1954, new national signalling systems which employ one or more signalling frequencies in the band of frequencies 2000-3400 c/s should be planned in such a manner that:—

(a) no fraction of a national signal having a duration exceeding 35 milliseconds can pass into another country;

(b) the connexions between an international circuit and a national circuit shall be split at the international centre 30 milliseconds before a signal is sent from this centre over the national signalling system.

Recommendation *(a)* permits the signalling system used in Country A to have a minimum signal recognition time based on this value of 35 milliseconds. It will then be possible to ensure, without taking any other precautions at the incoming end of an international circuit, that no fraction of a signal coming from country B, and being of the same, or nearly the same frequency as that used in country A, will be wrongly recognised as a signal in country A.

One method of meeting this recommendation is to adopt a splitting time of less than 35 milliseconds for the national systems.

Another method exists, which does not involve such a limitation in the splitting times of national systems, and which might be preferred when the design of the national signalling system is such that a short splitting time is not normally justified for that system alone. This second method involves the introduction, in the international terminal centre, of an arrangement for limiting the length of national signals which are liable to pass into the international circuit. Such an arrangement would only be used on circuits to those countries where the danger of interference would be liable to arise.

Recommendation *(b)* will avoid the false operation of the guard circuit of a signal receiver situated at the distant end of a national circuit. The signal receiver of country B, which is placed at B′ (see figure) at the distant end of the national circuit in country B, will not be liable to have its operation impeded due to a signal of a different frequency to that used for national signalling in country B, coming from country A.

Note. — These two recommendations were formulated with a view to avoiding disturbances in the future and, in particular, taking into consideration the conditions which

will exist when international calls are established on a fully automatic basis (subscriber-to-subscriber call). At present, when only semi-automatic operation is envisaged, the danger of mutual interference between national signalling systems is not much to be feared. If the operator controlling the establishment of a semi-automatic call has instructions to connect the national circuit to the international circuit only when the calling and called parties have replied and are at the telephone, the passage of a disturbing signal from one national signalling system to another cannot arise before that time. The only disturbing signal of which a fraction could normally pass over the international circuit is then the clearing signal from ore or the other of the subscribers.

2. Power of signals transmitted on national circuits

The C.C.I.F. hopes that Administrations and Private Operating Companies will, as far as possible, take into consideration for their national signalling systems, the limits laid down in point 3 of Chapter II above, (page 14) in respect to the maximum admissible power of signals transmitted to line.

3. Direct access from the national network to international semi-automatic circuits

The choice of the method of access from the national network to the international terminal centre is a purely national matter. Nevertheless, if an international circuit is taken by automatic switching from a centre other than the international centre from which the international circuit departs, steps should be taken to ensure that the signals conform to the conditions which exist at the international terminal centre at the point of departure of the international circuit. These steps must be such that the international terminal centre:—

(a) sends or retransmits, over the international circuit, signals corresponding to all the conditions necessary to ensure the correct functioning of the international links on which these signals can be used;

(b) receives all the signals arriving on the international circuit, translates them, if necessary, and repeats them to the originating centre in such a manner that the operator at this centre obtains the same signals as she would if she were situated at the international terminal centre.

4. General recommendations relating to national numbering plans

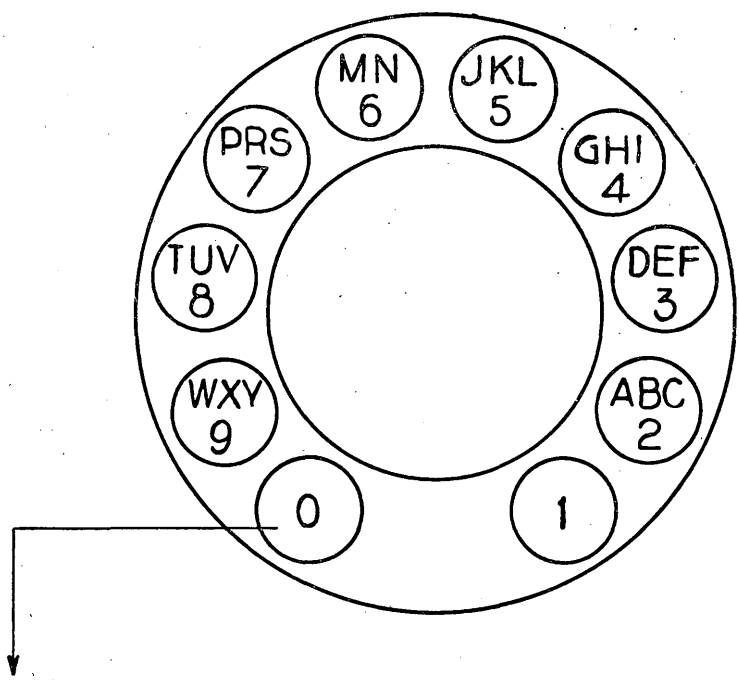
A national numbering plan should be established in such a manner that, in the Trunk Service in a particular country, a subscriber can always be called by the same number. This numbering plan must be applicable, without exception, to all incoming international calls but it can be modified, if considered necessary, for the inland service, for example, for the traffic between towns or neighbouring regions. The national numbering plan of a country should, whenever possible, be established in such a manner that it will permit the most economical routing to be determined for the international traffic destined for this country (for example traffic which may be routed via one of several incoming international centres) using the first or, if this is not possible the first two, digits of its subscribers' national numbers. The first one or the first two digits of the national numbers mentioned above are those which indicate the zone to which the call is destined. To avoid any ambiguity

it is desirable to point out that the prefix (for example, 0 in certain countries) which, for national automatic calls, indicates that the call is to be switched out of one national numbering zone to another national numbering zone, must not be considered as forming a part of the national number.

* * *

If an Administration or Private Operating Company of a country which uses the Latin alphabet wishes to make use of letters in its national numbering plan, it will be desirable to use dials (or keys) which conform to the association of letters and digits which is more generally used in Europe and which corresponds to the following figure, since the adoption of a standardized association of letters and digits will facilitate the work of operators in the international semi-automatic service.

SKETCH OF A DIAL SHOWING THE ASSOCIATION OF LETTERS AND NUMBERS MOST GENERALLY USED IN EUROPE



Note. — On the dials used by the British Administration only the letter O is associated with the digit 0. On the dials used by the French Administration the letters O and Q are associated with the digit 0.

B. Documentary Part

5. Essential characteristics of national signalling systems

The following tables 1 and 2 summarise the information received by the C.C.I.F. in 1954 on the subject of national voice-frequency signalling systems.

Notes on these tables

1. Concerning the possible frequency variation at the entry to the international circuit, account has been taken:—

— of the tolerances allowed at the terminals of the signal generator,
— of the frequency variation which may be due to the carrier-current systems used in the national network.

2. Where the national signalling system makes use of two frequencies, the words " separate " or " compound " have been used to indicate whether or not the two frequencies can be sent separately over the circuit during the period when the splitting of the circuit has not been effected by the national signal receiver, that is to say, for a period of time less than the " splitting time ".

6. Audible tones encountered in the national networks of different countries

Three tables (tables 3, 4, and 5) are given on pages 25 to 27 showing the information received following an inquiry by the C.C.I.F. on the nature of the different audible tones encountered in national networks. These tables were established in 1955.

TABLE 1

INFORMATION RECEIVED ON THE SUBJECT OF NATIONAL VOICE-FREQUENCY SIGNALLING SYSTEMS

European Countries

	Germany (Federal Republic)		Austria	Belgium	Denmark	Spain	France	Great Britain	Irish Republic			Italy	Netherlands	Norway	Sweden	Switzerland	U.S.S.R.	
Frequency (c/s)	3000	(2280)*	2280	2280	3000	2500	2000	600—750 separate	2040/2400 compound	600/750 separate	600/750 compound	2040/2400 compound	2400/2500 separate	2400	2400 (for 2 wires: 2200 and 2400)	3000	1200-1600 separate	2100
Tolerance at the generator terminals (c/s)	±7.5	±7.5	±3	±5	±6	±3	±6	±3	±6	±3	±3	±6	±2	±2	±10	±3	—	
Frequency variation possible at the entry to the international circuit (c/s)	±15	±15	±7	—	±8	±6	±12	±5	—	—	—	—	±7	—	±15	—	±8	±8
Splitting time (milliseconds)	30	30	30	8	35	10	15 then 35 with attenuated 18 db	140 or 320 | 400	60	140 or 320 | 400	110	40-60	55	25	35	70	25	25
Absolute level of the power of signals at the point of zero relative level (decibels)	−8	−8	−6	−6	−8	−6	−6	+3	−9	+3	−2	−9	+7	−6	0	−3.5	−4	−4

*for narrow band circuits

TABLE 2

INFORMATION RECEIVED ON THE SUBJECT OF NATIONAL VOICE-FREQUENCY SIGNALLING SYSTEMS

Extra-European Countries

	Argentina	Australia	Canadian (British Columbia Telephone Co.)	United States of America (U.S.A.) (A.T.T. Co.)	Japan
Frequency (c/s)	2040/2400 compound	600 - 750 separate	2600 (for 2 wires: 2400-2600)	1600 - 2000 | 2400 - 2600	1900 - 2300 separate
Tolerance at the generator terminals (c/s)	±6	±2.5	±3	±5	
Frequency variation possible at the entry to the international circuit (c/s)	±15	—	±10	±15	
Splitting time (milliseconds)	60	160/210	25 then attenuated 30 db	20 - 30 then attenuated 30 db	500
Absolute level of the power of signals at the point of zero relative level (decibels)	−9	+3	−6	−6 | −8 and after attenuated −20	−5

TABLE 3

RINGING TONE

Pays	Fréquence	— = Emission — Périodicité
		PAYS D'EUROPE
BELGIQUE — Bruxelles - Anvers	450 Hz + 50 Hz	
BELGIQUE — Autres réseaux	450 Hz + 50 Hz	
DANEMARK	450 Hz	
ESPAGNE	400 Hz	
FRANCE — Paris	25 + 400 Hz	
FRANCE — Province	25 ou 50 Hz + harmoniques	
GRANDE-BRETAGNE	133 + 16 2/3 Hz	
ITALIE	450 Hz ou 360 Hz	
NORVÈGE	400 Hz	
SUISSE	400 Hz	
PAYS-BAS	450 ou 400 Hz ou 25 + 400 Hz	
SUÈDE	400 Hz	
ALLEMAGNE (République fédérale)	450 Hz	
		AUTRES PAYS
CHILI	33 1/3 Hz	
CUBA	20 Hz	
ARGENTINE	16 2/3 Hz	
		Echelle : 1000 ms = 1 seconde

(*) The interval between the first signal and the second can vary from 0 to 9000 ms

TABLE 4

ENGAGED TONE

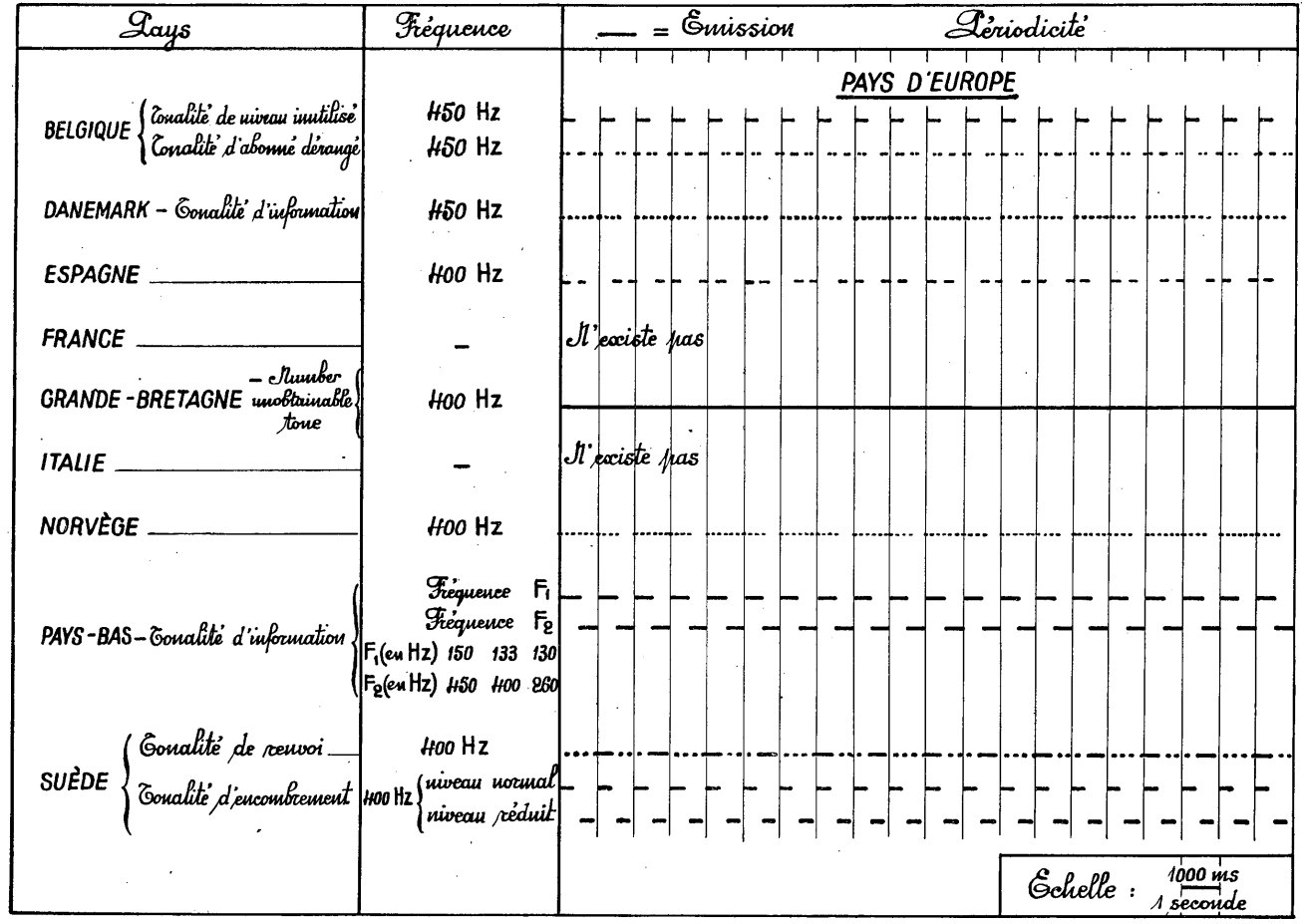
Pays	Fréquence	— = Emission — Périodicité
		PAYS D'EUROPE
BELGIQUE	450 Hz	
DANEMARK	450 Hz	
ESPAGNE	400 Hz	
FRANCE	400/450 Hz	
GRANDE-BRETAGNE	400 Hz	
NORVÈGE	400 Hz	
SUISSE	400 Hz ou	
PAYS-BAS	450 Hz	
SUÈDE	400 Hz	
ALLEMAGNE (République fédérale)	450 Hz	
ITALIE	450 Hz (ou 360 Hz)	
		AUTRES PAYS
CHILI	400 Hz abonnés / interurbain	
CUBA	400 Hz	
ARGENTINE	400 Hz	
		Echelle : 1000 ms = 1 seconde

TABLE 5

SPECIAL TONES

(Reference, information, "number unobtainable", engaged tones) (*)

(*) It may be advantageous to provoke the intervention of an assistance operator at the incoming international terminal exchange in the event of receipt of these tones.



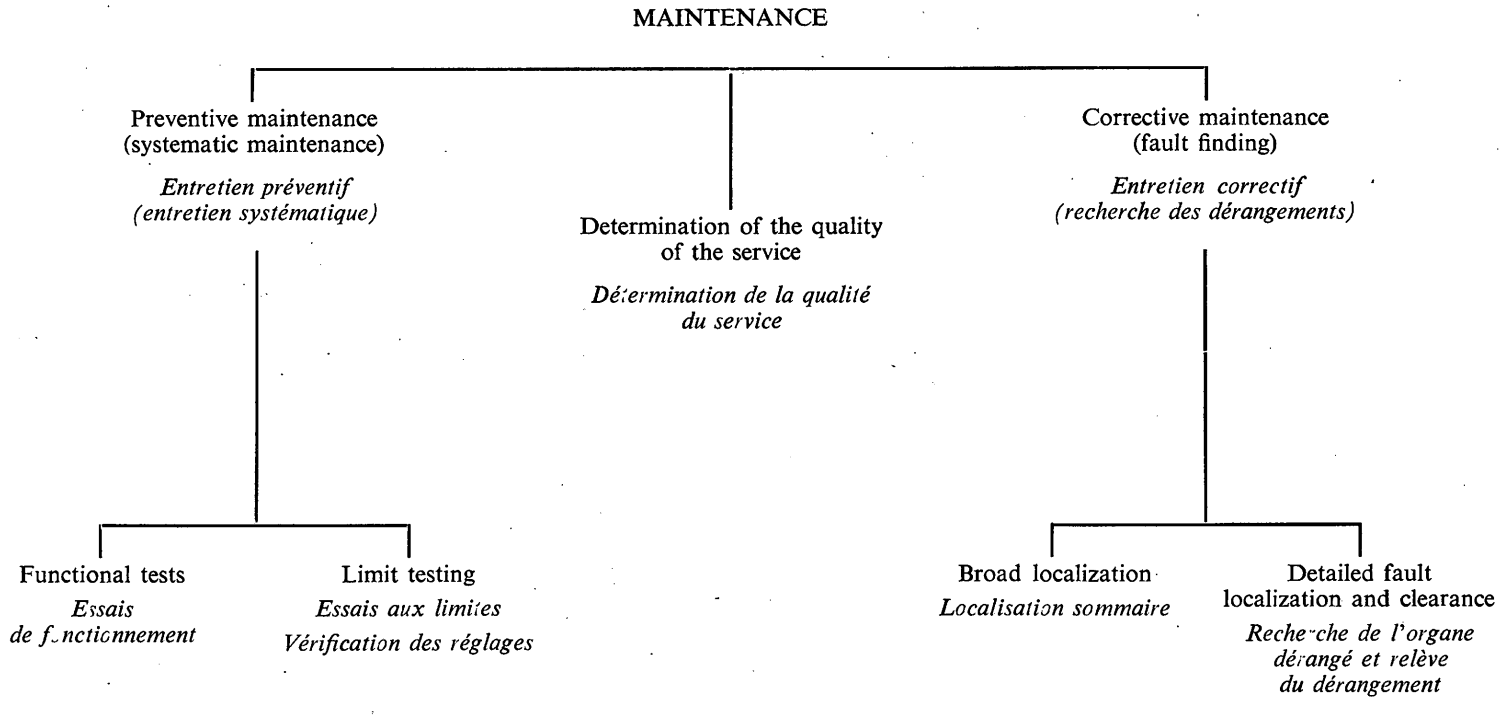


Diagram showing various operations implied by "maintenance"

PART III

GUIDING PRINCIPLES FOR THE MAINTENANCE OF SEMI-AUTOMATIC CIRCUITS

CHAPTER I

DEFINITIONS

International line : Telephone transmission system contained between the test jack panels of the two terminal repeater stations.

International circuit : The whole of the international line and the outgoing and incoming equipment proper to the line.

Automatic switching equipment : That part of an international centre concerned with switching operations for directing the call in the desired direction.

Maintenance : All the operations concerned with maintaining telephone circuits and automatic switching equipment in a good functional state. (See for this definition and the following the diagram on the opposite page.)

Preventive Maintenance : Tests, measurements and regulations to specified values effected before the appearance of a fault.

Corrective Maintenance : Tests, measurements and regulations effected as a result of a fault.

Determination of the quality of the service : Tests carried out under normal functional conditions to ascertain the probability of the appearance of faults.

Functional tests : Tests carried out under normal operating conditions to verify that a circuit or a particular part of the equipment functions correctly.

Limit testing : Tests carried out under conditions more severe than those corresponding to the specified nominal values, to dermine the margin of security which exists under normal operating conditions.

Localization of faults :

The *broad localization* of a faults consists of determining the division of technical responsibility in which the fault exists.

Fault finding consists of determining the faulty part of the equipment.

CHAPTER II

GENERAL RULES FOR THE ORGANISATION OF THE MAINTENANCE OF SEMI-AUTOMATIC CIRCUITS

1. *Principles.*

With international semi-automatic operation, each Administration shall assume responsibility for the testing and clearance of faults on its outgoing circuits. The other administrations will co-operate with tests and clearance of faults on these circuits at the request of the responsible Administration.

2. *International Maintenance Centre (I.M.C.)*

2.1 The body which will exercise this responsibility for the outgoing circuits of an international terminal centre is the " International Maintenance Centre " or in short I.M.C. The person in charge of the International Maintenance Centre will be referred to hereafter under the name of " Officer-in-Charge of I.M.C." or in short by the expression " officer-in-charge ".

2.2 To carry out the maintenance of outgoing circuits the International Maintenance Centre may give directions to the competent services of:—

— the international automatic exchange,
— the repeater station.

2.3 The operating services should report all faults affecting the international service to the International Maintenance Centre and to this Centre only.

2.4 The responsibilities of the International Maintenance Centre are as follows.

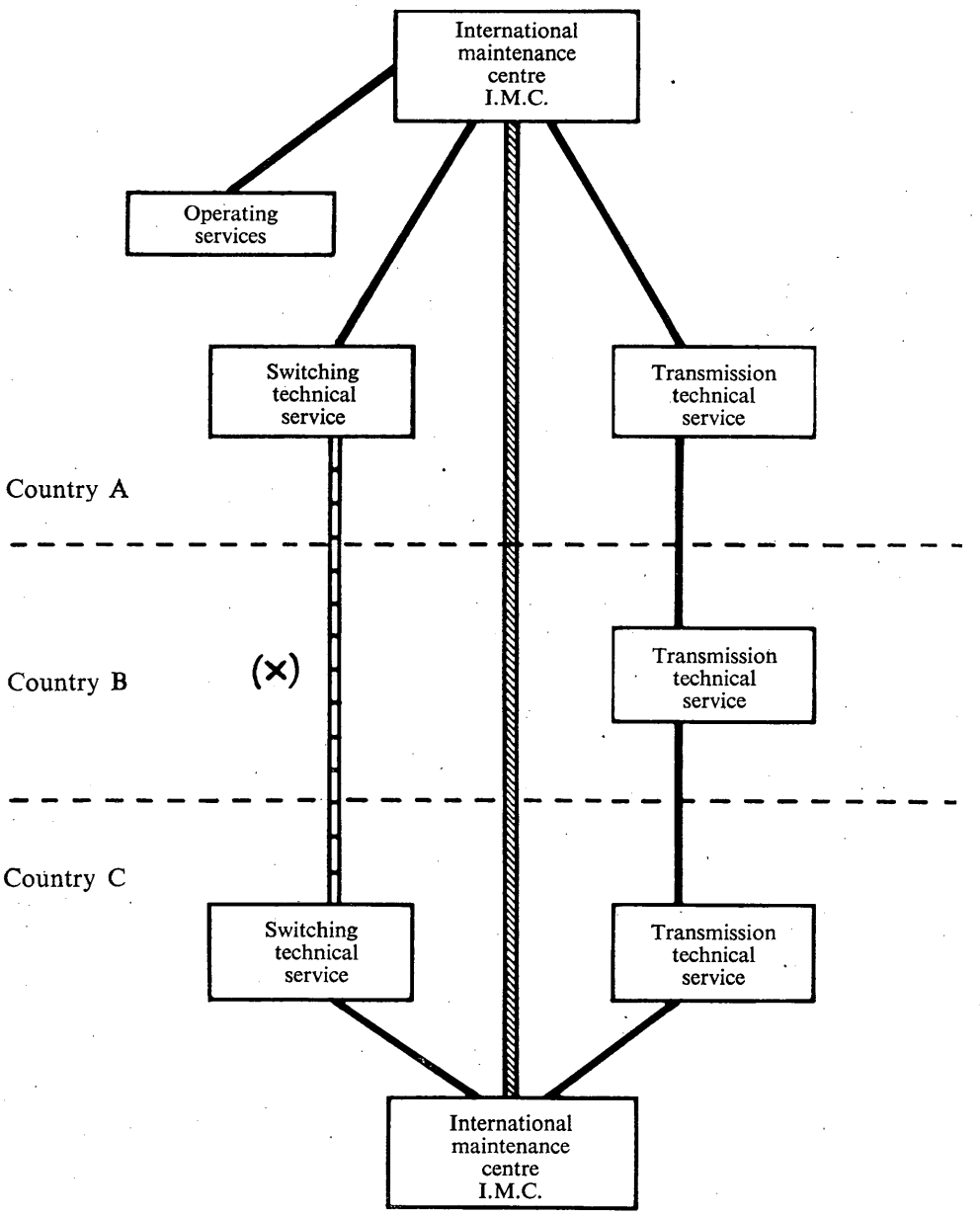
2.4.1. To receive all reports of faults on its outgoing international circuits and to conduct tests with a view to the broad localization of faults limited to ascertaining the division of technical responsiblity for their clearance.

2.4.2. To entrust the clearance of faults to the appropriate technical division as determined by the broad localization.

2.4.3. To ensure that the out-of-service times of its outgoing international circuits (due to faults or other causes) are kept to a minimum compatible with the needs of the service.

2.4.4. To return the circuit to the operating services after having verified its correct functioning.

Organisation Chart for maintenance of automatic circuits



(x) The connection between switching technical services of different countries is marked by asterisk, because such a connection is not considered as indispensable. The staff of international automatic exchanges do not normally need to know foreign languages. However this connection may be realized and may be of good service when it is possible to do so.

2.4.5. To keep detailed records of the faults, localizations and clearances with which it has been concerned.

2.4.6. To co-operate with the I.M.C.s of other countries in respect to the broad localization of faults on its incoming international circuits and to accept responsibility for the clearance of faults found to exist in or beyond the centre considered.

2.4.7. To be advised of the need to put any of its incoming international circuits out of use and to inform the I.M.C. of the outgoing centre of the fact.

2.4.8. To ensure that the tests prescribed for its outgoing international circuits are carried out at the specified times and that any faults revealed by such tests are dealt with expenditiously.

2.4.9. To ensure that new outgoing international circuits are satisfactory in operation before being brought into service and to co-operate with the I.M.C.s of other countries with any tests which may be necessary on new incoming circuits.

2.5. To ensure that the International Maintenance Centres are operated efficiently, it is desirable that the following conditions shall, as far as possible, be applied :

2.5.1. The officers-in-charge (and possibly their direct assistants) should possess a thorough knowledge of the switching equipment with which they will be concerned and have an adequate knowledge of transmission. In addition, these officers should be selected with a view to avoiding languages difficulties.

2.5.2. The officers-in-charge should possess sufficient authority to direct the clearance of faults.

2.5.3. The officers-in-charge should be attached to the I.M.C. and should not be distracted from their normal duties by other occupations which may impede the accomplishment of their principal task. These officers should be appointed from the commencement of the introduction of semi-automatic circuits into service and should not be subjected to frequent change of duties. They should be authorised to establish personal relations with their opposite numbers in other countries.

2.5.4. To facilitate exchange of views on the clearance of faults, the I.M.C. of the outgoing centre should possess circuit diagrams of the switching equipment installed in the corresponding incoming centres together with any other useful information. It is also desirable that the officers-in-charge of the I.M.C. should be able to visit the switching installations of other corresponding international centres.

3. *Control (repeater) Station.*

The repeater station attached to each international terminal centre should be the control station for the semi-automatic circuits outgoing from this centre. Consequently, in the case of an international route AB comprising semi-automatic circuits operated in the direction A to B and semi-automatic circuits operated in the direction B to A, there will be a control station at each end A and B of the group of circuits:—

— at A for the circuits A to B
— at B for the circuits B to A.

CHAPTER III

PREVENTIVE MAINTENANCE

1. *Functional tests.*

1.1. " Functional tests " are carried out under conditions similar to normal operating conditions and their purpose is to verify that a circuit or a particular part of the equipment functions correctly. The test conditions are such that a circuit or item of equipment will not be withdrawn from service as faulty if, apart from the test, it would be considered as satisfactory in service.

1.2. Functional tests are carried out locally, or from one end of an international circuit to the other.

1.3 The tests carried out locally will be left to the discretion of the Administration responsible for the international centre. The actual tests carried out will depend on the type of equipment concerned and the extent to which alarms and monitoring devices are provided to indicate failures in the establishment of calls. Functional tests of common equipment in the international automatic exchange come into this category.

1.4. Functional tests made from one end of an international circuit to the other are effected in such a manner that they can be made from the outgoing end of the circuit without co-operation of technical personnel at the incoming end of the circuit.

The tests carried out from end-to-end of a circuit are described in paragraphs 1.4.1., 1.4.2., and 1.4.3.

1.4.1. Verification of satisfactory signal transmission; checking that a seizing signal is followed by the return of a proceed-to-send signal and that a forward-clear signal is followed by the return of a release-guard signal.

1.4.2. Rough tests of the transmission conditions, if this is considered useful, by means of the loop test.

The above two tests, being of a simple nature, can be carried out quickly and consequently as frequently as desired, for example, daily.

Signalling tests made by sending seizing and forward-clear signals do not need the provision of any special equipment at the incoming international centre. On the other hand, the international signalling and switching specifications specify the compulsory provision of the loop at the incoming end of an international circuit.

1.4.3. Finally, if any Administration wishes to make functional tests which include the exchange of signals over the international circuit other than those mentioned in 1.4.1. above, use may be made of the test call answering devices (robot subscribers) which exist for the national service of the incoming country. Information concerning the calling numbers of these devices will be communicated to other international terminal centres.

2. *Limit testing.*

2.1. The object of these tests is to verify whether the operating margins specified for a particular type of equipment effectively exist or not. If necessary these tests may be followed by the readjustment of the equipment to as near the specified nominal values as is practicable.

2.2. Limit tests of the signalling will, in principle, be carried out locally. The frequency of such tests and the test conditions to be applied will be determined by the Administrations concerned.

These tests will be made using, in particular, the calibrated signal generator and the signal measuring apparatus foreseen in Chapter VII of the " International signalling and switching equipment Specifications ".

The verification of the adjustment of signal receivers will be carried out locally but, by special agreement between Administrations, this adjustment can be carried out by tests made from end to end of the circuit when the signal receiver cannot be dissociated from the terminal equipment of the carrier-current system of which it is an integral part.

The limit signalling tests will not normally be planned to be made from end to end of the circuit but it may nevertheless be desirable to be able to make such tests, for example, where technical disagreement arise between the two International Maintenance Centres concerned.

2.3 This section 2, Limit testing, does not concern routine maintenance tests made on the line and which are normally followed by a readjustment of the line, for example, to restore it to its planned nominal value of equivalent. Such steps are proper to the repeater stations and are carried out in conformity with the " Maintenance Instructions " of Volume III of the Green Book.

3. *Installation of the testing apparatus foreseen in the specifications.*

It is desirable that Administrations should apply the methods which are indicated in Chapter VII of the International signalling and switching equipment Specifications in order that more experience may be gained as to the best methods to be recommended.

CHAPTER IV

CORRECTIVE MAINTENANCE
LOCATION AND CLEARANCE OF FAULTS

1. The localisation and clearance of faults on automatic circuits will be carried out in accordance with the general rules described under II for the organisation of maintenance.

Within the framework of this organization four categories of technical personnel may be called upon for the clearance of faults.

(a) The I.M.C. personnel comprising one or more officers-in-charge of maintenance.

(b) At the repeater station (control), the transmission testing service.

(c) At the international automatic exchange, the personnel concerned with the maintenance of the international signalling and switching equipment.

(d) In the national automatic exchanges of the incoming country, the personnel concerned with the maintenance of the national switching equipment.

The functions of the maintenance personnel at the international and national automatic exchanges do not call for any particular comment except to say that this staff will not need to know foreign languages.

2. *Reporting of faults to the I.M.C.*

All faults affecting the international service will be reported to the International Maintenance Centre.

These faults are reported :—

— by operators,
— by the maintenance personnel of the international automatic exchange,
— by the repeater station staff,
— by the officers-in-charge of the I.M.C. of an incoming country.

The conditions under which operators will report circuits as faulty will be defined by Administrations.

Fault reports can result from functional tests of the equipment and can also arise from faults exposed during tests of the quality of service if this is the practice followed by an Administrations for such tests.

If an incoming centre is affected by a fault which concerns an important part of the installation at this centre and which is liable to impede the flow of traffic, the I.M.C. of the incoming centre should immediately inform the I.M.C.s of the outgoing centres which are working into the centre considered.

3. *Blocking of the circuit.*

Every circuit reported as faulty to the I.M.C. should be blocked on the initiative of the officer-in-charge if this has not already been done. (For example, in the case where automatic blocking is effected under the conditions described in Chapter VI of the Specifications.)

Every intervention of the maintenance personnel which incurs the blocking of a circuit should be brought to the notice of the outgoing I.M.C. possibly through the incoming I.M.C. or the control station.

The blocking of a circuit by the incoming centre by means of the blocking signal (single-frequency system) or by the continuous emission of one frequency (in the two-frequency system) should not exceed a duration of 5 minutes. If the intervention on the circuit must exceed this duration, the circuit should be withdrawn from service at the outgoing end and the I.M.C. of the incoming centre should make a request to the outgoing centre to this effect.

4. *Broad localization of faults.*

The maintenance officer-in-charge of the I.M.C. will first verify whether a fault exists and, if so, will then proceed with the broad localization of the fault. He will determine whether the fault is:—

(a) on the international switching equipment at the outgoing centre,

(b) on the line,

(c) in the incoming country.

In carrying out this localization he will avoid, as much as possible, having recourse to the intervention of the I.M.C. of the incoming country and he will use the means put at his disposal which are described in Chapter VII of the Specifications.

The experience already acquired from the international point of view confirms the excellent results obtained by the use of loop test in carrying out this broad localization.

5. *Priority of the localization tests.*

As a general rule the fault localization tests should have priority over maintenance routine tests of individual circuits.

6. *Fault Clearance.*

Faults will be passed:—

(a) to the maintenance personnel of the international automatic exchange if the fault is localized to the international switching equipment of the outgoing country;

(b) to the control station of the international line if the fault is localized to the line. (The control station is situated in the same country as the I.M.C.);

(c) to the I.M.C. of the incoming country if the fault is localized to the incoming country. This centre will in turn pass the fault:—

— either to the maintenance personnel of the international automatic exchange,
— or to any other national transmission or switching service concerned.

In so far as it is possible for the I.M.C. personnel to determine that a fault exists in the national network of a foreign country discretion should be used as to whether or not it will be useful to inform the I.M.C. of this country of such a fault. Normally, no attempt will be made to report faults found to exist in the national network of the incoming country except faults of a persistent nature or those affecting local zones which are particularly subject to faults.

7. *Record of the nature of faults when cleared.*

The I.M.C. responsible for an outgoing circuit should, after a fault has been cleared, receive particulars of the cause of the fault when this has been determined without ambiguity. These particulars should be limited to a few words, for example, in the case of an international automatic exchange (incoming, transit or outgoing):—

— automatic switching equipment,
— register,
— incoming or outgoing circuit equipment,
— signal receiver,

or such a report as:—

— line fault,
— national network.

This will, possibly, permit certain statistics to be obtained to bring to light, if necessary, any weak points which could exist in the equipment of an international centre.

PART IV

SPECIFICATIONS FOR STANDARD INTERNATIONAL SIGNALLING AND SWITCHING EQUIPMENT

SUMMARY

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PREAMBLE

The following Specifications for standard international signalling and switching equipment refer to two signalling systems which entail the use of registers at the two ends of an international circuit and which employ a special code for the transmission of numerical information.

The two signalling systems were thoroughly tested on behalf of the C.C.I.F. under actual service conditions during 1953 and 1954 and the present Specifications take account of the experience gained in the course of these tests.

* * *

It is of the greatest importance for the construction and functioning of the equipment that the clauses of these Specifications should be strictly observed. These clauses are, therefore, obligatory except where it is explicitly stipulated to the contrary.

The values which figure in this Specification are imperative and must be followed under service conditions.

* * *

The recommendations adopted by the XVIIth Plenary Assembly (Geneva, 1954) on the subject of the choice of an international signalling system for semi-automatic operation mention that, for the case of terminal traffic:

" By agreement between Administrations it may be possible to arrange for the transmission of numerical signals by means of dial type pulses without having recourse to the use of the special code of numerical signals foreseen in each of the two standard systems ".

The following considerations, which were formulated by the Working Party of the 8th S.G. charged with the establishment of the Specifications, must serve as a guide where modifications to an international signalling system are contemplated by bilateral agreement between Administrations with a view to the use of dial-type pulses for the transmission of numerical information:

1st case—If registers are maintained at the two ends of an international circuit and the facilities provided by the standard systems are to be wholly maintained, the modifications to be made to the equipment to cater for dial-type pulsing will concern only the signals exchanged between registers:

—the digital signals will be replaced by trains of 1 to 10 pulses;
—the end-of-pulsing signal will be constituted by a train of 15 pulses;
—the code-11 and code-12 operators will be called by a train of 11 and 12 pulses respectively.

These arrangements only involve changes to the registers and would probably result in some simplification which, in itself, would be of minor importance and would not appear to be justified. Nevertheless, if such arrangements are envisaged it will be necessary and sufficient to specify the characteristics of the pulses to be employed: duration of one pulse, interval between two successive pulses of the same train, silent interval between two successive trains of pulses, the other parts of the specification remaining unchanged.

2nd case—If, with the use of dial type pulsing, it is required to dispense with the outgoing or incoming registers, using the direct transmission of pulses from the dial itself on the

circuits, the modifications to be introduced in relation to the equipment of the standard systems would be more profound than in the preceding case for the following reasons:

(a) The code 11 and 12 signals will no longer be available for calling operators.

The calling of an incoming operator (possibly speaking a determined language), any one or a particular one of a group of suspended-call operators, must be arranged for:

—either by means of a special number with a small number of digits commencing with digits not used for subscribers' numbers;

—or with spare numbers similar to subscribers' numbers.

It will not be possible to standardise these numbers because this depends entirely on national numbering plans.

(b) The end-of-pulsing signal will not be available to indicate to the incoming international terminal centre that all the digits of the number demanded have been sent.

The Working Party of the 8th S.G., charged with the establishment of the Specifications, did not find it possible (in July 1955) to compile the detailed Specifications which would result from a change of a standard system to cater for the arrangements envisaged in the second case, since these arrangements depend on national conditions which exist at each end of the connection and the facilities required.

CHAPTER I

GENERAL CONSIDERATIONS RELATIVE TO OPERATING

1.1. Functions performed by international operators

1.1.(1) The operating methods used in the international semi-automatic service are described in Section III of " Instruction for Operators of the European International Telephone Service ". These operating methods are based on the existence of switching equipment (manual and automatic) serving the following categories of operators:

(a) outgoing operators
(b) code-11 operators
(c) code-12 operators
(d) assistance operators.

1.1.(2) *The outgoing operator* controls the setting-up of calls at the outgoing international exchange. (From the operating point of view she is in general the Controlling Operator and is sometimes referred to by this name in the Operating Instructions).

She must be able to set up calls to any one of the following points in the country of destination of the call:

(a) subscribers
(b) code-11 operators at the incoming international terminal exchange
(c) code-12 operators, and in particular a determined code-12 operator, at the incoming international terminal exchange
(d) incoming operators at a local manual exchange in the destination country.

The outgoing operator should be able to recall code-11 and code-12 operators on calls set up via these operators by sending a forward-transfer signal as defined later under 1.4.12.

1.1.(3) *The code-11 operator* is an incoming operator at the incoming international terminal exchange who is obtained by sending a special signal—code-11. This signal is the 11th of the 16 combinations provided by the numerical signalling code. This operator, called the " Incoming " *(translatrice)* Operator in the Operating Instructions, performs, for calls which cannot be routed automatically at the incoming international terminal exchange, the functions of an incoming operator in ordinary manual service.

1.1.(4) At the international incoming terminal exchange, the *code-12 operator* is, in principle, a suspended-call operator. She is obtained by keying a special coded signal, code 12, which is the 12th of the 16 combinations provided by the numerical signal code. The code-12 operator may be any operator of this

category, a particular operator, or one of a particular group of positions; her group or her position in the group is then indicated by a call number which follows the code 12.

Taking into consideration the direction in which a required call is set up, a suspended-call operator at the outgoing international terminal exchange can be called by an operator at the incoming international terminal exchange. From the technical and signalling points of view, the suspended-call operator at the outgoing international terminal exchange recalled by an operator at an incoming international terminal exchange must, however, be regarded as situated at the incoming end of the international circuit over which she is called.

1.1.(5) *Notes concerning code-11 and code-12 operators*

(a) Code 11 and code 12 operators must speak the *service* language used for the route, and should therefore be divided into linguistic groups which are selected by the language digit, the transmission of which is effected as described later (see under 1.2.2.).

(b) One operator may perform the functions of a code-11 and code-12 operator, and even those of an assistance operator, at the same time. Her intervention in respect of each of these functions is brought about by the desired signal.

(c) While a code-11 or code-12 operator is being called, the ringing tone of the incoming country should be sent over the line.

1.1.(6) *The assistance operator* situated at the incoming international terminal exchange is brought into circuit on an automatically established connection when the outgoing operator requests her intervention due to language difficulties or, for example, to interprete a national tone signal. It is not possible to obtain access to an assistance operator at a transit centre.

The assistance operator is called by means of the forward-transfer signal the sending of which is caused by the outgoing operator by means of, for example, the pressing of a key on the outgoing position. The choice of an assistance operator of the desired language group is determined by the language digit which is send during the process of setting up the call. For this reason the incoming link circuit must keep trace of the language digit received.

The outgoing operator has no supervision indicating that the assistance operator is being called, or when she answers or retires from the connection but the outgoing operator can, if the need arises, send the forward-transfer signal several times on the same call.

The assistance operator must be able:—

(a) to be connected in parallel across the connection (when she acts as an interpreter between the international outgoing operator and a subscriber or an operator of the incoming country),

(b) to be connected to one side only of the connection after having isolated the other. She operates in this manner particularly when she translates a verbal announcement or an audible tone returned from the incoming end.

The assistance operator will in no circumstances be able to block the international circuit.

1.2. Numbering scheme

1.2.1. *International code*

Two digit numbers will be used as " international codes " for routing calls to their destination country when these calls are made via a transit centre, or when common access to all outgoing routes is used from the outgoing positions.

Annexes 1 and 2 to the Specifications (pp. 95 and 96) give the list of international codes for automatic operation in Europe and the Mediterranean basin. Annex 1 gives this list in numerical order and Annex 2 gives the information on a geographical zone basis.

In Annexes 1 and 2 there appear codes called " special codes ". These codes should be used solely for the passage of terminal traffic over direct routes between two countries. They are used to identify a particular route in an outgoing international centre when it is desired, at this centre, to give operators access to the outgoing circuits via switches. When an international terminal centre has direct routes to several international terminal centres of the same country these special codes will allow a distinction to be made between these centres.

1.2.2. *Language digit*

A digit between 1 and 9 determines the *service* language which must be used on the connection, that is the language which the code-11, code-12 and assistance operators at the incoming international terminal centre must speak when they assist on a particular call. This digit must be sent for *all* calls.

The digit *0* will be used to indicate a fully automatic call. In fact, in fully automatic service, a language digit is of no use since the calling subscriber has not to enter into conversation with the operators of an incoming international centre (code 11, code 12 and assistance operators). On the other hand it is necessary to indicate a fully automatic call, since for such a call no end-of-pulsing signal is received by the incoming international centre.

To obtain access to the automatic test arrangement (see section 7.3.3. following the Specifications) combination No. 13 of the numerical signal code is used in place of the normal language digit.

The language digit is sent over the international circuit immediately before the national number: this digit is the first received by the register at the incoming international terminal exchange.

The language digit is:

— either transmitted by the operator to the outgoing register; in this case it must be sent by the operator immediately before the national number of the called subscriber;
— or sent automatically by the outgoing register. (The digit to be sent can either be invariable, or depend on the country of destination).

1.2.3. *National number*

The national number of the called subscriber is sent by the outgoing operator, for example, from a keyset.

The outgoing register must be designed for a national number the number of digits of which can reach 10.

1.2.4. *Sending-finished signal*

When the outgoing operator has completed sending the number, she presses a special button or operates a key which causes a local sending-finished signal to be sent to the outgoing register after the national number. The local sending-finished signal serves to indicate that there are no other digits to follow.

The transmission locally of the sending-finished signal to the outgoing register corresponds to the transmission of the end-of-pulsing signal on the international circuit which plays the same role and serves to indicate to the incoming register that there are no more digits to be received.

1.2.5. *Order of sending of numerical signals*

The elements of the numerical information are normally sent to the outgoing register by the operator in the following order. It is compulsory for this order to be followed for the transmission of the corresponding signals over the international line.

(a) for a call to a distant subscriber:

(i) the international code (if not omitted in the case of terminal service)
(ii) the language digit *
(iii) the national number of the called subscriber
(iv) the sending-finished signal.

(b) for a call to a code-11 or any code-12 operator:

(i) the international code (if not omitted in case of terminal service)
(ii) the language digit *
(iii) the code 11 or code 12
(iv) the sending-finished signal.

(c) for a call to a particular code-12 operator, or one of a particular group of positions:

(i) the international code (if not omitted in the case of terminal service)
(ii) the language digit *
(iii) the code 12
(iv) the number of the operator's group or of her position in the group. This number will have been quoted to the operator who would be required to recall the code-12 operator
(v) the sending-finished signal.

(d) for a call to a distant subscriber connected to a manual exchange which is obtained automatically via the incoming international terminal exchange:

(i) the international code (if not omitted in the case of terminal service)
(ii) the language digit *
(iii) the code of the terminal exchange in the national numbering scheme
(iv) the sending-finished signal.

---

* As indicated under 1.2.2. the sending of this digit by operators may not be necessary.

Note — In the case of fully automatic operation the order of sending of signals over the international line will be as follows:—

(i) the international code (omitted in the case of terminal service)
(ii) the digit *0* (replacing the language digit as indicated in 1.2.2. above). The emission of the digit *0* is effected by the outgoing register used for the international fully-automatic service
(iii) the national number of the called subscriber.

1.3. **Unidirectional operation of circuits**

International circuits for semi-automatic or automatic operation are operated unidirectionally so that the equipment in international centres (international terminal and transit centres) may be as simple as possible and to avoid double connections and lock-ups.

1.4. **Definitions and functions of signals**

1.4.1. **Seizing signal** (transmitted in the forward direction)

This signal is transmitted at the beginning of a call to initiate circuit operation at the incoming end of an international circuit.

The seizing signal can also perform switching functions, and for this purpose, two different types of seizing signal are provided, viz:

(a) terminal seizing signal which can be used for bringing into circuit, at the incoming international exchange, equipment used exclusively for switching a call to the called subscriber in the national network of the incoming country.

(b) transit seizing signal which can be used for giving access, at the incoming international exchange, to equipment serving to switch the call to another international exchange.

1.4.2. **Proceed-to-send signal** (transmitted in the backward direction)

This signal is transmitted from the incoming end of an international circuit, following the receipt of a seizing signal, to indicate that conditions have been established for the reception of the numerical routing information.

(In the two-frequency system two different proceed-to-send signals are provided:—

(a) the terminal proceed-to-send signal, used to invite the transmission of the necessary numerical information for routing the call within the national network of the destination country.

(b) the transit proceed-to-send signal, used to invite the transmission of only those numerical signals necessary for routing the call through the international transit exchange towards the incoming international terminal exchange).

1.4.3. **Pulsing signal** (transmitted in the forward direction)

This signal transmits an item of selective information for switching the call in the desired direction. In general a succession of pulsing signals is transmitted.

1.4.4. **End-of-pulsing signal** (transmitted in the forward direction)

This signal is transmitted from the outgoing international centre to indicate that no further pulsing signals are to be transmitted over the line.

Note—In principle, this signal will not be sent with full automatic operation.

1.4.5. **Number-received signal** (transmitted in the backward direction)

This signal is sent from the incoming international terminal centre when the incoming register at this centre has recognized that it has received a complete national number and has completed its functions.

Note 1. — In the case of semi-automatic operation the number-received signal can also be used to indicate to the outgoing operator that the international switching operations have been completed.

Note 2. — In fully automatic operation this signal is also essential to indicate to the outgoing register at the outgoing international centre that it can release and to set up speech conditions at this centre. It is therefore desirable that this signal be sent as soon as possible. (In the case of the 1 VF signalling system with fully automatic operation on international transit-switched calls this signal is also necessary for effecting the release of the register at the international transit centre.)

The incoming register (or an associated equipment) recognises that a complete national number has been received:—

(a) in countries where the national number is always made up of the same number of digits, by a simple verification of the number of digits received:

(b) in countries where this is not so:

(i) by determining what should be the number of digits of the number of a subscriber in a certain national numbering zone, from an analysis of the number received (according to the first digits), or

(ii) by the use of a national end-of-selection signal or a national " electrical " ringing-tone signal.

1.4.6. **Busy-flash signal** (transmitted in the backward direction).

This signal is sent to the outgoing international terminal centre to indicate that either the route or the called subscriber is busy. The conditions of use of this signal are as follows:

(a) The transmission of this signal by an international transit centre is *compulsory* for indicating that there is congestion at this centre.

(b) The transmission of this signal by an incoming international centre is *compulsory* in respect of congestion at this centre or on the outgoing routes directly connected to it, but it is *optional* in respect of congestion beyond this centre (congestion at a point in the national network of the incoming country or called subscriber's line busy). The transmission of this signal is optional since the national network of several countries do not permit its transmission.

Note. — In fully automatic operation the receipt of the busy-flash signal at the outgoing centre will cause:

—in all cases, an appropriate indication to be given to the calling subscriber, and

—normally (except for special arrangements to the contrary, for example, for observation of circuits), the sending of the forward-clear signal by the outgoing centre to release the international connection.

1.4.7. **Answer signal** (transmitted in the backward direction)

This signal is sent to the outgoing international terminal centre to indicate that the called party has answered the call. This signal has a supervisory function.

Note. — With fully automatic operation this signal will be used to indicate the beginning of the charging period, under conditions which remain to be studied.

1.4.8. **Clear-back signal** (transmitted in the backward direction)

This signal is sent to the outgoing international centre to indicate that the called party has cleared. This signal performs a supervisory function. It must not permanently release the circuit at the outgoing international terminal exchange.

Note. — In fully automatic operation it may nevertheless be envisaged that after a certain interval of time following the reception of the clear-back signal at the outgoing international terminal centre, the clear-forward signal will be transmitted in order to release the international connection.

Notes relative to the answer and clear-back signals

Note 1. — In general, the succession of answer and clear-back signals which will be transmitted when the called subscriber depresses and releases the switchhook of his telephone will not be able to follow the frequency of this operation of the switchhook, but the *final* position of the switchhook must always be indicated exactly for the outgoing international operator.

Note 2. — The " called party " referred to in the definitions of the answer and clear-back signals may be either the called subscriber himself or the operator who is obtained automatically in the incoming country, and who assures the completion of the call in this country.

Following is a detailed description of the conditions in which the answer and clear-back signals are transmitted in the different possible circumstances.

A. CALLS FOR WHICH THE INTERNATIONAL OUTGOING OPERATOR REACHES THE CALLED SUBSCRIBER BY AUTOMATIC SELECTION

The answer and clear-back signals are transmitted each time the called subscriber answers or clears.

B. CALLS FOR WHICH THE OUTGOING INTERNATIONAL OPERATOR DOES NOT REACH THE CALLED SUBSCRIBER ENTIRELY BY AUTOMATIC SELECTION

(a) Case where a single operator intervenes in the incoming country but on whose position the supervision cannot be retransmitted—(This operator can be a code-11 or code-12 operator or a manual exchange operator obtained by automatic selection from the outgoing international terminal centre).

The answer signal is sent when the operator enters the line.
The clear-back signal is sent when the operator clears the connection.

(b) Case where a single operator intervenes in the incoming country but on whose position the supervision can be retransmitted—(The operator envisaged is the same as in case (a) above).

(The passage of the supervision can be effected:

—via the cord circuits, the incoming operator intervening to clear down the connection at the end of the conversation,

—via cordless positions, in which case the connection is released automatically without the intervention of an operator when the called subscriber clears and when the outgoing operator causes the forward-clear signal to be sent).

The answer signal is sent when the operator enters the line.
A clear-back signal is sent when the operator goes out of circuit. This can happen for example when the operator hears the ringing tone but does not wait for the called subscriber to reply.
A second answer signal is sent when the called subscriber answers or when the incoming operator again enters the connection.
The clear-back signal is also transmitted when the called subscriber clears or when the incoming operator, by mistake, clears the connection before the called subscriber has cleared.
It is to be understood that the same signal (answer signal or clear-back signal) must not be sent twice in succession.

(c) Case where two operators intervene in the incoming country:

—code-11 or code-12 operator at the international terminal centre,
and
—an operator at a national manual exchange.

(c.1) Supervision is not retransmitted on the code-11 or code-12 operator's positions at the international terminal centre. The answer and clear-back signals are transmitted in the same conditions as in case (a).

(c.2) The code 11 or code 12 operator's position is normally able to provide through supervision; it is desirable to distinguish between two assumptions:

(c.2.1) If the whole of the national chain including the operator's positions is capable of transmitting the supervision from the called subscriber, the functional conditions can be as in case (b):

the intervention of an operator provokes the sending of an answer signal; her withdrawal provokes the sending of a clear-back signal, an answer signal is sent when the called subscriber answers and a clear-back signal is sent when the called subscriber clears. If an operator clears down the connection in error before the called party clears, a clear-back signal is sent.

(c.2.2) If the whole of the national chain is not capable of transmitting the supervision of the called subscriber, the supervision is transmitted from the point at which the supervision ceases.

* * *

In the three cases (a), (b), (c) above, it is recommended that the incoming operator shall be provided with the facility of drawing the attention of the outgoing operator by sending a succession of clear-back and answer signals for example by means of a special key.

C. Case of calls with full automatic operation

If it is decided not to prevent a calling subscriber obtaining direct access to an operator of the incoming country, the conditions under which this operator could be obtained and the answer and clear-back signals which would then be exchanged, must be studied later.

1.4.9. **Clear-forward signal** (transmitted in the forward direction)

This signal is sent in the forward direction on the termination of a telephone call when the operator at the outgoing international centre withdraws her plug from the jack or when an equivalent operation is performed.

This signal is recognised by the outgoing, incoming and transit equipment as the signal sent in the forward direction at the end of a call, at the cessation of which all the switching equipment used in the call must be released. Each international circuit however remains protected against subsequent seizure as long as the release guard signal has not been received from the corresponding end of the international circuit.

In a transit centre, the following arrangements must be made on disconnection:

(a) the GO channel must not be split until the clear-forward signal has completely ceased;

(b) the RETURN channel must be split as soon as possible after the recognition of the clear-forward signal;

(c) a clear-forward signal which is received at the moment of the establishment of the call must, when an outgoing circuit has already been taken but speech conditions have not yet been established, be repeated over the outgoing circuit.

Note. — In the case of fully automatic operation, the transmission of the clear forward signal is normally brought about by the calling subscriber restoring his telephone or performing an equivalent operation (case of a P.B.X. installation). This signal is also sent under fully automatic conditions following the reception of a busy-flash signal at the outgoing international centre.

1.4.10. **Release-guard signal** (transmitted in the backward direction)

This signal is transmitted in the backward direction in response to the clear-forward signal to indicate that the latter signal has been fully effective in bringing about the release of the switching apparatus at the incoming end of an international circuit. It serves to protect an international circuit against subsequent seizure as long as the disconnection operations controlled by the reception of the clear-forward signal have not been completed at its incoming end.

1.4.11. **Blocking signal** (transmitted in the backward direction)

This signal is sent to the outgoing end of the circuit to cause the international circuit to test busy at its outgoing end, when required.

The design of the signalling equipment at the outgoing end of an international circuit should be such that in the normal condition the receipt of the blocking signal will cause the circuit to be engaged to operators or automatic equipment which would otherwise have access to the circuits.

1.4.12. **Forward-transfer signal** (transmitted in the forward direction)

This signal is sent to the incoming international terminal centre when the outgoing operator at the outgoing international terminal centre wishes to seek the assistance of an operator at the incoming international terminal centre.

This signal will normally serve to bring an assistance operator into circuit in the case of a call completed automatically at this centre. In the case where a call is completed via an operator at the incoming international centre, this signal will cause this incoming operator (code-11 or code-12 operator) to be recalled.

1.5. **Diagram showing sequencing of signals**

The sequence of signals in semi-automatic telephone operation is shown diagrammatically in figures 1, 2 and 3 of Annex 3 (see p. 97 and following).

CHAPTER II

GENERAL TRANSMISSION CLAUSES

A. GENERAL CONDITIONS RELATIVE TO TRANSMISSION

2.1. **Use of four-wire circuits.**

In future, all international telephone circuits will have to be four-wire circuits according to C.C.I.F. recommendations with respect to modern type circuits.

2.2. **Equivalent of a circuit or of a chain of international circuits.**

International circuits in semi-automatic operation must be lined up and, the case arising, interconnected in such a way as to satisfy the following conditions:

(a) The equivalent in terminal service, measured at 800 c/s between the two-wire ends must have a standard nominal value which, in the present technical conditions, is equal to 0.8 neper or 7 decibels in each direction of transmission. This value takes into account the insertion loss of the outgoing and incoming switching equipment as well as all attenuation pads inserted in the circuit in terminal service.

Taking into account that in the future it may be considered desirable to reduce this present standard value of 0.8 neper or 7 decibels, it is expedient to provide in the switching equipment some arrangements (attenuation pads) which would possibly permit a change of this value without inconvenience.

(b) The interconnection 4-wire to 4-wire of two international circuits in a transit centre must be effected in such a manner that the equivalent of the connection made up of these two circuits joined together is of the same standard nominal value as the equivalent of a single circuit in terminal service.

This equivalent is measured in the same way as a single circuit in terminal service; it takes account of the insertion loss of the transit switching equipment as well as all attenuation pads inserted in the chain of international circuits.

(c) The relative levels of this chain of circuits must be in conformity with the hypsogrammes of the circuits which constitute the chain.

* * *

If these conditions *(a)*, *(b)* and *(c)* are satisfied, the nominal level of the point at which a signal receiver is connected to an international circuit will always be the

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same, whether the circuit is used in terminal service or constitutes the second or possibly the third circuit of a chain of several interconnected circuits.

2.3. **Method of interconnecting circuits.**

To avoid disturbances which reflexions, arising at the point of connection of two international four-wire circuits, could cause to signalling, it is recommended that the connection of these circuits should always be effected by the direct connection of the line wires. In addition it is necessary to take care to disconnect from the circuit, at the point of connection, the low-pass filters which may be inserted at the end of an international circuit when it has been envisaged that this circuit will, in general, be connected with national extension circuits having a cut-off frequency below 3400 p/s.

This recommendation does not concern the method of connection of two national trunk circuits used in international calls. It is for Administrations and Private operating companies to make the necessary arrangements for the connection of these circuits. In the same way, the method of connection between a national circuit and the international circuit can be chosen by the Administrations or National Private Operating Companies, it being understood that the signal receiver is connected to the four-wire end of the international circuit and that the connection with the national network will not give rise to reflections during the time that signals are being transmitted between two registers.

2.4. **Risk of instability.**

Arrangements should be made to reduce the risk of singing during the period between the time at which the speech path is established at the incoming international terminal exchange, and the time at which the called subscriber answers, and during the period between the moment at which the called subscriber clears and the moment at which the circuits are liberated. This result can be obtained in principle by one of the following methods:—

(i) The insertion of an attenuator in each path on the four-wire side of the connection.
(ii) The insertion of an attenuator in the two-wire side of the connection.
(iii) The insertion of a terminating impedance across the two-wire side of the connection.

It is recommended that, whatever may be the method adopted, it should always be effected at the *incoming* end of an international circuit, but that each Administration will be free to adopt the method it considers most convenient. Taking into account the experience obtained on manual circuits it is considered that for the present and for circuits set up to an equivalent of 0.8 neper (7 db) between the two-wire ends, it will be sufficient if arrangements are made to increase the stability of circuits by 0.4 neper (3.5 db).

2.5. **Crosstalk introduced in passing through an international exchange.**

2.5.1. *Crosstalk between different circuit connections*

The crosstalk, measured at the test break-jacks, between any two 2-wire connections set up through an international exchange should not be less than 8 nepers or 70 decibels.

A two-wire connection comprises a pair of wires from the test-jack frame, a switching equipment (made up of an incoming equipment, switching apparatus, and an outgoing equipment) and a pair of wires returning to the test-jack frame.

This limit of 8.0 nepers or 70 decibels corresponds with the value which can be tolerated for the transmission impairment of the chain of international and national circuits, taking account of the fact that there must be at least two international exchanges involved in the establishment of an international call and that the number of such international exchanges could reach four in the future.

The limit defined above should normally apply to the most unfavourable case, i.e. the case of two connections having parallel routes right through the international exchange. It can be stated that such a case is purely theoretical in fact, since the customary switching arrangements are such that if at one switching stage two connections use adjacent switches, then at the next switching stage these two connections will use switches which are not adjacent.

2.5.2. *Crosstalk between the* GO *and* RETURN *paths of a four-wire connection*

Provisionally, the crosstalk ratio between the GO and RETURN paths of a four-wire connection, passing through an international exchange, should not be less than 5.8 nepers (50 decibels).

2.6. **Systematic splitting of circuits to ensure reciprocal protection of international and national signalling systems.**

To avoid interference to one signalling system arising from another signalling system it is advisable to limit the length of:—

(1) the fraction of the *international* signal which may be able to pass from the international circuit into the national signalling system (protection of national systems).

(2) the fraction of the *national* signal which may be able to pass:—

(a) from the national signalling system to the international signalling system (protection of the international system),

(b) from one national signalling system to the national signalling system of another country via the international connection which has been established (protection of national systems).

A splitting arrangement is called for in the international signalling systems (see sections 4.3 and 5.3) in order to satisfy condition 1 above. This device, on the other hand, also serves to limit the duration of signals returning from the GO path over the RETURN path by reflection at the termination.

The C.C.I.F. has issued recommendations concerning national signalling systems so that condition 2 above may be satisfied. These recommendations, which do not concern the international signalling system, appear on page 19.

2.7. **Insertion of echo suppressors.**

2.7.(1) When transmission conditions over a particular route require the insertion of an echo suppressor, this insertion must be effected at a point where it will cause no interference with signalling over the international circuit.

2.7.(2) The use of circuits on which echo suppressors are permanently connected should be avoided for semi-automatic operation.

If, nevertheless, an echo suppressor is normally associated with the outgoing end of an international circuit, it should be disconnected when this circuit is used for a transit connection and forms the second or possibly the third circuit of an international connection.

2.7.(3) The echo suppressor should be inserted at the outgoing centre when an international connection which is set up from this centre requires an echo suppressor. The method adopted for controlling the connection of an echo suppressor at an outgoing international terminal exchange is left to the choice of the Administration responsible for this centre. A simple method is to leave the control of the insertion of an echo suppressor to the outgoing operator; if automatic alternative routing is used, a study of the routing plan will allow the routes for which echo suppressors should be necessary to be determined in advance, but it may be that operators will not be capable of identifying these routings. Another solution may be to control the connection of echo suppressors by the outgoing register according to the international code and the route followed by the call.

B. CLAUSES COMMON TO SIGNAL RECEIVERS (AND TRANSMITTERS) FOR THE TWO SIGNALLING SYSTEMS

2.8. **Level of signals and sensitivity of signal receivers**

2.8.1. *Nominal sending level of power*

The nominal sending level of power is defined in paragraphs 4.1.2. and 5.1.2. It corresponds with the " maximum permissible power " for the signalling frequencies (see page 14).

Note — The level of the leak current *(courants de fuite)* which could be transmitted over the line during signalling, if, for example, static modulators are used for signal transmission, should be 50 decibels (5.8 nepers) below the level of the signal current itself.

2.8.2. *Variations of absolute level of power of received signal*

The absolute level of power of the signalling current to be transmitted having been fixed at the maximum value compatible with the demands of transmission over the circuit, values defining the extreme absolute power levels between which signalling currents may be received depend on three factors:—

(1) the variation with time of the equivalent of international circuits at 800 c/s,

(2) the variation with frequency of the equivalent of international circuits, in relation to their nominal value at 800 c/s,

(3) the tolerance on the absolute level of power transmitted in relation to its nominal value.

To take account of these three variations, a maximum variation of ± 1 neper (± 9 decibels) has been allowed for the absolute level of the signalling current(s) received at the point of connection of the signal receiver, in relation to the nominal value of this level.

In the present state of the European network this margin normally permits two international circuits in tandem. Studies are in hand with a view to reducing the variations of equivalent with time to sufficiently narrow limits that the possibility of using three international circuits in tandem may be contemplated.

2.8.3. *Maximum sensitivity of the signal receiver*

It is desirable to limit the maximum sensitivity of the signal receiver (see 4.2.2.b and 5.2.2.b) taking account particularly of the fact that the lower limit fixed for the crosstalk ratio between the GO and RETURN paths of a 4-wire circuit is only 4 nepers (35 decibels).

2.9. Connection of the signal transmitter and signal receiver to the circuit

The signal receiver should be connected permanently to the four-wire side of the telephone circuit.

It should be protected against disturbance arising from the near end of the circuit by a buffer amplifier or other means. This device should provide a discrimination corresponding to an additional attenuation of at least 7 nepers (60 decibels) in respect of the disturbing currents coming from the near end of the circuit *.

The recommendations of Vol. III of the Green Book concerning international circuits must be respected after the connection of a signal transmitter and a signal receiver (1 or 2 VF transmitter or receiver) and of the switching equipment. In consequence, it is necessary to fix the limits of input and output impedance, insertion loss, attenuation distortion, non linear distortion, balance, and crosstalk of signal transmitters and receivers; a detailed specification concerning these conditions is given by way of example in paragraph 2.10 which follows.

2.10. Examples of detailed specification clauses relative to signal receivers and transmitters

The following clauses are furnished solely *by way of example* (see paragraph 2.9 above); also they are only applicable where the signal receiver is constructed as a quadripole and where nominal impedance of circuits is 600 ohms.

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* The value of 60 decibels is that which appeared in Volume VI of the Yellow Book. A question set for study by the 8th S.G. in 1955/1957 envisages the revision of this value. A fairly large number of Administrations consider, in fact, that a value of 40 decibels should be sufficient. It is for each Administration to consider if it will be satisfied with a value less than 60 decibels for the protection of its signal receivers, whilst fully respecting the conditions of operation of the signal receivers specified later under 4.2 and 5.2.

2.10.1. *Input and output impedance*

The nominal value of the input and output impedances of the signal receiver is 600 ohms.

If Z_E and Z_S indicate respectively the measured values of the input and output impedances of the signal receiver, they should, in the 300 to 3400 c/s frequency band, satisfy the condition:

$$\left|\frac{Z_E - 600}{Z_E + 600}\right| \ll 0.35 \text{ and } \left|\frac{Z_S - 600}{Z_S + 600}\right| \ll 0.35.$$

In the course of these measurements the free terminals should be looped by a resistance of 600 ohms and the voltage applied must not overload the equipment.

2.10.2. *Attenuation*

At 800 c/s, the composite attenuation of the signal receiver, measured with a generator and a receiver of internal resistance of 600 ohms, must be between the limits:

$$A \pm 0.05 \text{ neper}$$
$$\text{or}$$
$$A \pm 0.5 \text{ decibels.}$$

The value A is to be determined in accordance with the hypsogramme of the circuit according to the point of the circuit at which the signal receiver should be connected.

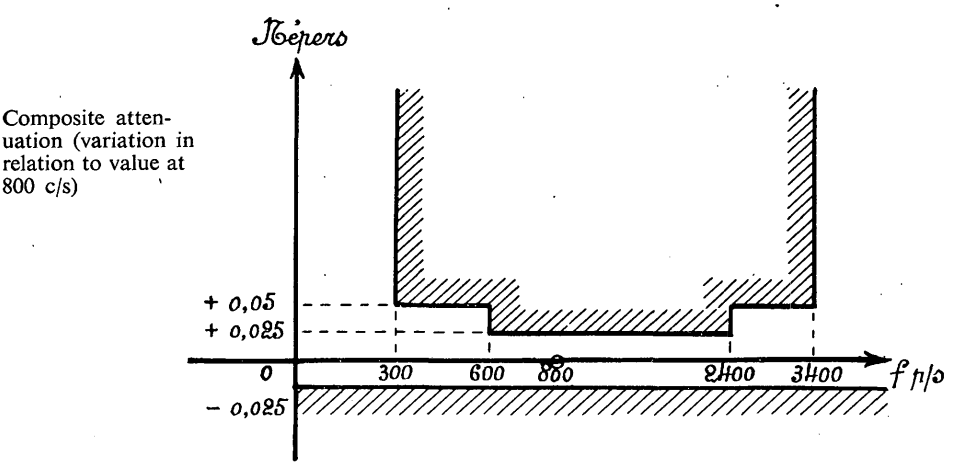
For this measurement the generator will have an EMF of

$$1.55\ e^n \text{ volts}$$

where n is the relative power level (in nepers) at the signal receiver input.

2.10.3. *Attenuation distortion*

The composite attenuation distortion of the signal receiver recorded in the 300-3400 c/s frequency band and measured under the conditions of paragraph 2.3.2 should not exceed the limits shown in the following graph.

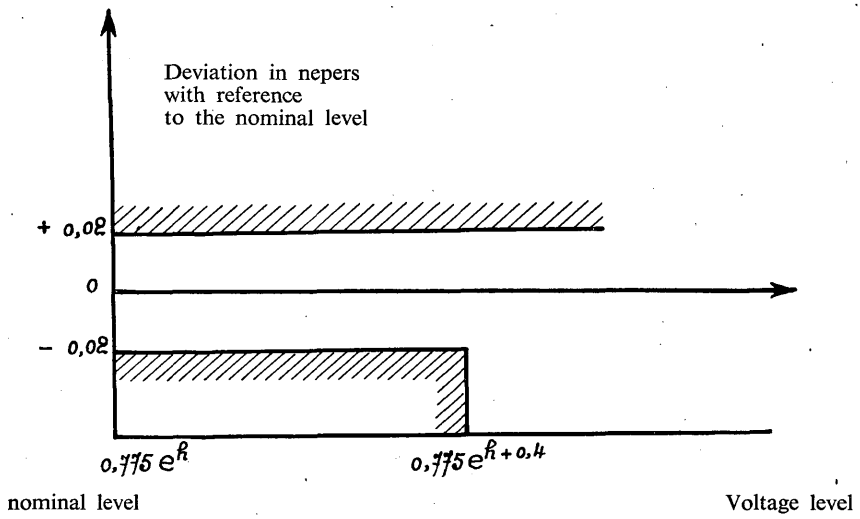


2.10.4. *Non-linear distortion*

In the 300-3400 c/s frequency band, the harmonic distortion produced by insertion in the line of the signal receiver must be such that the level variation with reference to the nominal level lies within the limits defined on the graph below.

The measurement should be made with apparatus of internal resistance of 600 ohms.

Non-linear distortion



2.10.5. *Balance*

The input and output of the signal receiver should present a high degree of balance with respect to earth, assuming very low admittance of each terminal with respect to earth.

The same clause should apply to the *signal transmitter.*

2.10.6. *Crosstalk between adjacent signal receivers*

The crosstalk ratio between two adjacent signal receivers should not be less than 8.5 nepers (74 decibels) in the 300-3400 c/s frequency band.

CHAPTER III

MISCELLANEOUS CLAUSES COMMON TO THE TWO SYSTEMS

3.1. Speed of switching in an international terminal or transit centre

3.1.(1) It is recommended that apparatus shall be used at international centres (international terminal or transit centres) which will ensure a rapid speed of switching and with which the duration of selection will be as short as possible.

3.1.(2) It is also recommended that:

(a) the incoming register at the incoming international terminal centre shall begin to establish the national part of the connection as soon as the register has received a sufficient number of digits and without waiting to receive the complete number of the called party;

(b) in the case of the single-frequency system the transit register at the international transit centre shall proceed to send the numerical signals as soon as possible after receiving the corresponding digits from the preceding centre.

3.1.(3) At the outgoing international terminal centre:

— with semi-automatic operation it may be desirable that the outgoing register should start sending numerical signals to line without waiting to receive all the digits of the called party's number. This may, however depend on national conditions.

— with full automatic operation, it is evident that the sending of numerical signals must begin without waiting for the receipt of all the digits of the called party's number because the outgoing register will, in general, be unable to recognise, a priori, when the complete number of digits has been received.

3.1.(4) It is permissible at incoming and transit centres to use continuous hunting (of circuits or common equipment) to benefit from the advantages obtainable by this method: i.e. economy in the number of outgoing circuits to be provided or an improvement in the quality of service for a given number of circuits. However, in particular to determine the release conditions of registers, the following durations must be adhered to concerning the maximum delay introduced in returning a busy-flash signal:

— maximum delay of 5 seconds following the recognition of a seizing signal at an incoming or transit centre if a free register and/or link circuit is not found,

— maximum delay of 10 seconds following the receipt, at an incoming centre, of the information necessary for determining the required route, if a free outgoing circuit is not found,

— maximum delay of 10 seconds following the receipt of the international code at a transit centre, if a free outgoing circuit is not found.

3.2. **Release of registers**

3.2.1. **Outgoing register**

3.2.1.(1) *Normal release conditions*

The outgoing register shall release in one or the other of the two following cases:

Case 1. — The register has sent forward all the numerical signals and has received a local end-of-sending signal from the outgoing operator indicating that there are no more digits to follow.

Case 2. — The register has received:

— either, a number-received signal from the incoming international centre indicating that all the digits comprising the complete national number have been received,

— or, a busy-flash signal [except in the case of the two-frequency system where rerouting via an alternative route is employed (see point 3.7 following) in which case the busy flash signal initiates rerouting and the outgoing register then releases at a later stage].

3.2.1.(2) *Abnormal release conditions*

Arrangements should be made at the outgoing centre for the possibility of releasing the outgoing register when any one of the following conditions arise:

(a) With semi-automatic operation, if after a delay of 10-20 seconds from the seizure of the register or the receipt of the last digit no further digit or an end-of-sending signal is received.

Note. — The register will also release under full automatic operating conditions after a certain delay following the seizure of the register or the receipt of the last digit if no further digit or a number-received signal is received. This delay, greater than that fixed above for semi-automatic operation, will be defined as a function of the maximum time foreseen for the receipt of a number-received signal under the most unfavourable conditions.

(b) An international code is received for which no routing has been provided.

(c) A proceed-to-send signal or a busy-flash signal is not received within:

— 10 to 20 seconds following the sending of a seizing signal (single-frequency system),

— 10 to 30 seconds following the sending of a seizing signal (two-frequency system),

— 15 to 30 seconds following the sending of the international code digits to a transit centre (two-frequency system, transit traffic);

(d) In the two-frequency system, an acknowledgement signal is not received within 5 to 10 seconds following the sending of a digit.

(e) In the two-frequency system, a third transit proceed-to-send signal is received.

In the various cases mentioned above an appropriate indication should be given to the operator or calling subscriber.

3.2.2. Transit register

3.2.2.(1) *Normal release conditions*

A. SINGLE-FREQUENCY SIGNALLING SYSTEM.

The transit register shall release in one *or* the other of the two following cases:

1st case. — The register has accomplished the whole of the following operations:

(a) it has selected an outgoing circuit,

(b) it has sent all the numerical signals that it has received (except, of course, the international code digits when the following centre is a terminal centre),

(c) it has received an end-of-pulsing signal from the preceding centre and has sent the corresponding signal forward.

2nd case. — The register has received:

— either a number-received signal from the incoming international centre,

— or a busy-flash signal

and has set up the necessary conditions for either of these signals to be transmitted or repeated to the outgoing centre.

B. TWO-FREQUENCY SIGNALLING SYSTEM.

The transit register shall release as soon as it has completed the whole of the following operations:

(a) it has selected an outgoing circuit,

(b) it has sent forward a seizing signal.

Nevertheless, a different practice can be adopted which consists of delaying the release of register until either a proceed-to-send signal or a busy-flash signal is received from the following centre. In effect, it may be judged more convenient to make use of the register when it is desired to give an alarm indicating the non-receipt of a proceed-to-send signal. In this case, the circuit should be switched to the conversation condition in both directions of transmission immediately following the operations mentioned in *(a)* and *(b)* above so as to permit the passage through the transit centre of the proceed-to-send signal on the one hand and on the other hand to permit the following numerical signals to pass.

Note. — In the two signalling systems, if congestion conditions are encountered at the outgoing side of the transit centre, the register will release after having returned a busy-flash signal, and effected the connection of a speaking machine.

3.2.2.(2) *Abnormal release conditions*

A. SINGLE-FREQUENCY SIGNALLING SYSTEM.

The transit register will release *after having returned a busy-flash signal* * under any one of the following conditions:

* In the single-frequency signalling system, the busy-flash signal is the only means available for informing the outgoing centre of an abnormal condition. In the two-frequency signalling system the sending of this signal is unnecessary because the outgoing register is always present on the line and can itself detect the abnormal condition.

(a) No digit is received within 20 to 40 seconds following the sending of a proceed-to-send signal to the preceding centre.

(b) An international code is received for which no routing has been provided.

(c) A proceed-to-send signal is not received within 10 to 20 seconds following the sending of a seizing signal to the following centre.

(d) An end-of-pulsing signal or number-received signal is not received within 30 to 60 seconds following the receipt of the last digit (see 3.3.2 concerning switching to speech conditions at a transit centre).

(e) A busy-flash signal is received (see 3.3.2 concerning switching to speech conditions at a transit centre).

B. TWO-FREQUENCY SIGNALLING SYSTEM.

The transit register will release *without returning any signal* * under any one of the following conditions:

(a) The international code digits are not received within 5 to 10 seconds following the sending of a proceed-to-send signal to the outgoing centre.

(b) An international code is received for which no routing has been provided.

On the other hand, if the release of the transit register is deferred until a proceed-to-send signal is received, in accordance with the alternative method mentioned in paragraph 3.2.2 (1) B, it will release if a proceed-to-send signal or busy-flash signal is not received within 10 to 30 seconds following the sending of a seizing signal to the following centre.

3.2.3. **Incoming registers**

3.2.3.(1) *Normal release conditions*

The incoming register will release when all the numerical information necessary to establish the connection in the incoming country has been sent and a number-received signal has been returned over the international circuit. The register will determine when the complete number has been received under the conditions defined in paragraph 1.4.5.

If the incoming register ascertains that congestion conditions exist at the outgoing side of the incoming international centre, it will release after having returned a busy-flash signal.

3.2.3.(2) *Abnormal release conditions* (1 V.F. and 2 V.F. systems)

The incoming register will release if any one of the following three conditions occur:

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* In the single-frequency system too, the busy-flash signal is the only means available for informing the outgoing centre of an abnormal condition. In the two-frequency signalling system the sending of this signal is unnecessary becaused the outgoing register is always present on the line and can itself detect the abnormal condition.

(a) When after a delay of 30 to 60 seconds beginning at the time the last digit has been received, no further digit is received and it has not been established by one of the methods described in paragraph 1.4.5, that the number received is a complete number.

(b) No digits are received within 5 to 10 seconds in the two-frequency system or 20 to 40 seconds in the single-frequency system following the return of a proceed-to-send signal.

(c) A number is received for which no routing exists or an incomplete number is received followed by an end-of-pulsing signal.

In cases *(a)* and *(b)* the incoming register in the single-frequency system must return a busy-flash signal before it releases to indicate that an abnormal condition has occurred at the incoming centre. It is, in effect, the only means of informing the outgoing centre that abnormal conditions have occurred. In the two-frequency system the return of a signal is unnecessary because the outgoing register remains in circuit and can itself detect the anomaly in the establishment of the call.

In case *(c)*, before the incoming register releases (in both the single-frequency and two-frequency systems) a number received signal will be returned followed if possible by an audible indication given by a talking machine, a number-unobtainable tone or by the intervention of an interception operator.

3.3. **Establishment of speech conditions**

3.3.1. *Outgoing international terminal centre*

Speech conditions shall be effected when the outgoing register releases (see 3.2.1).

3.3.2. *International transit centre*

A. SINGLE-FREQUENCY SYSTEM.

Speech conditions shall be established in both directions of transmission when the transit register releases (see 3.2.2) but arrangements should be made before the release of the register to permit the passage or the retransmission of the number-received signal or busy-flash signal coming from the incoming centre to the outgoing centre.

On the other hand, in order to ensure the correct transmission of subsequent signals which may arrive, speech conditions must be effected within the 240 ms which follow the reception of the number-received signal.

B. TWO-FREQUENCY SYSTEM.

Speech conditions shall be established immediately the transit register has sent the seizing signal (see 3.2.2).

3.3.3. *Incoming international terminal centre*

Speech conditions shall be established immediately the incoming register has sent the number-received signal or the busy-flash signal, and, if these signals are not sent, at the time the register releases under abnormal conditions (see 3.2.3.(2)).

3.4. Delay in the transmission of line signals

To avoid surges (transitory currents) originating from the closing or opening of direct-current circuits on the line wires in the switching equipment, preventing the correct operation of the signal receiver at the other end of the circuit when they precede or succeed the sending of signals, the following arrangements should be made for the transmission of voice-frequency signals:

(a) The exchange side of the international circuit shall be disconnected 30 to 50 m.s. before beginning to send a voice-frequency signal over the international circuit.

(b) The exchange side of the international circuit shall not be reconnected until 30 to 50 m.s. following the end of sending of a voice-frequency signal over the international circuit.

3.5. Transit routing

To avoid inopportune routings which do not conform to the " European switching plan for semi-automatic traffic " it may be possible, technically, to provide a means at transit centres to enable the origin of the call to be ascertained and from this information prevent unwanted routings.

3.6. Indication of congestion conditions at transit centres

In the case of congestion at a transit centre:

(1) The busy-flash signal shall be returned (see paragraph 1.4.6. concerning the definition of this signal) to indicate that no free outgoing circuit is available or that there is no transit register or link circuit available. In cases where continuous hunting is used the busy-flash signal should be returned within the period specified in paragraph 3.1.(4).

(2) A verbal announcement giving the name of the centre at which congestion has occurred should be given.

The busy-flash signal and the verbal announcement provided by a talking machine will be used at the outgoing centre in accordance with the arrangements judged most suitable by the Administration of the country concerned *.

3.7. Automatic routing via an alternative route (overflow) and re-routing

3.7.(1) In the case of a call which cannot find a free circuit on one route at an outgoing international terminal centre or international transit centre, technical arrangements can be made, if desired, to route the call automatically over another route (alternative route). This operation is designated under the name *overflow.*

3.7.(2) In the case where congestion occurs at an intermediate transit centre, arrangements can be made, if desired, to reroute automatically the call

* In the two-frequency system the succession of proceed-to-send signals (transit or terminal) can be used to provide, either with lamps or with indicators, a visual indication of the centre at which the congestion has occurred.

An Administration which desires to make use of a verbal announcement from a talking machine must not, of course, convert the busy-flash signal which precedes an announcement into an audible tone signal.

from the outgoing international terminal centre over another route (alternative route). This operation is known as *re-routing*. The re-routing of a call is brought about by the reception of a busy-flash signal at the outgoing international terminal centre. It is, of course, assumed with re-routing that the outgoing register remains connected to the line; a facility which is not normally provided with the single-frequency system since the register releases after having sent the numerical signals to the transit centre.

Re-routing will serve no purpose when congestion conditions are experienced at the incoming terminal centre. In the same way, a call must not overflow from a direct route used exclusively for terminal traffic to an alternative transit route if the busy-flash signal has been received on the direct route. In addition, in order to avoid re-routing in the case of congestion on the national network of the incoming country, a call switched via a transit centre shall not be re-routed if a busy-flash signal is received by the outgoing register after the receipt of a terminal proceed-to-send signal.

3.8. Indication of the route taken by a call when alternative routing is employed

When it is necessary for accounting, traffic observations or maintenance reasons to provide the outgoing operator, observation supervisor or maintenance personnel with an indication of the route taken by a call under alternative routing conditions, arrangements may be made to indicate, by means of visual signals (lamps or indicators) the actual route (1st, 2nd or 3rd choice) taken by a call from the *outgoing* international terminal centre.

In the case of the two-frequency system, it will also be possible to distinguish between a route involving one or two transit switching centres by counting the number and type of proceed-to-send signals received at the outgoing international terminal centre. This information used in combination with the choice of route selected at the outgoing centre will enable the actual route taken by the call to be determined.

3.9. Arrangements to be made in the equipments for obtaining information concerning the traffic and the quality of service

It will be expedient when designing the international signalling and switching equipment to consider the possibility of including arrangements (telephone meters, traffic recorders, etc.) for obtaining information concerning the traffic, the degree of utilisation of circuits and the quality of the service. This will avoid having, later, to introduce substantial modifications to equipment already in service.

The information which should be obtained, in a manner standardised on an international plan, has not yet been defined by the C.C.I.F..

Annex 4 (pages 108 and 109) gives (purely by way of example) the facilities which the Swedish Administration considers it reasonable to envisage when providing international signalling and switching equipment.

CHAPTER IV

1 V.F. SYSTEM

4.1. Signal transmission.

4.1.1. *Signalling frequency*

The signalling frequency shall be 2280 $\pm$ 6 c/s.

4.1.2. *Absolute level of power transmitted*

The absolute level of power of the signalling current non-modulated, at the zero level point, shall be — 0.7 neper (— 6 decibels) with a tolerance of $\pm$ 0.1 neper or $\pm$ 1 decibel.

4.2. Specification for the signal receiver

4.2.1. *Operating limits of the signal receiver*

The signal receiver shall function in the conditions specified in 4.2.5, to a signalling current of

$$2280 \pm 15 \text{ c/s},$$

the absolute level of power N of the signalling current non-modulated being between the limits,

$$-1.7 + n \ll N \ll +0.3 + n \text{ nepers}$$

or

$$-15 + n \ll N \ll +3 + n \text{ decibels}$$

where n is the relative power level at the signal receiver input.

These limits represent a margin of $\pm$ 1 neper ($\pm$ 9 decibels) relative to the absolute nominal level of the signalling current at the input to the signal receiver.

The tolerances above are allowed to take account of both the variations in the transmitted current and the variation which may arise in transmission over the line.

4.2.2. *Conditions for non-operation of signal receiver*

(a) Selectivity

The signal receiver shall not operate to a signal the frequency of which is more than 150 c/s removed from the nominal value of 2280 c/s and which is within the range of received levels specified in 4.2.1.

(b) Maximum sensitivity of the signal receiver

The signal receiver shall not operate to a signal the frequency of which is 2280 $\pm$ 15 c/s, but the absolute power level of which at the point of connection

of the receiver is (— 3 — 0.7 + *n*) nepers or (— 26 — 6 + *n*) decibels, n being the relative power level of this point.

This limit is 3 nepers or 26 decibels below the absolute nominal level of the signalling current at the input to the signal receiver.

4.2.3. *Efficiency of guard circuit*

The signal receiver must be protected by a guard circuit against false operations due to speech currents, circuit noise or other currents of miscellaneous origins circulating in the line.

The guard circuit will avoid:

(a) signal imitations. (Signals are imitated if the duration of the resulting pulse of direct current at the output of the signal receiver is sufficiently long to be recognised by the switching equipment).

(b) operations of the splitting device which can interfere with the conversation.

By way of example, the efficiency of the guard circuit should be such that:

(a) normal voice currents will not, on the average, cause more than 1 false operation of a duration greater than 55 milliseconds per 10 hours of conversation (the minimum recognition time of a signal is 60 milliseconds).

(b) the number of false splits of the conversation path brought about by speech currents will not lead to an appreciable reduction in the transmission quality of the circuit.

4.2.4. *Limits relative to the guard circuit*

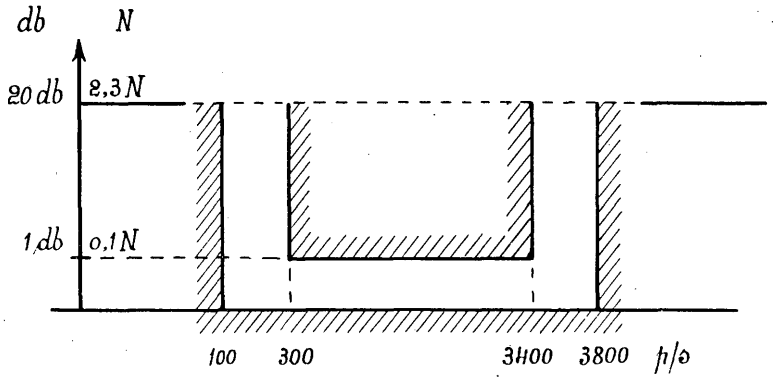
A. *Steady noise*

Considering:

(a) that when there is noise on the telephone circuit, a too sensitive guard circuit could give rise to signalling difficulties and, in particular, inhibit the response of the signal receiver.

(b) that a psophometric E.M.F. of 2 millivolts, measured at a relative level point of — 0.8 neper (or — 7 decibels) is provisionally allowed as the maximum permissible limit of circuit noise in the case of a single circuit, and therefore a psophometric E.M.F. of 3 millivolts, in the case of two circuits in tandem,

it is recommended that, with the frequency and the level of the signalling current being within the limits specified in paragraph 4.2.1, the signal receiver should satisfy the conditions indicated in paragraph 4.2.5 (lines *a* and *b*) in respect of the distortion of signals in the presence of a noise having a psophometric E.M.F. of 3 millivolts at the point of relative level — 0.8 neper (— 7 decibels), produced by a generator having a uniform curve of energy output over the frequency spectrum, followed by a filter having an attenuation frequency characteristic within the limits indicated by the graph below.



B. *Surges*

Taking into account that a guard circuit with a long hang-over time can cause difficulties in the reception of a signal when, for example, some surges have immediately preceded the signal, it is recommended that the following condition be fulfilled:

If a disturbing current, of a frequency corresponding to the maximum sensitivity of the guard circuit, and having an absolute power level of $(-1.15 + n)$ neper or $(-10 + n)$ decibels, at the relative level point n where the signal receiver is connected, ceases 30 milliseconds before a signal of a frequency and level within the limits defined in paragraph 4.2.1 is applied, the lengths of the received signals must not be affected beyond the limits specified in paragraph 4.2.5.

4.2.5. *Distortion of received signals*

The frequency of the signalling current and its level being within the limits specified in paragraph 4.2.1 the following conditions should be fulfilled by an isolated pulse transmitted over the line of a duration of at least 40 ms. or by a pulse of duration t_1 between 40 and 60 ms. forming one of a train of pulses each of which is separated from the preceding one by an interval of $(100 - t_1)$ ms:

(1) the response time for the restitution of the start of the pulse should be less than 20 ms,

(2) the alteration of the duration of the pulse should be within $\pm$ 8 ms in the presence of noises defined in paragraph 4.2.4.

4.3. **Splitting arrangement**

4.3.(1) To avoid the line signals * of the international signalling system causing disturbances to national signalling systems, the international circuit should be split (completely cut) at the outgoing and incoming international centres on the reception of a signal in such a way that no fraction of a signal exceeding 35 ms duration may pass out of the international circuit.

This splitting device will also operate to the benefit of the international signalling system when speech conditions are established by preventing signals being returned from the GO channel to the RETURN channel via the termination at the receiving end and giving rise to false signals at the centre from which the signal originates.

* See the definition of line signals under 4.4.(1.)

The splitting time of 35 ms defined above may possibly be reduced by each Administration or private operating Company concerned in order to facilitate the protection of its national network against the effect of signals coming from the international circuit. It is nevertheless desirable to note that the adoption of a shorter splitting time can lead to an increase in the number of false operations of the splitting device due to speech currents and impair the quality of transmission during conversations.

4.3.(2) The splitting must be maintained for the duration of the signal but must cease within 25 ms of the end of the direct-current signal which caused the splitting device to function.

4.3.(3) The splitting of the line should not give rise to transients which might cause interference with signalling over the international circuit or other signalling systems associated for the setting-up of an international call.

4.4. Signal code

4.4.(1) Signals of the one-frequency system include:

(1) signals called " line signals " which serve to control the operations of connection and to give supervision;

(2) numerical signals: arythmic code signals.

4.4.2. *Line signals*

4.4.2.(1) *Code for line signals*

The code for the line signals is given in table 1.
The symbols used in table 1 have the following significance:

X short signal element
XX long signal element
S silent interval between the elements of the same signal

4.4.2.(2) *Transmitted duration of elements of line signals*

The elements of each of the voice-frequency signals sent over the line which appear in table 1 should have a duration of:

X : 150 ± 30 ms
XX : 600 ± 120 ms
S : 100 ± 20 ms

(The durations of the elements of the *X* and *XX* signals are multiples of a pulse of 50 ms duration with a tolerance of $\pm$ 10 ms).

Each signal, the transmission of which is begun, must be sent completely. If two signals must be sent, one immediately after the other, in the same direction it is necessary that a silent interval should separate the two successive signals. The length of this interval must not be less than 240 ms but must not, however, be too long in order that the speed of signalling be not unreasonably retarded.

TABLE 1

N° de la liste List n°	Nom du signal Name of signal	Système à 1 F 1 VF System
	SIGNAUX EN AVANT FORWARD SIGNALS	
1	Prise (a) terminale - terminal	X
	Seizure (b) pour transit international - for international transit	XX
3	Signaux de numérotation - Numerical signals	Code arythmique Arythmic code
4	Fin de numérotation - End of impulsing signal	
9	Signal de fin - Clear forward	XXSXX
12	Signal d'intervention - Forward transfer	XSX
	SIGNAUX EN ARRIÈRE BACKWARD SIGNALS	
2	Invitation à transmettre - Proceed to send	X
5	Numéro reçu - Number received	X
6	Occupation - Busy flash	X X
7	Réponse du demandé - Answer	XSX
8	Raccrochage du demandé - Clear back	X X
10	Libération de garde - Release guard	XXSXX
11	Blocage - Blocking (x)	Emission permanente Continuous

* The maintenance Instructions given to the maintenance staff will stipulate that a circuit may only be blocked for a limited period.

1 V.F. system signal code

Line signals

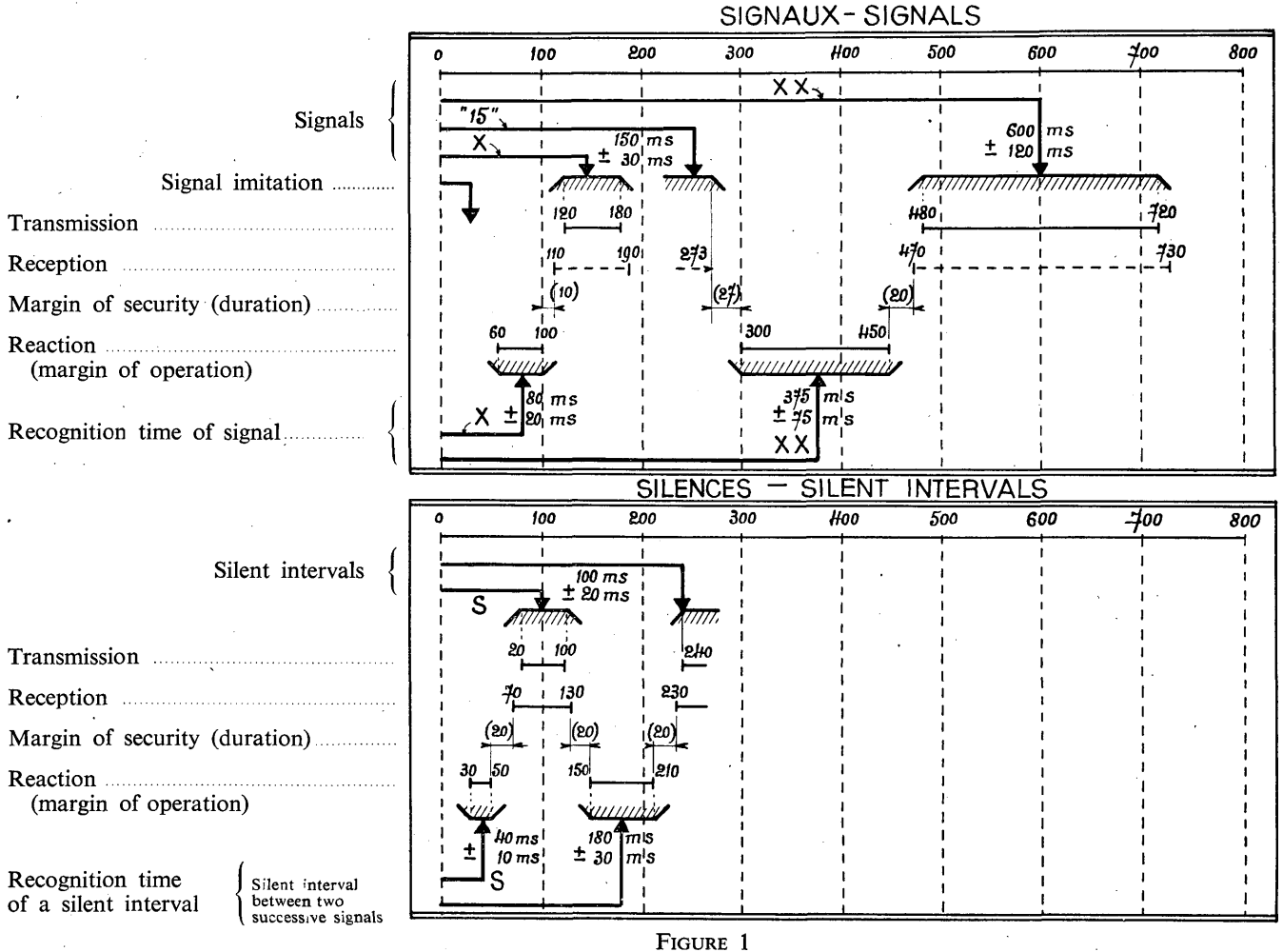


FIGURE 1

1 V.F. system: durations of signal elements (line signals)

4.4.2.(3) *Recognition time of elements of line signals at the receiving end*

At the output of the signal receiver the duration of the direct current signal elements corresponding to the line signals is determined in terms of the transmitted duration of the voice-frequency signal elements and the distortion due to the line and to the signal receiver. This distortion is taken as equal to 10 ms maximum.

The incoming switching equipment must only recognise a signal element after a certain time, called the recognition time, has elapsed following the commencement of the receipt of the direct-current signal element so as to reduce the risk of recognizing false signals and to discriminate between different signals.

The recognition times of the line signal elements should be:

$$X \quad : \quad 80 \pm 20 \text{ ms}$$
$$XX \quad : \quad 375 \pm 75 \text{ ms}$$
$$S \quad : \quad 40 \pm 10 \text{ ms.}$$

A silent interval having a duration greater than 210 ms at the receiving end should certainly be interpreted as an interval between two successive signals.

In order to avoid a series of numerical signals being wrongly interpreted as a clear-forward signal, the equipment which recognises the long signal *XX* must recommence the measurement of the length of the signal after any silent interval of a duration equal to or greater than 30 ms.

4.4.2.(4) The diagram of figure 1 shows for the elements of these line signals:

(a) the transmitted duration (transmission at voice frequency over the line);

(b) the received duration (D.C. current at the output of the signal receiver);

(c) the " margins of security " which have been foreseen to take account of drift in the adjustment of equipment, etc.

(d) the recognition time (margin of operation of incoming switching equipment); this margin is defined between two limits of time; a lower limit t and a higher limit *T*. The switching equipment must *not* recognise a signal element *before t*, but must *certainly* recognise it *before the end of the time T*.

4.4.3. *Numerical signals*

4.4.3.(1) *Principle of the arythmic code*

The numerical signal code is given in table 2. This code is a binary code of four elements, each element being constituted either by the presence of the signalling current transmitted on the line, or by the absence of this current. These elements must succeed each other at a determined speed; this speed is indicated by the presence of a start element (transmission of a frequency) and a stop element (non-transmission of the frequency) between which the 4 characteristic elements of the numerical signals are sent.

The code is in all ways similar to the arythmic code used for telegraph transmission and differs from it only by its lower modulation speed and by the fact that it only comprises 4 elements instead of the 5 used in telegraphy.

4.4.3.(2) *Clauses relative to the transmission of the arythmic code signals*

The theoretical duration of the unit interval corresponding to the start element, to each of the 4 active elements, and to the stop element is 50 ms (which corresponds to a " speed of modulation " of 20 bauds).

The timing system which is included in the outgoing register must be such that its speed does not differ from the theoretical speed corresponding to a speed of modulation of 20 bauds defined above, by more than 1 %.

Taking the beginning of the emission of the start as the origin of time, the instants of the end or of the beginning of the transmission of the voice frequency signal over the international circuits must be at the theoretical instants: 50, 100, 150, 200, 250 ms with a tolerance of $\pm$ 10 ms; this tolerance takes into account the maximum difference due to a deviation of speed in the time base and a tolerance for the transmission of the signal.

4.4.3.(3) *Clauses relative to the reception of arythmic code signals*

At the incoming end, taking as the origin of time the beginning of the start on the D.C. signalling wire at the output of the receiver, the exploration of the electrical condition of this wire should be made at the theoretical instants: 75, 125, 175, 225 ms.

The duration of exploration should be between 0.5 and 3 ms.

The timing system which is included in the incoming register and which is started at the reception of a " start " element should function in synchronism with the timing system used at the outgoing end and, like the latter, should have a speed which does not differ by more than 1 % from the theoretical speed corresponding to a speed of modulation of 20 bauds.

4.4.3.(4) The diagram in figure 2 shows how the different tolerances to be foreseen for the arythmic code signals combine.

This diagram shows particularly the " period of exploration " i.e. the period of time during which exploration should take place.

4.4.4. *General remark with reference to the operation of signalling and switching equipment*

It is well understood that the tolerances defined in sections 4.4.2 and 4.4.3 above concerning the transmitted duration of signals and their recognition times at the receiving end must be carefully observed whatever may be the circumstances and in particular whatever may be the variations of battery voltage likely to arise under service conditions.

TABLE 2

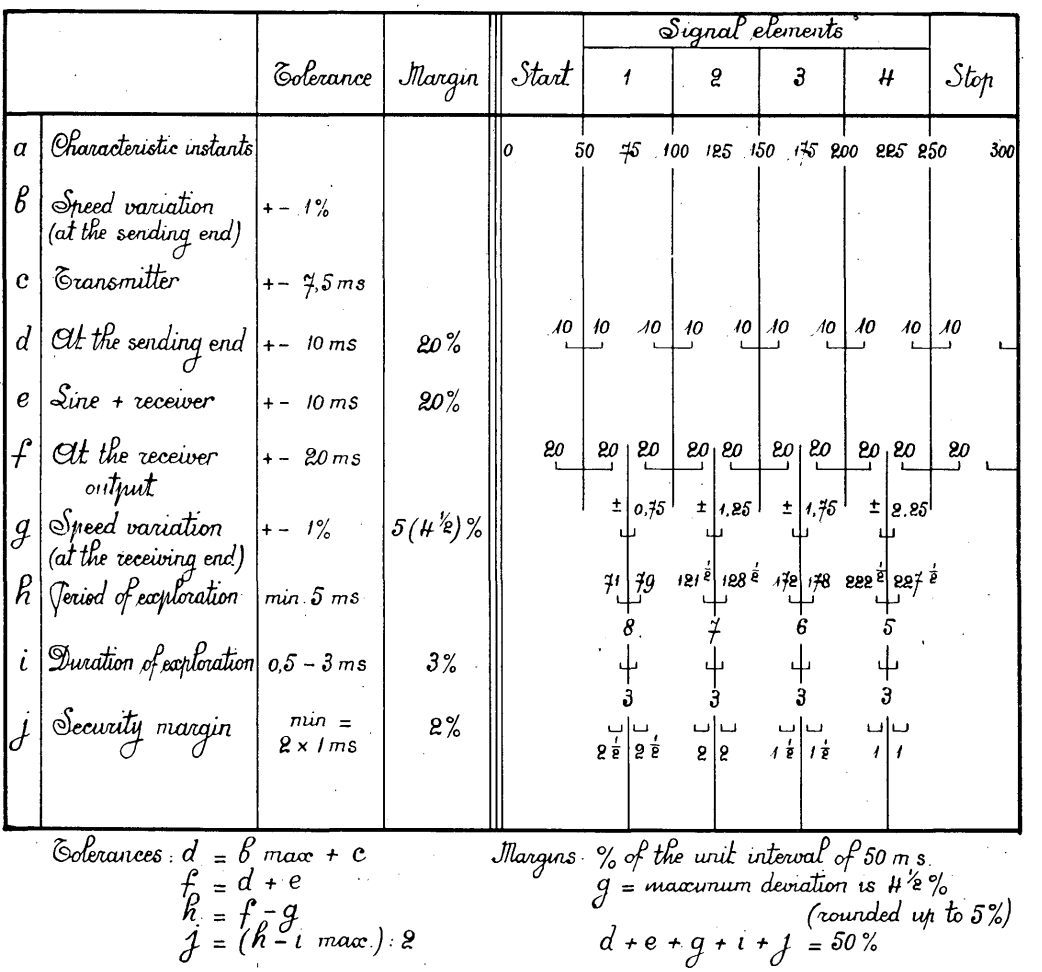
Arythmic Code Signals of the 1.V.F. System

Valeur arithmétique des relais marqueurs excités Arithmetic value of the marking relays energised		8	4	2	1	
Caractère Figure	Start	Moments 1	2	3	4	Stop
1	—				—	
2	—			—		
3	—			—	—	
4	—		—			
5	—		—		—	
6	—		—	—		
7	—		—	—	—	
8	—	—				
9	—	—			—	
Figure 0 (10)	—	—		—		
Call operator code 11 (11)	—	—		—	—	
Call operator code 12 (12)	—	—	—			
Spare code (except for the case foreseen in 1.2.2.) (13)	—	—	—		—	
Spare code (14)	—	—	—	—		
End-of-pulsing (15)	—	—	—	—	—	
Spare code (16)	—					
	0	50	100	150	200	250 300
	Milliseconds					Milliseconds

Note — The relationship between digits transmitted and the different combinations of the arythmic code is effected by attributing the value of 8, 4, 2 or 1 to the presence of a positive signal element depending on the moment No. 1, 2, 3 or 4 of the signal at which it is found.

FIGURE 2

Diagram of tolerances for the arythmic code



Notes. — 1) The value indicated under *e* as the maximum distortion caused by the line and receiver together must be considered as a reasonably satisfactory indication, and not as the maximum value which may be observed under the most unfavourable circumstances.

2) The time base at the incoming end must be considered as likely to make a new start 279.5 ms after a preceding start. The time available for the preparation of the time base is therefore between the instants 270 and 279.5 ms, that is 9.5 m.s.

CHAPTER V

Two-frequency system

5.1. Transmission of signals to line

5.1.1. *Signalling frequencies*

The signalling frequencies shall be:

2040 $\pm$ 6 c/s ("x" frequency) and

2400 $\pm$ 6 c/s ("y" frequency), these frequencies being applied separately or in combination.

5.1.2. *Absolute level of power transmitted*

The absolute level of power of a signalling current non-modulated, at the point of zero relative level shall be -1 neper (-9 db) with a tolerance of ± 0.1 neper or ± 1 db.

The levels mentioned above are also applicable to each signalling frequency in the case of a signal element constituted by a combination of the two frequencies (compound signal element) but the two signalling frequencies constituting such a signal must not differ in level by more than 0.05 neper or 0.5 db.

5.2. Signal-receiver Specification

5.2.1. *Operating limits of the signal receiver*

The signal receiver must meet the conditions specified under 5.2.5 for signalling currents received which satisfy the following three conditions.

(a) The frequencies of the signalling currents shall be within the limits

"x" frequency: 2040 $\pm$ 15 c/s

"y" frequency: 2400 $\pm$ 15 c/s

(b) The absolute level of power N of each received signalling current shall be within the limits

$$-2 + n \leqslant N \leqslant n \text{ nepers}$$

or

$$-18 + n \leqslant N \leqslant n \text{ decibels}$$

where n represents the relative level of power at the entry to the signal receiver.

These limits represent a margin of ± 1 neper (± 9 db) with reference to the nominal absolute level of each signalling current received at the entry to the signal receiver.

(c) The absolute level of the two signalling currents non-modulated may differ from each other, but the 2400 c/s signalling current shall not be received at a level more than 0.35 neper (3 db) above or more than 0.7 neper (6 db) below that of the 2040 c/s signalling current.

The tolerances defined in paragraphs *(a)*, *(b)* and *(c)* above take into account the variations at the sending source and the variations which can arise in the line transmission.

5.2.2. *Non-operating conditions of the signal receiver*

(a) *Selectivity*

The signal receiver shall not operate to a signal of which the absolute level of power at the receiving end is within the limits of level specified in paragraph 5.2.1 but of which the frequency differs by more than 150 c/s from the nominal value of 2040 c/s or of 2400 c/s.

(b) *Maximum sensitivity of signal receivers*

The signal receiver shall not operate under the action of a signal the frequency of which is within the limits 2040 $\pm$ 15 c/s or 2400 $\pm$ 15 c/s but of which the absolute level of power at the point of the circuit at which the receiver is connected is $(-3-1+n)$ nepers or $(-26-9+n)$ db, "n" being the relative level of power at this point.

This limit is 3 nepers (or 26 db) below the nominal absolute level of the signalling current at the entry to the signal receiver.

5.2.3. *Efficiency of the guard circuit*

The signal receiver shall be protected by a guard circuit against false operation due to voice currents, circuit noise or any other currents of different origins circulating on the line.

The purpose of the guard circuit is to avoid:

(a) signal imitations. (Signals are imitated if the durations of the resulting direct current pulses at the output of the signal receiver are long enough to be recognised as signals by the switching equipment),

(b) the operation of the splitting arrangements which can impair speech.

As an indication, the efficiency of the guard circuit should be such that:

(a) normal speech currents do not provoke on the average more than 1.0 simultaneous operations of the receiver relays, corresponding to each of the two signalling frequencies, of a duration greater than 55 ms, per 10 hours of conversation (the minimum recognition time of a compound signal element is 60 milliseconds),

(b) the number of false splits of the speech path caused by voice currents should not result in an appreciable impairment of the quality of transmission on the circuit.

5.2.4. *Limits relating to the guard circuit*

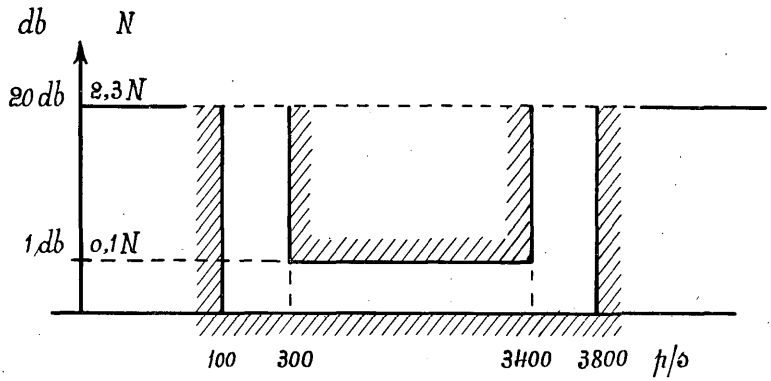
A. *Steady noise*

Considering,

(a) that when there is noise on a telephone circuit a too sensitive guard circuit can give rise to signalling difficulties and, in particular, inhibit the response of the signal receiver,

(b) that a psophometric e.m.f. of 2 millivolts measured at the relative level point −0.8 nepers (or −7 db) has been provisionally fixed as the maximum limit of circuit noise admissible in the case of one circuit and therefore a psophometric e.m.f. of 3 millivolts, for a chain of two interconnected circuits,

it is recommended that, with one or two signalling currents within the limits of level specified in paragraph 5.2.1, the signal receiver shall satisfy the conditions specified in paragraph 5.2.5 for the distortion of signals in the presence of a noise having a psophometric e.m.f. of a value of 3 millivolts at the relative level point −0.8 neper (or −7 db). The noise will be produced by a generator having a curve of uniform spectral energy followed by a filter having frequency attenuation characteristics within the limits indicated in the graph below.



B. *Surges*

Since a guard circuit with too long hangover time may cause difficulty in receiving a signal when, for example, surges have immediately preceded the signal, it is recommended that the following condition should be fulfilled:

If a disturbing current having a frequency corresponding to the maximum guard circuit sensitivity and an absolute power level of $-1.15 + n$ nepers (or $-10 + n$ db) at the relative level point n where the receiver is connected, ceases 30 ms before the application of a signalling current satisfying the limits defined in paragraph 5.2.1, the received duration of signals should not be affected beyond the limits specified in paragraph 5.2.5 which follows.

5.2.5. *Distortion of received signals*

The frequencies of the signalling currents and their levels being within the limits specified in paragraph 5.2.1, the following conditions should be fulfilled:

(1) the delay in the restitution of the start of a pulse constituted by one of the two signalling currents should be less than 20 ms,

(2) the distortion of signals in the presence of the noise defined in paragraph 5.2.4 should be less than:

(a) 5 ms — when the signal receiver receives an *isolated pulse of current of a single frequency* having a minimum duration of 25 ms.

(b) 8 ms — when the signal receiver receives a *compound pulse* of current of two frequencies and having a minimum duration of 50 ms.

(c) 6 ms — when the signal receiver receives a pulse of current of a *single frequency* having a minimum duration of 80 ms *preceded by a compound signal element* (separated or not by an interval of silence of 5 ms maximum). Consequently the distortion of a signal suffix, measured from the moment when the prefix ends to the moment when the suffix ends, and taking account of the distortion of the prefix signal mentioned under *(b)*, will be less than 6 + 8 = 14 ms.

5.3. Splitting arrangements

5.3.(1) To avoid line signals * of the international signalling system causing disturbances on national signalling systems, the international circuit should be split at outgoing and incoming international centres on the receipt of a compound signal in such a manner that any fraction of the combination of the two frequencies of a duration greater than 55 ms shall not pass out of the international circuit.

This splitting arrangement will also benefit the international signalling system, when speech conditions are set up, in preventing signals sent back from the GO path to the RETURN path via the termination at the receiving end, causing false signals at the centre from which the signal is transmitted.

The splitting time of 55 ms defined above may be reduced by interested Administrations or Private operating companies to facilitate the protection of their own national network against the effects of signals coming from the international circuit. It should be noted, however, that the adoption of a shorter splitting time can result in an increase of the number of false splits due to the action of voice currents, and so impair speech transmission.

5.3.(2) The split should be maintained for the duration of the signal, but should cease within 25 ms of the end of the direct current signal which caused the operation of the splitting device.

5.3.(3) The splitting of the line must not give rise to surges which can interfere with the signalling on the international circuit or with other signalling systems associated for the setting-up of an international call.

5.4. Code of signals

5.4.(1) The signals of the two-frequency system comprise:

(1) signals called " line signals " which serve to control the operations of connection and supervision,

(2) signals used for the transmission of numerical information: binary code signals for digits and acknowledgement signals.

5.4.(2) *Line signals*

5.4.2.(1) *Code of line signals*

The signal code for line signals is given in table 3.

* See the definition of " line signals " under 5.4.(1).

TABLE 3

Code of signals 2 V.F.

Line signals

N° de la liste Siot n°	Nom du signal / Name of signal	Système à 2F 2VF System
	SIGNAUX EN AVANT / FORWARD SIGNALS	
1	Prise / Seizure — a) terminale – terminal	PX
	Prise / Seizure — b) pour transit international – for international transit	PY
3	Signaux de numérotation – Numerical signals	Code binaire Binary code
4	Fin de numérotation – End of pulsing signal	Code binaire Binary code
9	Signal de fin – Clear forward	PXX
12	Signal d'intervention – Forward transfer	PYY
	SIGNAUX EN ARRIÈRE / BACKWARD SIGNALS	
2	Invitation à transmettre / Proceed to send — a) terminale – terminal	X
	Invitation à transmettre / Proceed to send — b) de transit international / international transit	Y
5	Numéro reçu – Number received	P
6	Occupation – Busy flash	PX
7	Réponse du demandé – Answer	PY
8	Raccrochage du demandé – Clear back	PX
10	Libération de garde – Release guard	PYY
11	Blocage – Blocking (*)	PX
–	(Déblocage) = utilisation du signal 10 – (Unblocking) = use of signal 10	PYY

* In addition to the blocking which is provoked by the reception of a Blocking signal at the outgoing end of a circuit, the outgoing equipment should be such that a *temporary* condition of " circuit busied " should result at the outgoing end on receiving, on a free circuit, one or other of the frequencies X or Y or both these frequencies. This condition should be maintained for as long as the frequency or frequencies are received. The maintenance instructions given to the maintenance staff should stipulate that such an occupation of a circuit should be of short duration

The existence of two frequencies in this code makes it possible to form a characteristic signal in which both frequencies are transmitted simultaneously and which can be used as a preparatory signal element (called prefix) to the control signal element (called suffix) having a single frequency.

The two-frequency signal prefix element is much less susceptible to be imitated by voice currents than a single-frequency element of the same duration and serves to prepare or sensitize a switching circuit for the reception of the suffix element which follows. The prefix signal element also serves to bring about the splitting of the line to prevent the remaining part of the signal passing out of the section in which it is intended to operate.

The symbols used in table 3 have the following significance:

Prefix signal element P prefix signal constituted by two frequencies x and y

control signal elements or " suffixes "
- X short signal element of the single frequency, x
- Y short signal element of the single frequency, y
- XX long signal element of the single frequency, x
- YY long signal element of the single frequency, y.

5.4.2.(2) *Sending duration of line signal elements*

The elements of each of the voice-frequency line signals which figure in table 3 shall have a duration of:

P	150 ± 30 ms
X and Y	100 ± 20 ms
XX and YY	350 ± 70 ms

(The durations of the signal elements P, X and Y, XX and YY are multiples of a pulse of a duration of 50 ms with a tolerance of $\pm$ 10 ms).

Once the sending of a signal has begun it must be sent completely. If it is necessary to send two signals one immediately following the other, it is essential that a silent interval should separate the emission of two successive signals in the same direction. The duration of this interval should not be less than 100 milliseconds but should not, however, be too long in order that signalling should not be slowed up unnecessarily.

The emission, by an incoming or transit centre, of the proceed-to-send or busy-flash signal should not take place until 50 ms following the end of the receipt of the corresponding seizure signal. Such a delay will normally result from the operation of equipment (operating times of relays, time of hunting for register).

On sending, there will be no intentional interval of silence between the prefix element and the suffix element of a signal but where such an interval exists its duration at the sending end must not exceed 5 ms.

It can happen, when sending the P prefix element, that the two frequencies will not be sent simultaneously. The interval of time between the moments when each of the two frequencies is sent must not, in this case, exceed 1 ms. In the same way, if the suffix element does not immediately follow the prefix but an interval of silence precedes the suffix as explained in the paragraph above, the interval of time between the two instants when the sending of each of the two frequencies ceases shall not exceed 1 ms.

5.4.2.(3) *Recognition time of line signal elements received*

At the output of the signal receiver, the durations of the direct current signal elements corresponding to line signals are determined in terms of the durations of the voice frequency signals elements and the distortions due to the line and signal receiver.

This overall distortion due to the line and the signal receiver is considered to be 10 ms maximum for a prefix-signal element and 15 ms for a suffix signal element. (The distortion of the suffix-signal element may be greater than that of the prefix signal element because it depends not only on the distortion of the pulse consisting of a single frequency which is sent as a suffix element, but also on the moment when the other frequency used for the prefix element ceases).

The incoming switching equipment should only recognise a signal after a certain time, called " recognition time ", has elapsed following the commencement of the receipt of the direct current signal, so as to reduce the risk of recognising false signals and to discriminate between signals elements of different lengths.

The duration of the recognition times of line signal elements shall be:

P:	80 ± 20 ms
X and *Y*:	40 ± 10 ms
XX and *YY*:	200 ± 40 ms.

The incoming switching equipment shall be able to recognise a signal correctly when the prefix and the suffix of this signal are separated by an interval of silence of a duration less than or equal to 15 ms.

5.4.3. *Numerical signals*

5.4.3.(1) *Numerical binary signal code*

The numerical signal code is given in table 4. This code is a binary code of 4 elements separated each from the next by an interval of silence; each element consisting of the emission of one or other of the signalling frequencies.

The symbols used in table 4 have the following significance:

x short element of the single frequency *x*
y short element of the single frequency *y*
s short element of silence

5.4.3.(2) *Sending duration of the signal elements x and y*

The sending duration of the signal elements *x* and *y* to line, as voice frequency signals, shall be:

$$35 \pm 7 \text{ ms.}$$

The sending duration of the interval of silence *s* between signal elements of the same digit shall have the same value of 35 ± 7 ms.

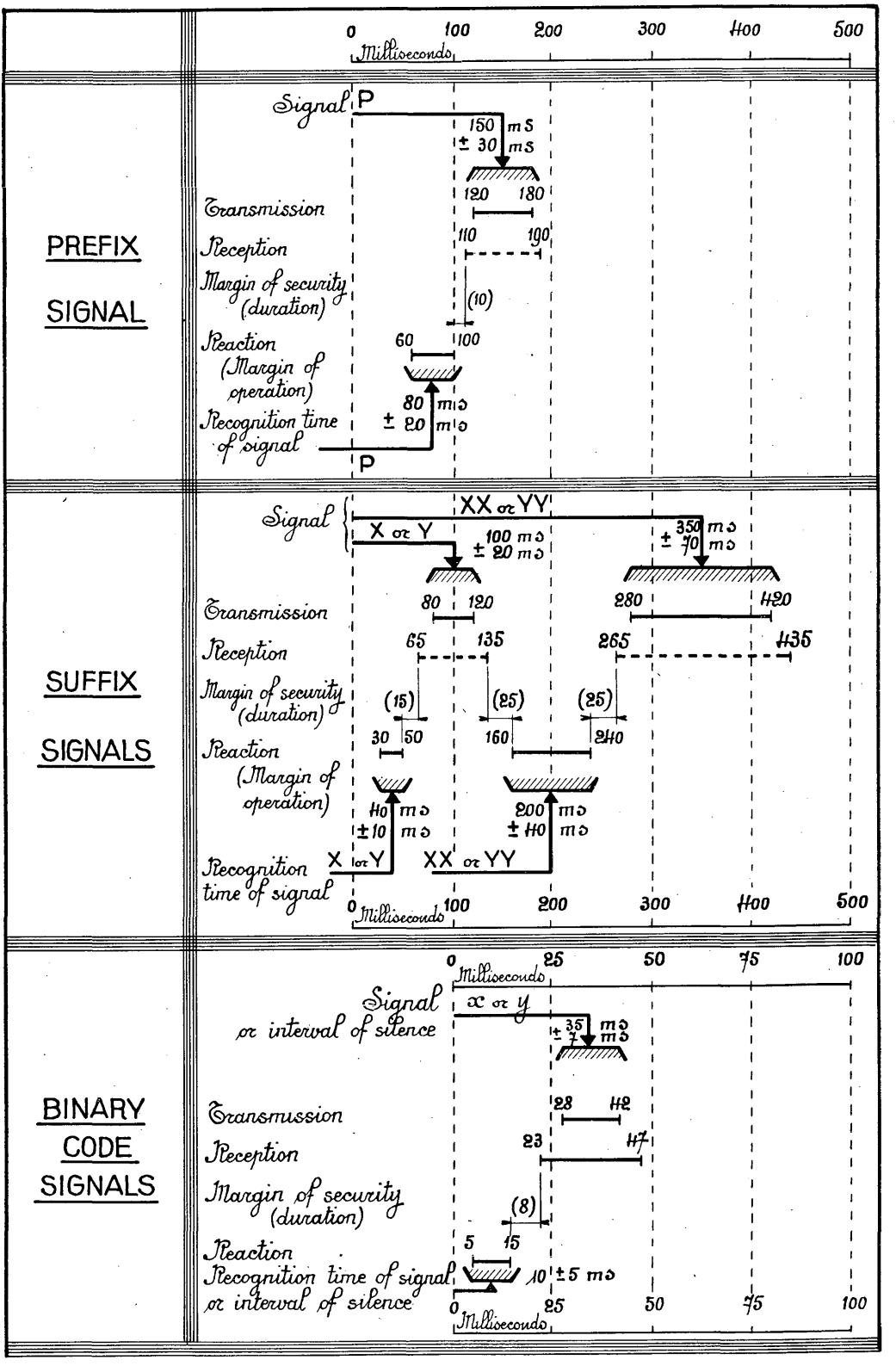
(The maximum duration of the signal elements and intervals of silence is not a critical factor in the conception of the system but is specified in order that the speed of signalling shall not be unduly slow).

2 VF System

Figures 3 and 4 — Duration of signal elements 2 V.F. system

FIGURE 3 — *(Prefix signal and suffix signal).*

FIGURE 4 — *(Binary-code signals).*



5.4.3.(3) *Duration of the recognition time of the x and y elements received*

The duration of the recognition time by the incoming switching equipment:

(a) of the direct-current signal elements x and y,

(b) of intervals of silence s

which are received at the output of the signal received shall be:

$$10 \pm 5 \text{ ms}$$

5.4.3.(4) *Acknowledgement signals*

Incoming and transit international centres shall return an acknowledgement signal to the outgoing international centre *at the end of the reception* of the 4th element of a numerical signal.

The acknowledgement signal returned by an incoming international terminal centre (terminal acknowledgement) shall be constituted by the signal element x defined above.

The acknowledgement signal returned by an international transit centre (transit acknowledgement) shall be constituted by the signal element y defined above.

At the outgoing international centre a numerical signal will only be sent if a signal is received from the incoming end acknowledging the receipt of the preceding numerical signal. However, to avoid this procedure delaying the transmission of numerical signals, the sending of numerical signals may begin as soon as the acknowledgement signal x or y *is recognized.*

5.4.4. *Signalling timing diagrams*

The diagrams shown in figures 3 and 4 indicate for line signal elements (figure 3) and for numerical signal elements x and y (figure 4):

(a) the sending duration (sent as voice frequency signals on the line);

(b) the received duration (received as direct current signals at the output of the signal receiver);

(c) the margins of security which have been planned to take account of drift in the adjustment of the equipment, etc. ...

(d) the recognition times (margin of operation of the incoming switching equipment; this margin is defined between two limits of duration; a lower limit t and an upper limit T. The switching equipment shall *not* recognise a signal element *before* t but must *certainly* have recognised it *at the end of time* T).

5.4.5. *General remark on the subject of the operation of the signalling and switching equipment*

It is to be understood that the tolerances defined in sections 5.4.2 and 5.4.3 above concerning the duration of sent signals and the duration of the recognition times at the receiving end should be rigorously observed whatever the circumstances may be and in particular whatever voltage variations may arise in sources of power supplies under service conditions.

TABLE 4

Binary Code 2 V.F. system

Figure		Combination			
	1	y	y	y	x
	2	y	y	x	y
	3	y	y	x	x
	4	y	x	y	y
	5	y	x	y	x
	6	y	x	x	y
	7	y	x	x	x
	8	x	y	y	y
	9	x	y	y	x
Digit 0	(10)	x	y	x	y
Call operator code 11	(11)	x	y	x	x
Call operator code 12	(12)	x	x	y	y
Spare code (except in the case envisaged under 1.2.2.)	(13)	x	x	y	x
Spare code	(14)	x	x	x	y
End-of-pulsing	(15)	x	x	x	x
Spare code	(16)	y	y	y	y

The relation between the transmitted digit and the different combinations of the binary code is made by attributing to the presence of an element *X* the value 8, 4, 2 or 1 depending on whether this element *X* constitutes the 1st, 2nd, 3rd or 4th element of the numerical code.

CHAPTER VI

ALARMS AND ARRANGEMENTS TO BE MADE IN THE CASE OF FAILURES EXPERIENCED IN THE SWITCHING OF A CALL

6.1. Indication given to outgoing operator

As a general rule when an abnormal condition has been recognised in the establishment of call, the outgoing operator should receive an appropriate indication of the fact so that she will know that it is necessary to make a new attempt to establish the call.

The tables constituting Annex 5 indicate in a detailed manner the signals which are received at the outgoing centre in the case of abnormal conditions in the establishment of the call. Each Administration will itself define in what manner these signals must be translated into appropriate indications for outgoing operators.

6.2. Alarms given to the technical personnel and arrangements to be made in case of faults. General arrangements

6.2.(1) As a general rule when an abnormal condition is recognised which may be due to a fault, an alarm indicating this condition must be given and, if possible, initiate any other operation which avoids circuits being placed out of service unnecessarily and which facilitates tracing of faults.

6.2.(2) The alarm and fault indication arrangements specified for such items as blown fuses, disconnected heat coils, failures of power supplies or signalling currents, etc. will be those normally adopted by Administrations (these arrangements depend, of course, on specifications particular to each Administration).

6.2.(3) The occupation of each item of equipment such as line circuit equipment, link circuit, operators' calling equipment, selectors, registers, etc. can be indicated by the lighting of a lamp placed in close proximity to the equipment concerned.

6.2.(4) Arrangements may be made permitting the progress of a call to be followed, in particular the sending or reception of digits or successive numerical codes. In this respect, each Administration will decide the arrangements it desires to install, taking account of the practice which it normally follows in this matter.

6.3. Particular arrangements to be provided in the case of signalling failures

6.3.1. *Blocking of an outgoing circuit*

Installations should provide the following facilities for blocking outgoing circuits. These facilities will be used or not according to the maintenance instruction which will be promulgated.

6.3.1.(1) If after sending a seizing signal, a proceed-to-send signal or a busy-flash signal is not received within 10 to 30 seconds the outgoing circuit should be blocked and an alarm given.

6.3.1.(2) In the two-frequency system, the outgoing circuit will be blocked, and an alarm will be given if a proceed-to-send signal or a busy-flash signal is not received within 15 to 30 seconds of the sending of the international code to a transit centre.

6.3.1.(3) If after sending a clear-forward signal, a release-guard signal is not received within 5 to 10 seconds, the outgoing end of the circuit shall be blocked and an alarm given. At the incoming end of the circuit the clear-forward signal should be recognised at any time even if the circuit is in the idle state; the incoming line circuit must therefore be able to recognise a clear-forward signal and to return a release-guard signal even if the clear-forward signal has not been preceded by a seizing signal.

6.3.2. *Non-receipt of a clear-forward signal at the incoming centre after sending a clear-back signal*

If after sending of a clear-back signal a clear-forward signal is not received within 2 to 3 minutes, steps should be taken in the incoming circuits at the incoming international terminal exchange to release the national part of the connection (if a similar arrangement is not already made in the national network of the incoming country). This arrangement avoids, in the case of interruptions of the line or equipment faults, the national circuits of the country of destination or the subscriber's line remaining blocked indefinitely.

6.3.3. *Non-receipt at an outgoing centre of an answer signal following the receipt of a number-received signal*

It may be advisable to consider, in view of full automatic working, the possibility of releasing the international connection at the outgoing international terminal exchange if the reception of a number-received signal is not followed by the reception of an answer signal after a certain delay.

In semi-automatic operation, it is desirable that the possible release of the national part of the connection in the incoming country in the case of the absence of an answer signal, should only arise after a delay sufficient to avoid any difficulty in the case of special services (absent-subscriber's service, for example).

6.3.4. *Abnormal recognition of a release-guard signal at a transit centre*

In the case where a release-guard signal is recognised at a transit centre without a clear-forward signal having been recognised, arrangements should be made at the transit centre to:

— send, in the backward direction, a blocking signal to busy the outgoing end of the incoming circuit at the transit centre,

— release, immediately, the outgoing circuit from the transit centre.

With these arrangements, it can be avoided that, at the outgoing centre, the reception of a release-guard signal gives a wrong indication of the effective release of the transit equipment.

6.4. **Maximum duration of a blocking signal**

When a blocking signal is sent on a circuit, an alarm should be given at the outgoing end of the circuit if the blocking condition persists for a period of time greater than about 5 minutes.

CHAPTER VII

TESTING ARRANGEMENTS

7.1. Access points planned for testing

7.1.(1) It will be convenient from a maintenance point of view to distinguish between three clearly defined sections.

(a) The *international line*: telephone transmission system situated between the test racks of two terminal repeater stations.

(b) The *international circuit*: the whole of the international telephone line together with the outgoing and incoming equipment proper to the line.

(c) The *automatic switching equipment*: part of the international centre concerned with switching the call in the desired direction.

7.1.(2) Access points must be foreseen for testing:—

— the international line,
— the associated outgoing and incoming equipment proper to this line,
— the switching equipment.

It must be possible to test the telephone line, the outgoing equipment and the incoming equipment separately or in combination one with the other.

It must be possible to test the incoming and outgoing equipment in combination with the switching equipment of the centre concerned. Each access point must permit tests to be made in parallel with the speech wires, and possibly with the signalling wires, without disconnection.

7.1.(3) An equipment permitting observations to be made of all the signals exchanged on the international circuits and which can be connected via the parallel access points mentioned above should be provided for international centres equipped for automatic switching.

7.1.(4) The following arrangements should be made on these access points:

— the occupation of a circuit will be marked by a visible indication situated in close proximity to the access points of the circuit,
— when a circuit is taken at an access point this circuit will be rendered unaccessible to selectors and will be marked engaged on the outgoing operator's positions,
— when an incoming circuit is taken at a breakjack a blocking signal must be sent to the corresponding outgoing centre.

7.2. Systematic testing arrangements of items of equipment (local maintenance)

7.2.(1) Arrangements for the systematic testing of individual items of equipment must be made in each international centre equipped for automatic switching: circuit equipment, connecting circuits, operator's line calling equipment, selectors, registers, etc. The testing arrangements will be planned in accordance with the practice followed in each country for the local maintenance of the switching equipment.

7.2.(2) The following principles must be respected by testing arrangements:

(a) A piece of apparatus must not be taken for test until it is free; a signal could indicate to the personnel that a piece of apparatus has not been taken for test because it is engaged on a call; it will then be possible to test this piece of apparatus later.

(b) A piece of apparatus taken for test will be marked engaged for the duration of the test. When an incoming circuit equipment is taken for test a blocking signal should be sent to the outgoing centre (see 6.4.).

7.3. Rapid testing arrangements

7.3.1. *Principles of the rapid transmission testing methods.*

Two methods can be adopted for effecting rapid transmission tests:—

(a) the first method consists of making a loop measurement of the GO and RETURN channels of an international circuit, these channels being connected together when the circuit is idle.

(b) the second method consists of extending the circuit to an automatic transmission testing equipment situated at the incoming international terminal centre, by means of a special code.

The first method necessitates the provision of the arrangements described later in paragraph 7.3.2. at the incoming end of all circuits.

The second method assumes the existence of rapid transmission testing apparatus in all centres between which this method is used. This testing apparatus, which can be used irrespective of the type of signalling system employed, must be designed in accordance with the arrangements mentioned in paragraph 7.3.3. which follows.

Note. — The first method effects an overall test of the transmission on the GO and RETURN channels without being able to differentiate between the conditions of each of the two directions of transmission. The second method permits separate tests of the quality of transmission in the two directions. (A situation can occur, however, when it is not possible to determine whether a transmission fault is situated on the GO channel or on the RETURN channel of the circuit).

Since access to the incoming testing apparatus requires, in the case of the second method, an exchange of signals over the circuit, a checking of good signalling conditions is realized to some extent.

7.3.2. *First method—Loop transmission measurements*

A permanent loop will be established between the GO and RETURN channels of an international circuit at its incoming end when the circuit is in the idle condition in order that transmission tests can be made independently of the signalling contitions.

The loop between the GO and RETURN channels shall be established in such a manner that the hypsogrammes of each of the two channels will be respected when the circuit is in the idle conditions (loop established); the loop may therefore include an attenuation pad of a value calculated to meet this demand.

The disconnection of the loop at the incoming end of the international circuit is effected on receipt of a seizing signal. The loop must be disconnected within 35 ms so as to guarantee that the part of a seizing signal which passes round the loop and which is returned to the outgoing end cannot be recognised as a signal.

7.3.3. *Second method — Automatic testing apparatus*

The second method for rapid transmission tests consists of extending the international circuit, by means of a special code, to an automatic testing apparatus at the incoming terminal centre. The application of the second method assumes the existence of the incoming testing apparatus at the incoming international centre and outgoing testing apparatus at the outgoing international centre. This apparatus should be designed on an *experimental basis* according to the conditions described in the following.

7.3.3.(1) *Incoming testing apparatus*

(1) *Connection to the incoming testing apparatus*

The incoming testing apparatus will normally be situated on the 4-wire part of the circuit.

Access to this apparatus from the international centre will be obtained by sending successively on the international circuit:—

(a) code No. 13 replacing the language digit (see 1.2.2.),

(b) code No. 12 followed by the two digits 00,

(c) end-of-pulsing signal (code No. 15).

If the incoming testing apparatus is free, an answer signal will be returned when the connection is established.

If the incoming testing apparatus is occupied, a busy-flash signal and busy tone will be returned.

Note. — If the busy-flash signal is not returned, the tests cannot be carried out by automatical means only.

(2) *Measuring condition*

When the answer signal has been sent, the incoming testing apparatus will pass to the measuring condition in which condition the level of the test signal sent by the outgoing testing apparatus will be measured. The passage to the measuring condition will be effected 500 ms following the end of sending of the answer signal. This delay is necessary so that the noise which may be produced at the moment of the passage of the circuit to the speech conditions will not influence the measuring arrangement.

The measurement of the received signal will be effected with an accuracy of ± 0.1 nepers.

The incoming testing apparatus will determine whether the level of the test signal is within the prescribed limits; these limits will be predetermined by an adjustment of the apparatus to the specified values. These limits will correspond provisionally to a deviation of ± 4 db or ± 0.5 N with respect to the nominal level at which the test tone should be received.

(3) *Passage to the sending condition*

If the received test signal is within the prescribed limits (deviation of ± 4 db or 0.5 N from the nominal value) the incoming testing apparatus will send a test signal on the RETURN channel of the circuit.

This test signal will be of the same frequency 800 c/s as the test frequency sent on the GO channel of the circuit by the outgoing testing apparatus. The frequency sent should be controlled within ± 1%. The test signal sent by incoming testing apparatus will be at a level corresponding to a power of 1 milliwatt at the point of zero relative level of the circuit. The sending level must be maintained to ± 0.05 nepers.

(4) *Indication of unsatisfactory transmission on the* GO *channel of the circuit*

If the level of the received test signal is outside the prescribed limits or if that apparatus does not receive the test signal, a clear-back signal will be returned to the outgoing end. This clear-back signal will be sent after a 5 second interval and will indicate to the testing officer at the outgoing centre that the GO channel of the circuit has not the requisite quality for transmission.

7.3.3.(2) *Outgoing testing apparatus*

(1) *Connection to the incoming testing apparatus*

The outgoing testing apparatus will be designed to permit the sending of the code mentioned under (1) in paragraph 7.3.3.(1) above.

(2) *Sending condition*

The receipt of an answer signal, which will be returned by the incoming testing apparatus, will cause the sending of the test signal by the outgoing testing apparatus. This test signal will be sent for a duration between 500 and 800 ms. In order to make allowance for the time necessary for the incoming testing apparatus to pass into the measuring condition this sending should not follow immediately the receipt of the answer signal but should be delayed for a period of at least 500 ms after the receipt of this signal.

The test signal will be sent automatically or under the control of the officer making the tests. If the test signal is sent automatically the delay in sending the test signal following the receipt of the answer signal should be between 500 and 800 ms. If the test signal is sent under the control of the operator the latter should operate quickly taking account of the fact that the clear-back signal can be returned by the incoming testing apparatus after a delay of 5 seconds.

The test signal will be at a frequency of 800 c/s ± 1%.

The level of the sent test signal will be regulated to correspond to a power of 1 milliwatt at the point of zero relative level of the circuit. Its frequency will be defined to accuracy of ± 0.05 nepers.

(3) *Passage to the measuring condition*

As soon as the outgoing testing apparatus has sent the test signal, it will pass automatically from the sending condition to the measuring condition. In this condition, the level measuring apparatus will measure the level of the test signal received from the incoming end. The operator or the automatic apparatus at the outgoing end will verify whether the level of the received signal is within the prescribed limits.

7.4. Apparatus for the verification of the functioning of equipments and the measurement of signals

7.4.1. *General*

To be able to verify (in principle locally) that the equipment functions correctly and possibly to be able to readjust the equipment, the international centres should have available apparatus of the two following types:

(a) calibrated signal generator

(b) signal measuring apparatus.

These apparatus should conform to the following characteristics.

7.4.2. *Calibrated signals generator*

— *Duration* of sent signals: may vary between the extreme limits catered for in the equipment Specifications, should therefore be:

1-frequency system: 25 to 800 ms.
2-frequency system: 3 to 500 ms.

Accuracy demanded on the duration of sent signals:

(a) signal generator for the 1-frequency system:

— line signals:

accuracy is set by the higher of the two following values: 1 ms error or ± 1 % of the nominal value of the sent signal.

— numerical signals:

accuracy equal to ± 0.4 % of the length of arythmic code signals.

(b) signal generator for the 2-frequency system:

accuracy is set by the higher of the two following values: 1 ms error or ± 1% of the nominal value of the sent signal.

— *Frequency* or frequencies of the sent signal: equal to the nominal value of the signalling frequency or frequencies. The sent frequency shall not differ by more than ±5 c/s of its nominal value and shall not vary during the time required for testing.

— *Level* of the sent signal(s): variable between the extreme limits set by the equipment Specifications and must be able to be set to a particular fixed value equal to the nominal value as determined in these Specifications.

Tolerances on the reading of the level of the sent signalling frequencies: ±0.2 db or ±0.02 nepers.

7.4.3. *Signals measuring apparatus*

— Duration of signals to be measured, which are between the extreme limits set by the equipment Specifications, may then be:

1-frequency system: 25 to 800 ms.
2-frequency system: 3 to 500 ms.

Accuracy demanded on the duration of the measured signals:

(a) apparatus for the 1-frequency system:

— line signals:

the accuracy is set by the higher of the two following values: 1 ms error or $\pm$ 1% of the nominal value of the received signal,

— numerical signals:

accuracy equal to $\pm$ 1% of the length of the arythmic code signals.

(b) apparatus for the two-frequency system:

accuracy is set by the higher of the two following values: 1 ms error or $\pm$ 1% of the nominal value of the received signal.

— Signal frequency or frequencies to be measured: will be between the extreme limits set by the Specifications, the reading being made with an accuracy of $\pm$ 1 c/s.

— Level of the signalling frequency or frequencies to be measured: variable between the extreme limits set by the Specifications, the reading being made with an accuracy of $\pm$ 0.2 db or 0.02 neper.

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Transit centre

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ANNEX 1

Numerical list of international codes

20	Poland
21	Algeria
22	Belgium
23	Austria
24	—
25	Finland
26	Arabia
27	Cyprus
28	Bulgaria
29	Gibraltar
30	Greece
31	Egypt
32	—
33	France
34	Israel
35	Hungary
36	Turkey
37	Lebanon
38	Norway
39	Italy
40	Libya
41	Jordan
42	Portugal
43	Malta
44	United Kingdom of Great Britain and Northern Ireland
45	—
46	Sweden
47	Rcumania
48	Morccco (French protectorate)
49	Germany
50	Spain
51	Morocco (Spanish zone)
52	Ireland
53	—
54	Syria
55	Netherlands
56	—
57	Czechoslovakia
58	—
59	Albania
60	Luxembourg
61	Denmark
62	Tunisia
63	Yugoslavia
64	Iceland
65	—
66	Switzerland
67	—
68 … 79	USSR (European republics)
80 … 89	*Spare* code (in addition to codes 24, 32, 45, 53, 56, 58, 65, 67)
90 … 99	*Intercontinental traffic*
00 … 19	*Special codes*

ANNEX 2

List of international codes on a geographical basis

I. *Western Europe*

Belgium	22
Luxembourg	60
France	33
United Kingdom of Great Britain and Northern Ireland	44
Ireland	52
Spain	50
Portugal	42
Gibraltar	29

II. *Northern Europe*

Denmark	61
Finland	25
Norway	38
Netherlands	55
Sweden	46
Iceland	64

III. *Central Europe*

Austria	23
Hungary	35
Italy	39
Germany	49
Switzerland	66
Czechoslovakia	57
Poland	20

IV. *Eastern and Balkanic Europe*

Albania	59
Bulgaria	28
Greece	30
Roumania	47
Yugoslavia	63
Turkey	36
USSR (European republics)	68, 69, 70 to 79

V *Mediterranean Basin Europe*

Algeria	21
Arabia	26
Cyprus	27
Egypt	31
Israel	34
Jordan	41
Lebanon	37
Libya	40
Malta	43
Morocco (French protectorate)	48
Morocco (Spanish zone)	51
Syria	54
Tunisia	62

VI. *Spare codes*

24, 32, 45, 53, 56, 58, 65, 67 and 80 to 89.

VII. *Intercontinental traffic*

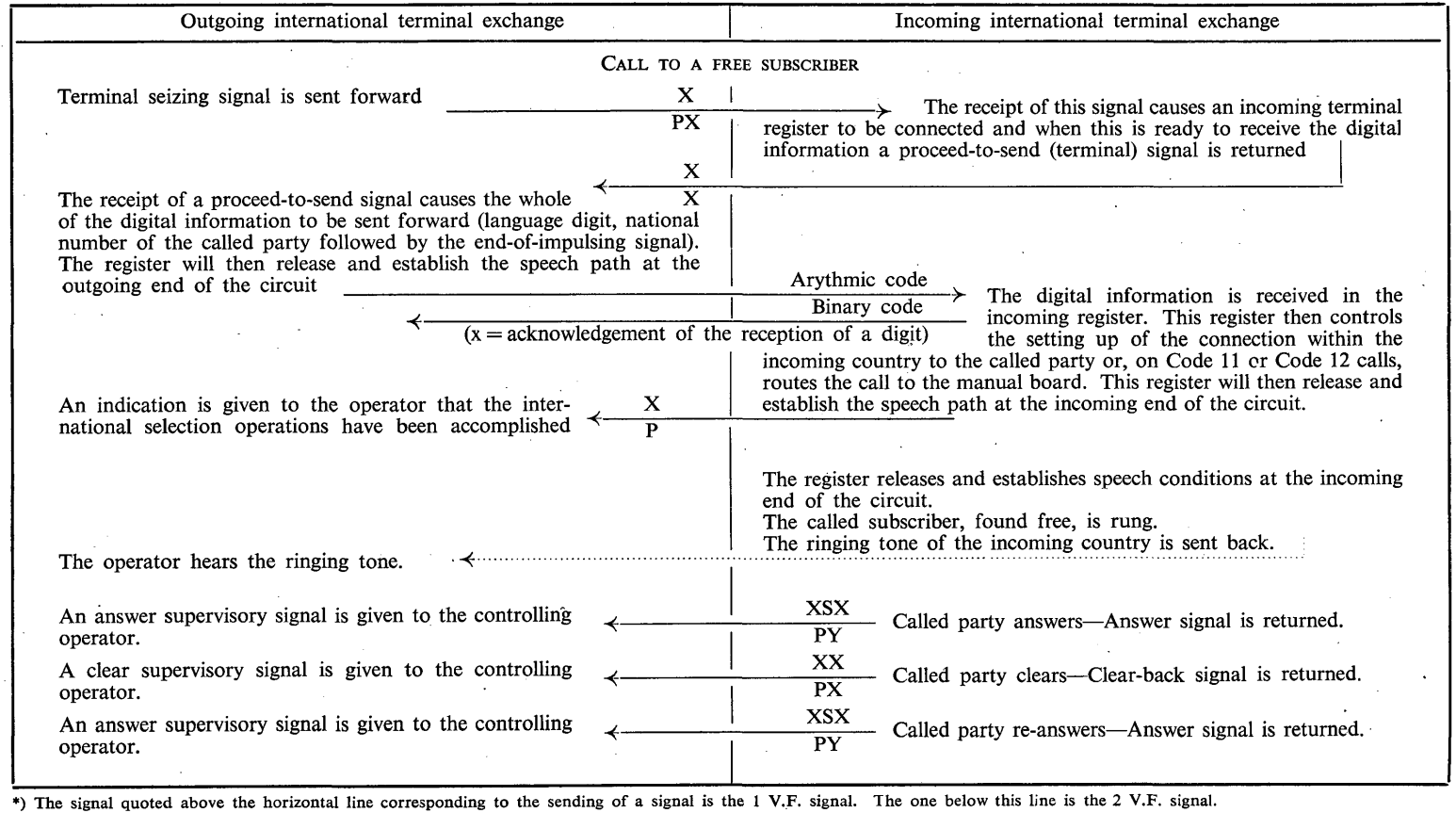
Codes of the series 90 to 99.

VIII. *Special codes*

Series 00 to 19

ANNEX 3

FIGURE. 1 — **Signalling sequences for direct semi-automatic operations using the 1 V.F. or 2 V.F. signalling systems *)**



*) The signal quoted above the horizontal line corresponding to the sending of a signal is the 1 V.F. signal. The one below this line is the 2 V.F. signal.

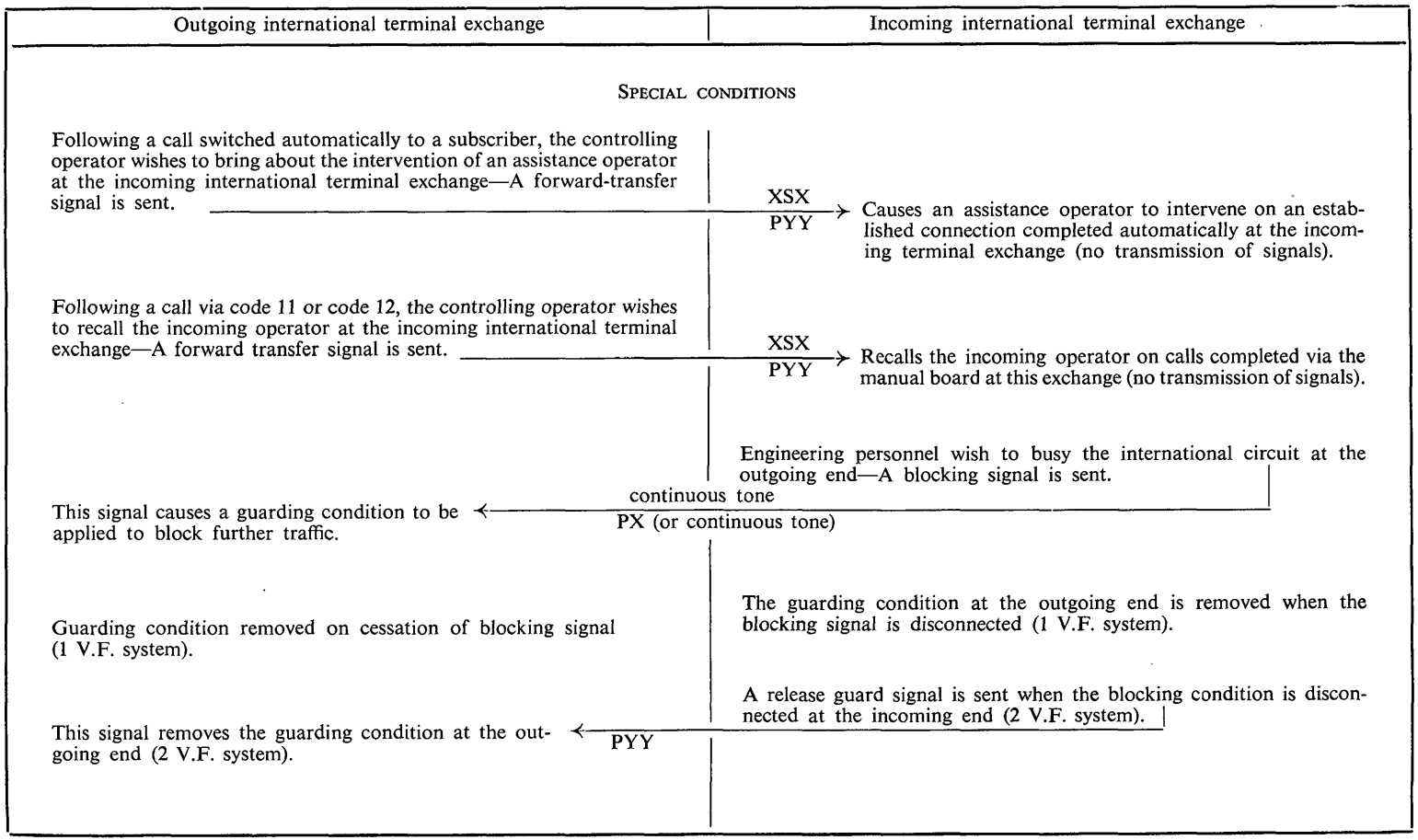
Outgoing international terminal exchange		Incoming international terminal exchange
Controlling operator clears down the connection. Clear-forward signal is sent	XXSXX → PXX	Releases the connection of the incoming exchange and when release is fully effective a release-guard signal is returned.
This signal removes the guard from the outgoing end and frees the circuit for further traffic.	← XXSXX PYY	

CALL TO A BUSY SUBSCRIBER

The succession of signals is the same as for a call to a free subscriber up to the point of sending the number-received signal.

		Transmission of the number-received signal and establishment of speech conditions at the incoming end.
An indication can be given to the outgoing operator that the international selection operations have been completed.	← X P	
		1st case. — *The national network of the incoming country can give the busy flash signal.* The national busy-flash signal is detected by the international incoming equipment. The busy-flash signal is sent back.
A " busy " indication is given to the outgoing operator.	← XX PX	
The operator hears the busy tone. The outgoing operator releases the connection (see above).	←	The busy tone of the incoming country is sent back.
		2nd case. — *The national network of the incoming country cannot give the busy-flash signal.* The busy tone of the incoming country is sent back.
The operator hears the busy tone, *possibly with supervisory conditions indicating that national selection is taking place.* The operator releases the connection (see above).	←	

FIGURE 1 *(continued)*



Annex 3

FIGURE 2. — **Transit operation semi-automatic service using the single-frequency signalling system.**

Assuming an international circuit in the desired direction has been taken, an outgoing register has been associated with the circuit, the digital information has been keyed into this register and that an end-of sending signal has been received indicating that keying has been completed, the following signalling sequences will occur.

Outgoing international terminal exchange	International transit exchange	International transit exchange	Incoming international terminal exchange
	CALL TO A FREE SUBSCRIBER		
Transit seizing signal is sent forward XX →	Causes transit register to be connected. Proceed-to-send signal is returned		
Causes all the digital information to be sent forward ← X			
arythmic code →	Received in the transit register; a circuit in the desired direction is taken.		
(Country code, language digit, national number of the called party or Code 11 or Code 12, followed by the end-of-pulsing signal). The register then releases and the speech path is established at the outgoing end.	If an indirect route is taken a transit seizing signal is sent forward XX →	Causes transit register to be connected. Proceed-to-send signal is returned.	
	Causes all the digital information to be sent forward ← X		
	arythmic code →	Received in the transit register. A circuit in the desired direction is taken.	
	The transit register then releases and the speech path through the transit exchange is established.	If a direct route is taken a terminal seizing signal is sent forward X →	Causes a terminal register to be connected....

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FIGURE 2 *(continued)*

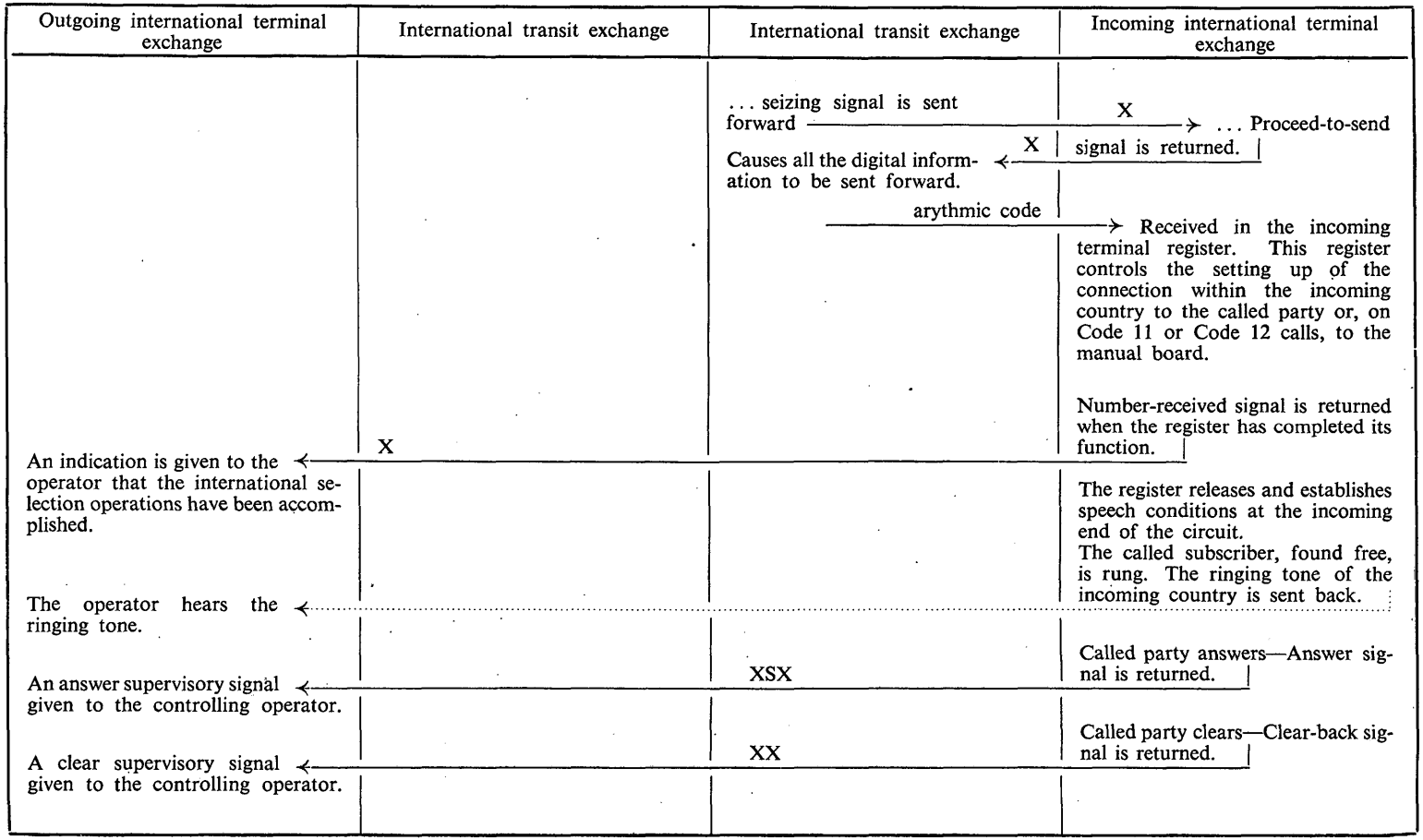
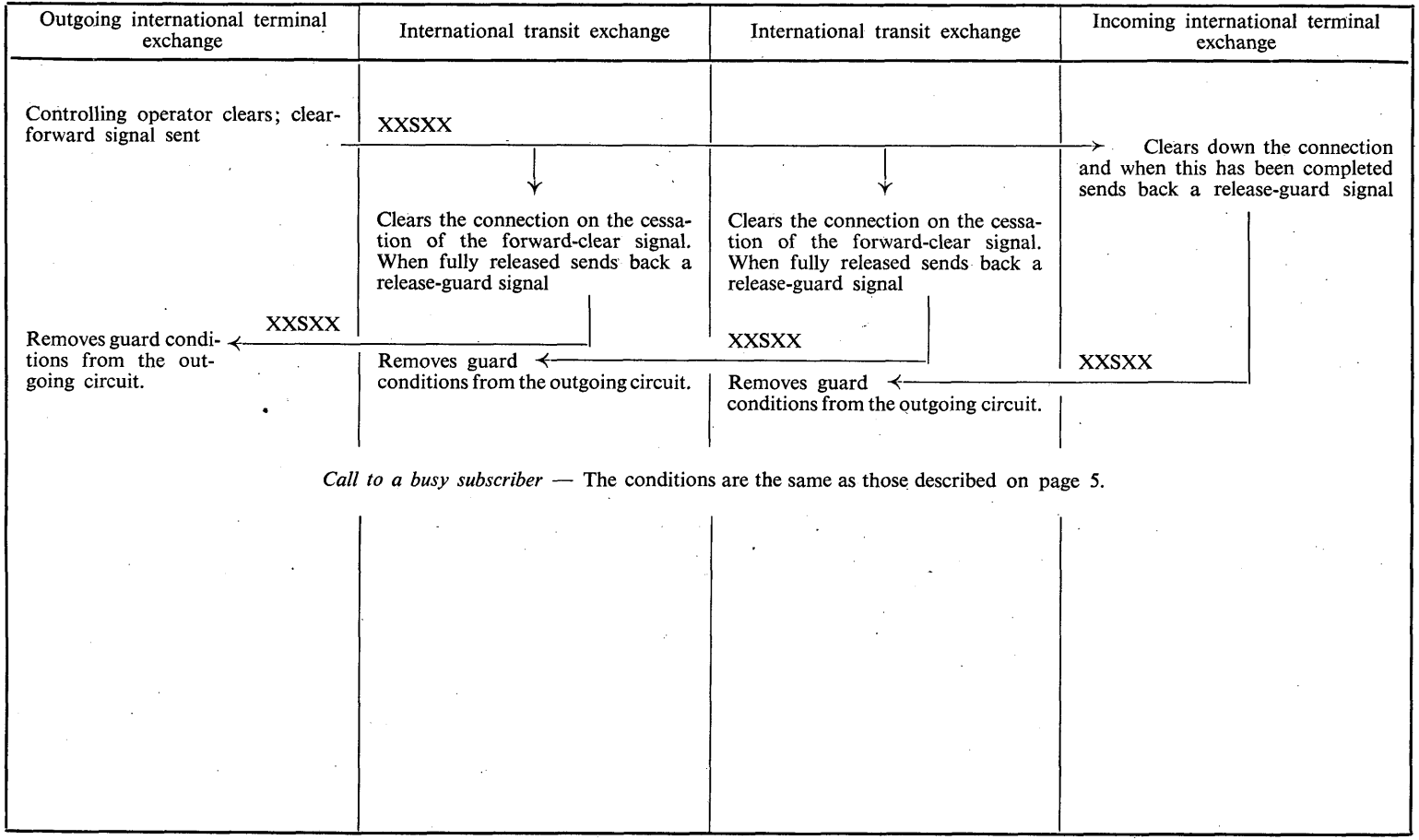
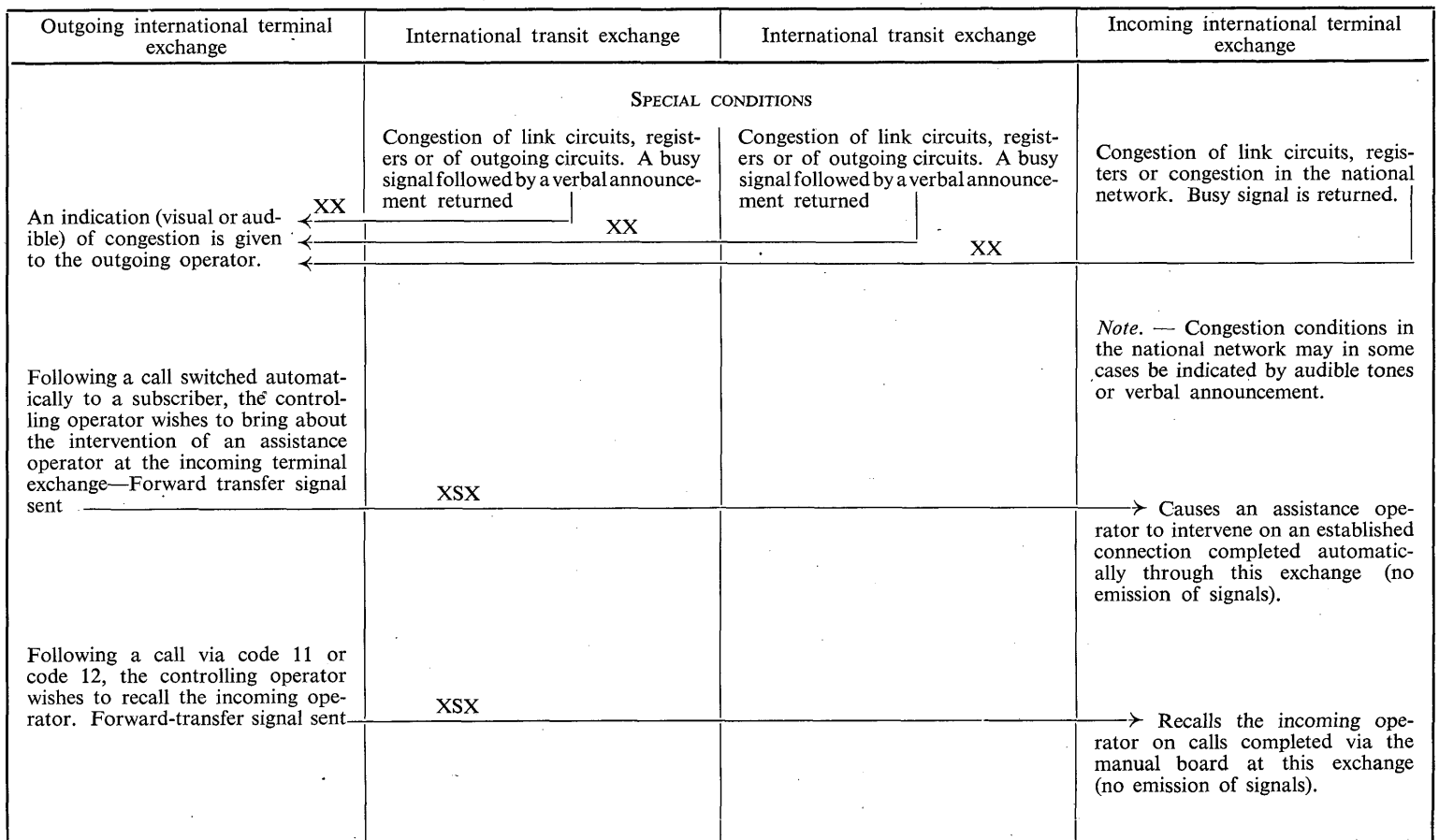


FIGURE 2 *(continued)*



Call to a busy subscriber — The conditions are the same as those described on page 5.

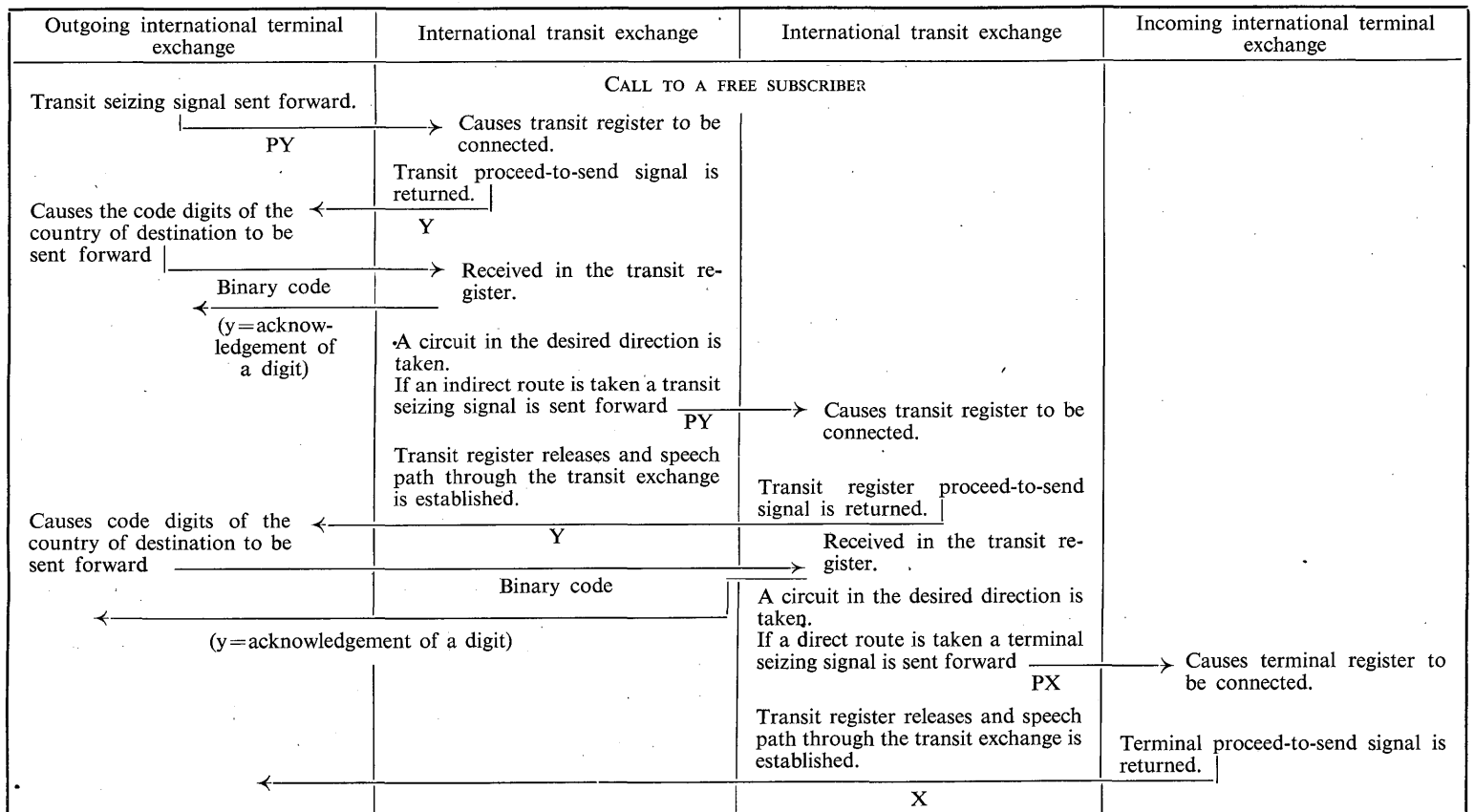
FIGURE 2 *(continued)*



Annex 3

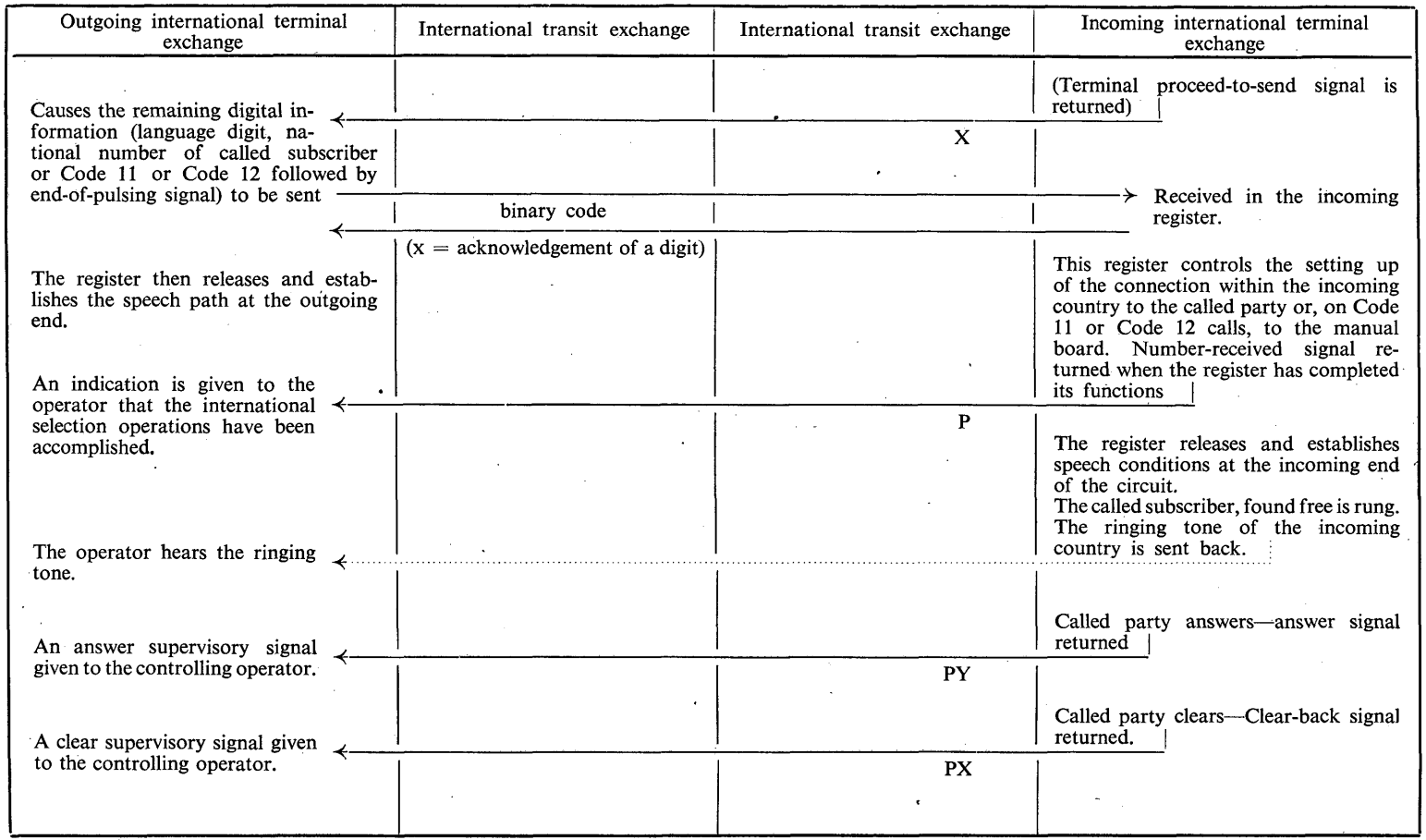
Figure 3 — Transit operation semi-automatic service using the two-frequency signalling system.

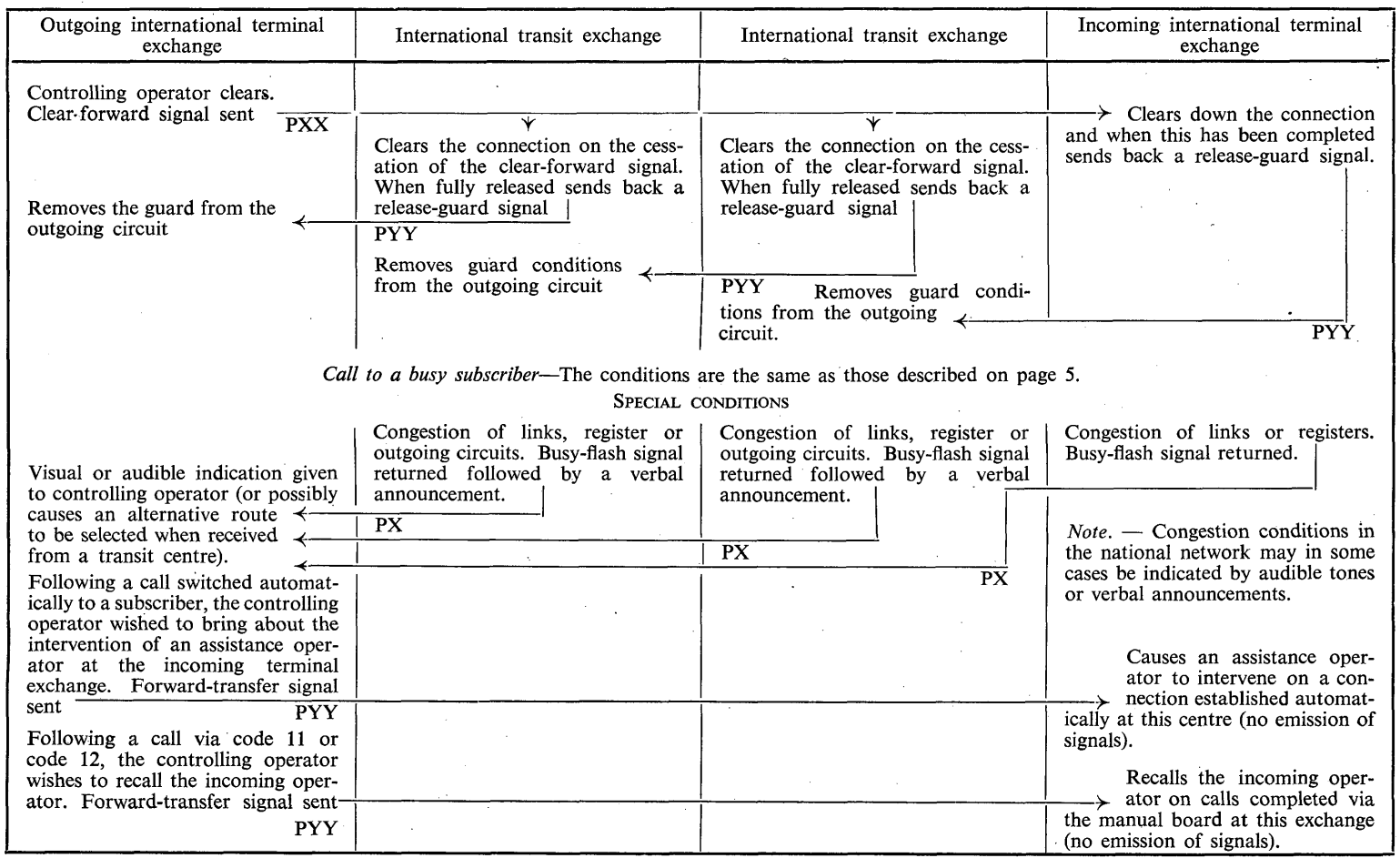
Assuming an international circuit in the desired direction has been taken, an outgoing register has been associated with the circuit, the digital information has been keyed into this register and that an end-of-sending signal has been received indicating that keying has been completed, the following signalling sequences will occur:



Assuming an international circuit in the desired direction has been taken, an outgoing register has been associated with the circuit, the digital information has been keyed into this register and that an end-of-sending signal has been received indicating that keying has been completed, the following signalling sequences will occur:

FIGURE 3 *(continued)*




Outgoing international terminal exchange
International transit exchange
International transit exchange
Incoming international terminal exchange
Controlling operator clears. Clear-forward signal sent
PXX
Clears the connection on the cessation of the clear-forward signal. When fully released sends back a release-guard signal
Clears the connection on the cessation of the clear-forward signal. When fully released sends back a release-guard signal
Clears down the connection and when this has been completed sends back a release-guard signal.
Removes the guard from the outgoing circuit
PYY
Removes guard conditions from the outgoing circuit
PYY
Removes guard conditions from the outgoing circuit.
PYY
Call to a busy subscriber—The conditions are the same as those described on page 5.
SPECIAL CONDITIONS
Congestion of links, register or outgoing circuits. Busy-flash signal returned followed by a verbal announcement.
Congestion of links, register or outgoing circuits. Busy-flash signal returned followed by a verbal announcement.
Congestion of links or registers. Busy-flash signal returned.
Visual or audible indication given to controlling operator (or possibly causes an alternative route to be selected when received from a transit centre).
PX
PX
PX
Note. — Congestion conditions in the national network may in some cases be indicated by audible tones or verbal announcements.
Following a call switched automatically to a subscriber, the controlling operator wished to bring about the intervention of an assistance operator at the incoming terminal exchange. Forward-transfer signal sent
PYY
Causes an assistance operator to intervene on a connection established automatically at this centre (no emission of signals).
Following a call via code 11 or code 12, the controlling operator wishes to recall the incoming operator. Forward-transfer signal sent
PYY
Recalls the incoming operator on calls completed via the manual board at this exchange (no emission of signals).

ANNEX 4

Facilities to be provided for when designing international switching and signalling equipment, in order to obtain information on traffic, use of circuits and grade of service. Proposals by the Swedish Administration.

Taking as a guide the experience obtained on the Swedish national network, the Swedish Administration has drawn up the following list. This list gives the facilities that it seems normal to provide for in order to collect on an international basis, data concerning the volume of traffic handled, the use of circuits and the grade of service.

At the centre at which traffic data are recorded an outgoing circuit is subjected to recording for all calls irrespective of whether they originate at the centre itself or are passed through that centre.

A. *Circuits used exclusively for traffic terminating in the destination country at the distant end of the circuit (terminal calls).*

1. Recording of the volume of outgoing traffic separately for each route. This recording is effected preferably by means of automatic traffic recorders.

1.1. The relay set of the outgoing end of each circuit is provided with circuit arrangements permitting the recording of the total *occupation time* for the circuit during the period of measurement, e.g. busy hour.

1.2. The relay set of the outgoing end of each circuit is provided with circuit arrangements permitting the recording of the total *chargeable time* for the circuit during the period of measurement.

2. Recording for each route, the number of outgoing calls made on each circuit. This registration is effected by means of call meters.

2.1. The relay set of the outgoing end of each circuit is designed so as to permit a meter to be connected in such a way that the total number of calls made on the circuit is recorded. Alternatively the total number of calls on a route may be recorded.

2.2. The relay set of the outgoing end of each circuit is designed so as to permit the connecting up of a meter in such a way that the total number of chargeable calls made on the circuit is recorded.

3. Recording of the congestion on the outgoing circuits.

3.1. The relay set of the outgoing end of each circuit is designed so as to permit a meter, common to all circuits included in a traffic route, to be connected up in such a way that it records the total number of times an outgoing call for that route is lost on account of congestion.

B. *Circuits used for traffic terminating in the destination country at the distant end of the circuit (terminal calls) as well as for traffic transited at that distant end (transit calls).*

1. Recording of the volume of outgoing traffic separately for each route. This recording is effected preferably by means of automatic recorders.

1.1. The relay set of the outgoing end of each circuit of a route is provided with circuit arrangements permitting the recording of that part of the total occupation time for the circuits of the route which is caused solely by *terminal* calls during the period of measurement.

1.2. The relay set of the outgoing end of each circuit of a route is provided with circuit arrangements permitting the recording of that part of the total occupation time for the circuits which is caused solely by *transit* calls during the period of measurement.

1.3. The relay set of the outgoing end of each circuit of a route is provided with circuit arrangements permitting the recording of that part of the total *chargeable* time of the circuits which is caused by *terminal* calls during the period of measurement.

1.4. The relay set of the outgoing end of each circuit of a route is provided with circuit arrangements permitting the recording of that part of the total *chargeable* time of the circuit which is due to *transit* calls during the period of measurement.

2. Recording separately for each route of the number of outgoing calls made on the circuits. This recording is effected by means of call meters.

2.1. The relay set of the outgoing end of each circuit of a route is designed so as to permit a call meter to be connected up in such a way that the total number of terminal calls made on the circuit is recorded. Alternatively the total number of *terminal* calls on all the circuits of the route may be recorded on one meter.

2.2. The relay set of the outgoing end of each circuit of a route is designed so as to permit a meter to be connected up in such a way that the total number of *transit* calls made on the circuit is recorded. Alternatively the number of transit calls on all the circuits of the route may be recorded on one meter.

2.3 The relay set of the outgoing end of each circuit is designed so as to permit a meter to be connected up in such a way that the total number of chargeable *terminal* calls made on the circuit is recorded on the meter in question. Alternatively the total number of chargeable *terminal* calls on the same route may be recorded on one meter.

2.4. The relay set of the outgoing end of each circuit is designed so as to permit a meter to be connected up in such a way that the total number of chargeable *transit* calls made on the circuit is recorded on the meter in question.

3. Recording of congestion on the outgoing circuits.

The relay set of the outgoing end of each circuit is designed so as to permit a meter, common to all circuits in a traffic route, to be connected up in such a way that the total number of calls lost due to congestion of the route is recorded on the meter.

C. *Registers.*

1. Recording of the number of times a register is used for setting up calls.

1.1. The total number of times a register is used for setting up *terminal* calls is recorded on separate call meter.

1.2. The total number of times a register is used for setting up *transit* calls is recorded on a separate call meter.

1.3. The total number of times a register is used for setting up incoming *terminal* calls is recorded on a separate call meter.

1.4. The total number of times a register is used for handling incoming *transit* calls is recorded on a separate call meter.

2. Recording separately for each group of registers the number of times when a call for a register occurs and all available registers are engaged (register traffic congestion).

D. *Recording on incoming traffic.*

Normally, it should be sufficient to record the traffic flow and other traffic data of a route at the end where the calls originate or are fed to the route. However, there are some arguments in favour of making possible some traffic measurements also at the incoming end of a route for checking purposes and to allow a quick determination of data without having to call in the aid of the distant exchange. For these reasons it is desirable to design the equipment at the incoming end of the circuits so as to permit the measurement at that end of a few fundamental traffic data, possibly not more than the total traffic strength and the number of calls for each route.

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ANNEX 5

Description of the operations corresponding to the various normal and abnormal conditions which may arise in setting up a call.

Outgoing centre

Table 1 — Normal conditions
1- and 2-frequency systems 112

Table 2 — Abnormal conditions
1-frequency system 113

Table 3 — Abnormal conditions
2-frequency system 114

Incoming centre

Table 4 — Normal conditions
1- and 2-frequency systems 115

Table 5 — Abnormal conditions
1- and 2-frequency systems 116

Transit centre

Table 6 — Normal conditions
1- and 2-frequency systems 117

Table 7 — Abnormal conditions
1-frequency system 118

Table 8 — Abnormal conditions
2-frequency system 119

TABLE 1

OUTGOING CENTRE—NORMAL CONDITIONS

1 and 2 frequency systems

Conditions		Subscriber free	Subscriber busy or national congestion		Congestion outgoing from the incoming centre (1+2 VF) or from the transit centre (1.V.F.)	Congestion of common equipment at the centre			Congestion outgoing from the transit centre (2. V.F.)
			The busy flash signal			Incoming		Transit	
			is not provided	is provided		Terminal traffic	Transit traffic		
Operations effected	Release of register	SA - After sending code 15 EA - After reception of number-received signal		SA - After sending code 15 or EA - after reception of number-received or busy-flash signal	SA - After sending code 15 or after reception of busy-flash signal	(1 VF) After reception of busy-flash signal	(1 VF) SA - After sending code 15 or EA - After reception of busy-flash signal (2 VF) After reception of busy-flash	After reception of busy-flash signal *	
	Speech conditions	After release of register		SA - After release of register					
	Action on the international circuit			EA - Release of the circuit after reception of the busy-flash signal				Possible automatic re-routing (2 V.F.)	
	SA - Local signals given to the operator	End of international selection operations		End of selections, then busy	Busy			Busy or re-routing	
	EA-Transmission of an appropriate indication to the calling subscriber			Busy				Busy (possibly *)	
Information received	Signals received	Number received		Busy-flash proceeded or not by number-received	Terminal proceed-to-send, then:	Busy-flash signal	Transit proceed-to-send, then:		Transit proceed-to-send, then:
	Audible indication received	Ringing tone	Busy tone		Name of transit centre			Name of transit centre *	
References		145 321 (1)		145 321 (1)		146 321 (1)		146 321 (1) 36, 37	

SA—Semi-automatic service
EA—Fully automatic service subscriber to subscriber
*—Not applicable to the 2 V.F. system, if automatic re-routing is provided

TABLE 2

OUTGOING CENTRE — ABNORMAL CONDITIONS

1 V.F. System

	Conditions	The outgoing register receives no more digits	Registration of an unused international code	Non-receipt of a backward signal after sending the seizure signal	The outgoing register not having detected an anomaly, the incoming register receives: an incomplete number not followed by code 15	The outgoing register not having detected an anomaly, the incoming register receives: an incomplete number followed by code 15	The outgoing register not having detected an anomaly, the incoming register receives: a non-existent national number	Abnormal conditions at a transit centre
Operations effected	Release of register	10-20 seconds after seizure or the receipt of the last digit	Immediately the anomaly is recognised	10-20 seconds iafter sending the seizure signal	After sending code 15 or after receipt of the number-received signal			After receipt of the busy-flash signal
	Speech conditions				After release of the register			
	Action on the international circuit			Possible blocking of the circuit				
	Local signals given to the operator	Faulty call	Wrong number	Fault	Busy	End of international selection operations		Busy
	Local signals given to the subscriber	Appropriate audible indication			Busy tone			
Information received	Signals received				Busy-flash	Number-received		Busy-flash
	Tone received					If possible, national number unobtainable tone or verbal announcement		
	References	321 (2) a	321 (2) b	321 (2) c	323 (2) a and b	323 (2) c	323 (2) c	321 (1)

* The indications to be given to operators in situations quoted on this line will be determined by each Administrati on, as this question is a purely national matter.

TABLE 3

OUTGOING CENTRE — ABNORMAL CONDITIONS

2 V.F. System

Conditions		The outgoing register receives no more digits	Registration of an unused international code	Non-receipt of a backward signal after sending the seizure signal	Non-receipt of an acknowledgement signal after sending a digit	The outgoing register not having detected an abnormal ty, the incoming register receives		Non-receipt of a backward signal after sending the international code to a transit centre	Receipt of a third transit proceed-to-send signal
						an incomplete number followed by code 15	a non-existing national number		
Operations effected	Release of register	10-20 seconds after seizure or the receipt of the last digit	Immediately the anomaly is recognised	10-30 seconds after sending the seizure signal	5-10 seconds after sending the digit	After sending code 15 or after receipt of the number-received signal		15-30 seconds after sending the international code	After receipt of the third signal
	Speech conditions					After release of the register			
	Action on the international circuit			Possible blocking of the circuit					
	Local signals given to the operator *	Faulty call	Wrong number	Fault	Fault	End of international selection operations		Fault	Congestion
	Local signals given to the subscriber	Appropriate audible indication							
Information received	Signals received					Number received			
	Tone received					If possible, national number-unobtainable tone, or verbal announcement			
References		321 (2) a	321 (2) b	321 (2) c	321 (2) d	323 (2) e	323 (2) c	321 (2) c	321 (2) e

* The indications to be given to operators in situations quoted on this line will be determined by each Administration, as this question is a purely national matter.

TABLE 4

INCOMING CENTRE — NORMAL CONDITIONS

1 V.F. and 2 V.F. Systems

Conditions / Operations effected	Normal conditions				
	Called subscriber free	Subscriber busy or national congestion		Congestion immediately outgoing from the incoming centre	Congestion of common equipment at the incoming centre
		The incoming centre cannot recognise the busy condition	The incoming centre can recognise the busy condition		
Release of register	After sending the number-received signal			After sending the busy-flash signal	
Speech conditions	After sending the number-received signal				
Sending of number-received signal	After recognition of the complete national number and sending of the numerical information to the national network equipment				
Sending of busy-flash signal			After sending the number-received signal	0-10 seconds after receipt of the information necessary for determining the route	0-5 seconds after receipt of the seizing signal
Sending of an audible indication	Sending of the national ringing tone after sending the number received signal	Sending of the national busy tone after sending the number-received signal			
References	145 323 (1)	145 146 b	145 146 b	146 b 31 (4) 323 (1)	31 (4)

TABLE 5

INCOMING CENTRE — ABNORMAL CONDITIONS

1 V.F. and 2 V.F. systems

Conditions / Operations effected	Abnormal conditions			
	Non-receipt of first digit	Break in the receipt of digits	Receipt of an unused number	Receipt of an incomplete number followed by code 15
Release of register	1 V.F.-20-40 / 2 V.F.- 5-10 sec. after sending the proceed-to-send signal	30-60 seconds after receipt of the last digit	After sending the number-received signal	
Speech conditions	After release of the register			
Sending number-received signal			After recognition of the anomaly	
Sending busy-flash signal	1 V.F.: immediately before release of the register			
Sending national number unobtainable tone or a verbal announcement			If possible (after sending number-received signal)	
References	323 (2) b	323 (2) a	323 (2) c	

TABLE 6

TRANSIT CENTRE — NORMAL CONDITIONS

1 V.F. and 2 V.F. Systems

<table>
<tr><th>Conditions / Operations effected</th><th colspan="3">Normal conditions</th></tr>
<tr><th></th><th colspan="2">Successful attempt (so far as transit centre is concerned)</th><th>Congestion on switches or on international circuits outgoing from the transit centre</th><th>Congestion on common equipment at the transit centre</th></tr>
<tr><td rowspan="4">Release of register</td><td></td><td>1 V.F.</td><td>2 V.F.</td><td rowspan="4">After sending busy-flash signal</td><td rowspan="4"></td></tr>
<tr><td>After sending</td><td>code 15</td><td>Seizing signal</td></tr>
<tr><td>or after receipt of</td><td>number-received signal</td><td>proceed-to-send signal</td></tr>
<tr><td colspan="2">or busy-flash signal</td></tr>
<tr><td>Speech conditions</td><td>1 V.F.
After release of the register</td><td>2 V.F.
After sending the seizing signal</td><td>After sending busy-flash signal</td><td></td></tr>
<tr><td>Sending of busy-flash signal</td><td colspan="2"></td><td>0-10 seconds after receipt of the international code</td><td>0-5 seconds after receipt of the seizing signal</td></tr>
<tr><td>Sending of a verbal announcement (name of transit centre)</td><td colspan="2"></td><td colspan="2">After sending the busy-flash signal</td></tr>
<tr><td>References</td><td colspan="2">322 (1) A-B</td><td>146 a
31 (4) 322 (1) A-B
36</td><td>146 a
31 (4)
36</td></tr>
</table>

TABLE 7

TRANSIT CENTRE — ABNORMAL CONDITIONS

1 V.F. System

Conditions / Operations effected	Abnormal conditions				
	Non-receipt of digits from the preceding centre	Receipt of an unused international code	Non-receipt of a proceed-to-send signal	Non-receipt of code 15 or a number-received signal	Receipt of a busy-flash signal
Release of register	After sending the busy-flash signal				
Speech conditions	After sending the busy-flash signal				
Sending of busy-flash signal	20-40 seconds after sending the proceed-to-send signal	After recognition of the anomaly	10-20 seconds after sending the seizing signal	30-60 seconds after receipt of the last digit	After receipt of the busy-flash signal
Action on the outgoing international circuit			Possible blocking of the circuit		
References	322 (2) a	322 (2) b	322 (2) c 631 (1)	322 (2) d	322 (2) e 332 (a)

TABLE 8

TRANSIT CENTRE — ABNORMAL CONDITIONS

2 V.F. System

Conditions / Operations effected	Abnormal conditions		
	Non-receipt of the international code	Receipt of a unused international code	Non-receipt of a proceed-to-send or a busy-flash signal
Release of register	5-10 seconds after sending the proceed-to-send signal	After recognition of the anomaly	10-30 seconds after sending the seizing signal [1]
Speech conditions	After release of register		
Sending of busy-flash signal	This signal is not sent in the 2 V.F. system		
Action on the outgoing international circuit			Possible blocking of the outgoing circuit
References	322 (2) B a	322 (2) B b	322 (2) B 631 (1)

If the register is still connected, cf: 3.2.2.(1) B

GENERAL SWITCHING RECOMMENDATIONS OF THE C.C.I.F.

5th Amendment

New Recommendation (of a general character) to be introduced as a new Part in Volume V of the Green Book

(The title of this 5th Part, which has been placed at the end of the Book, so as not to alter the existing order of the parts in Volume V, would be " General Switching Recommendations of the C.C.I.F. ".)

METHODS OF IMPROVING THE RELIABILITY OF CONTACTS IN SPEECH CIRCUITS

In order to improve the reliability of contacts in speech circuits, the following methods can be taken into consideration:

a) Use of precious metals such as platinum, palladium, gold, silver, or alloys of these metals. If, for one reason or another, it is not desired to wet the contacts, or if enough contact pressure cannot be provided, it is preferable to use the metals or alloys mentioned above, with the exception of pure silver.

b) Use of high contact pressure.

c) Double contacts.

d) Lubrication (with suitable oils) of certain non-precious metal contacts in the case of sliding contacts (e.g. wipers).

e) D.C. " wetting " of contacts, care being taken to avoid the introduction of noise due to transients when the contacts are made or broken.

f) Air filtration or other protective measures to avoid dust.

g) The maintenance of suitable humidity.

h) The use of protective covers.

i) Protection against fumes, vapours, and gases.

j) Avoidance of the use near contacts of materials likely to be detrimental to the contacts.

On the other hand, in the case of the application of voice-frequency signals to a transmission path, as it is not possible to use wetted contacts, due to the surges which occur at the time of the closing and opening of the contact, it is preferable to use static modulators with rectifier elements.

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