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PART I

Recommendations Q.120 to Q.139

SPECIFICATIONS OF SIGNALLING

SYSTEM No. 4

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SIGNALLING SYSTEM No. 4

CHAPTER I

DEFINITION AND FUNCTION OF SIGNALS

Recommendation Q.120

1. DEFINITION AND FUNCTION OF SIGNALS

1.1 **seizing signal (sent 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 two different types of seizing signal are provided for this purpose, viz:

a) the *terminal seizing* signal, which can be used at the incoming international exchange, to seize equipment used exclusively for switching the call to the national network of the incoming country;

b) the *transit seizing* signal, wich can be used in the exchange at the incoming end of the international circuit to seize equipment used exclusively for switching the call to another international exchange.

1.2 **proceed-to-send signal (sent in the backward direction)**

This signal is sent from the incoming end of an international circuit, following the receipt of a seizing signal, to indicate that the equipment is ready to receive the numerical signals.

In System No. 4 two different proceed-to-send signals are provided:

For definitions, see Recommendations Q.10/E.160 and Q.104.

a) the *terminal* proceed-to-send signal, used to invite the sending of the language digit (or the discriminating digit plus the national (significant) number ;

b) the *transit* proceed-to-send signal, used to invite the sending of only those numerical signals (beginning with the first digit of the country code) necessary for routing the call through the international transit exchange towards the incoming international exchange or to another international transit exchange.

1.3 **numerical signal (sent in the forward direction)**

This signal provides an element of information necessary to effect the switching of the call in the desired direction. There is always a succession of numerical signals sent.

1.4 **end-of-pulsing signal, also called for System No. 4 code 15 (sent in the forward direction)**

This numerical type signal is sent from the international outgoing exchange to show that there are no more numerical signals to follow. In semi-automatic working, this signal is always sent. In automatic working, this signal *may* be sent, viz., when, in the outgoing international exchange, it is known that there are no more digits to follow.

1.5 **number-received signal (sent in the backward direction)**

1.5.1 This signal is sent from the incoming international exchange to the outgoing international exchange when the incoming register has recognized that all the digits required for routing the call to the called subscriber have been received.

Purpose of the signal

1.5.2 In the semi-automatic working, the number-received signal may be used to inform the outgoing operator that the international switching operations have been completed.

1.5.3 In automatic working, this signal is essential to show the outgoing register at the outgoing international exchange that it can release, and to set up speech conditions at this exchange. Hence, it is desirable that the signal be sent as soon as possible.

Generation of the signal

1.5.4 In semi-automatic working, the incoming register (or associated equipment) after reception of the end-of-pulsing signal acknowledges this numerical signal with an x and then sends back the number-received signals.

See definition in Recommendation Q.10/E.160.

1.5.5 In automatic working, the incoming register (or associated equipment) recognizes that all the digits of a national (significant) number have been received :

1.5.5.1 by the receipt of the end-of-pulsing signal; or

1.5.5.2 a) by checking the number of digits received, in countries where the national (significant) number is always made up of the same number of digits; or

b) in countries where this is not so:

i) by the receipt of the maximum number of digits, used in the numbering plan of the country; or

ii) by analyzing the first digits in the national (significant) number to decide how many digits there are in the subscribers' numbers in the particular national numbering zone; or

iii) by using a national end-of-selection or national ‘‘electrical’’ ringing-tone signal; or

iv) exceptionally, by observing that 4 to 10 (for new equipment 4 to 6) seconds have elapsed since the last digit was received, and that no fresh information has been received; in such circumstances, retransmission to the national network of the last digit received must be prevented until the end of the waiting period which causes the number-received signal to be sent over the international circuit. In this way, it is ensured that no national answer signal

See Recommendation Q.180 for interworking between Systems No. 4 and No.5, Q.232 for interworking between Systems No. 4 and No. 5 | fIbis , Q.261 for interworking between Systems No. 4 and No. 6, Q.381 for interworking between Systems No. 4 and R2, Q.382 for interworking between Systems No. 5 and R2, Q.383 for interworking between Systems No. 5 | fIbis and R2 and Q.388 for interworking between Systems No. 6 and R2.

can arrive before the number-received signal has been sent.

1.6 busy-flash signal (sent in the backward direction)

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

a) An international transit exchange *must* send this signal to indicate that there is congestion at that exchange or on the appropriate outgoing routes.

b) An incoming international exchange *must* send this signal if there is congestion at that exchange or on the outgoing routes directly connected to it, but sending the signal is *optional* when there is congestion beyond that exchange (when there is congestion at a point in the national network of the incoming country or when the called subscriber’s line is busy). This signal is optional because there are several countries that do not send it from their national networks.

Note — The receipt of the busy-flash signal at the outgoing exchange will cause:

— an appropriate indication to be given to the outgoing operator or to the calling subscriber; and

— in automatic working, the sending of the clear-forward by the outgoing exchange to release the international connection (except when otherwise arranged, for example, in the case of observations on circuits).

1.7 **answer signal (sent in the backward direction)**

This signal is sent to the outgoing international exchange to show that the called party has answered the call

In semi-automatic working, the signal has a supervisory function.

In automatic working, it is used:

— to start metering the charge to the calling subscriber,

— to start the measurement of call duration for international accounting purposes.

1.8 **clear-back signal (sent in the backward direction)**

This is sent to the outgoing international exchange to indicate that the called party has cleared. In the semi-automatic service, it performs a supervisory function. It must not permanently open the speech path at the outgoing international exchange.

In automatic working, arrangements must be made to clear the international connection, stop the charging and stop the measurements of call duration if, between one and two minutes after receipt of the clear-back signal, the calling subscriber has not cleared. Clearing of the international connection should preferably be controlled from the point where the charging of the calling subscriber is carried out.

Notes on the answer and clear-back signals

1.8.1 *Note 1* — In general, the sequence of answer and clear-back signals that will be sent when the called subscriber depresses and releases the switch-hook of his telephone will not always be able to follow the frequency of this operation of the switch-hook, but correct indication of the *final* position of the switch-hook must *always* be given:

— to the outgoing international operator in semi-automatic operation;

— to the outgoing international equipment in automatic operaton.

1.8.2 *Note 2* — The ‘‘call party’’ referred to in the definitions of the answer and clear-back signals may be:

— the called subscriber;

— in semi-automatic working, the operator who puts the call through in her own country and who sends an answer signal when she answers the call.

1.8.3 *Note 3* — The following is a detailed description of the various possible circumstances in which the answer and clear-back signals are sent.

A. *Called subscriber obtained automatically by the international outgoing operator*

The answer and clear-back signals are sent every time the called subscriber answer or clears.

B. *Called subscriber not obtained automatically by the international outgoing operator*

See Recommendation Q.27 for the action to be taken to ensure that answer signals both national and international, are transmitted as quickly aspossible.

a) *Only one operator involved in the incoming country, without through-supervision via her position* — (This operator can be an incoming or a delay operator or a manual exchange operator obtained automatically from the outgoing international exchange.)

The answer signal is sent when the operator enters the circuit.

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

b) *Only one operator involved in the incoming country, with through-supervision via her position* — (The operator can be the same as for a) above.)

Through-supervision can be effected:

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

— 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 clear-forward signal to be sent.

The answer signal is sent when the operator enters the circuit.

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 circuit.

The clear-back signal is also sent when the called subscriber clears or when the incoming operator, by mistake, clears the connection before the called subscriber has cleared.

The same signal (answer signal or clear-back signal) must not be sent twice in succession.

c) *Two operators involved in the incoming country* .

These can be:

— an incoming or a delay operator at the international exchange; and

— an operator at a national manual exchange.

c.1) There is no through-supervision via the operators' positions at the international exchange. The answer and clear-back signals are sent as described in a) above.

c.2) The international operator's position is normally able to provide through-supervision. There are still two cases to consider:

c.2.1) If the whole of the national chain, including the operator's positions, gives through-supervision from the called subscriber, the operating conditions can be as described in b) above. An operator intervenes to send an answer signal: her withdrawal causes 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 does not give through-supervision from the called subscriber, supervision is extended from the point at which through-supervision cases.

In a), b) and c) above, it is recommended that the incoming or the delay operator should have facilities to recall the outgoing operator by sending a succession of clear-back and answer signals, by means of a special key, for example.

If *automatic service requirements* necessitate the action described under C below, it will inevitably follow that in *semi-automatic working* correct supervision cannot be given, so that the sequence of answer and clear-back signals described above cannot be guaranteed.

C. *Automatic calls*

When direct access by a subscriber to an operator's position in the incoming country cannot be barred, it is essential, to avoid mistakes in charging, not to give the answer signal at the moment this operator replies. Arrangements must be made to ensure that the answer signal is sent when the called subscriber, or paid special service, answers. The answer signal is sent:

— either by an operator (using a key); or

— automatically, by through-supervision.

1.9 **clear-forward signal (sent in the forward direction)**

1.9.1 This signal is sent in the forward direction at the end of a call when:

a) in semi-automatic working, the operator at the outgoing international exchange withdraws her plug from the jack, or when an equivalent operation is performed;

b) in automatic working, when the calling subscriber hangs up or otherwise clears (as in the case of a subscriber's installation with extension telephones).

In automatic working, this signal is also sent after receipt of a busy-flash signal by the outgoing international exchange, and when there is forced release of the connection; see §§ 4.3.1 and 4.3.2 in Recommendation Q.118 and Recommendation Q.131.

In semi-automatic working there may be forced release in the case of § 4.3.1 of Recommendation Q.118.

1.9.2 At the end of the clear-forward signal, all switching units held on the call must release at the outgoing, incoming and transit international exchanges. (The clear-forward signal must therefore be recognized at an international transit exchange.) Each international circuit, however, is guarded against subsequent seizure until the release-guard signal has been received from the incoming end of the international circuit concerned.

1.9.3 In a transit exchange, 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 recognition of the clear-forward signal;

c) a clear-forward signal received at the moment a call is established, but before speech conditions have been set up, must be repeated over the outgoing circuit that has been seized.

1.10 **release-guard signal (sent in the backward direction)**

This signal is sent in the backward direction in response to the clear-forward signal, to indicate that the latter has been fully effective in bringing about the release of the switching equipment 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 reception of the clear-forward signal have not been completed at its incoming end.

1.11 **blocking signal (sent in the backward direction)**

This signal is sent, when required, to the outgoing end of the circuit to cause engaged conditions to be applied to the outgoing end of the international circuit.

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

1.12 **forward-transfer signal (sent in the forward direction)**

This signal is sent to the incoming international exchange when the outgoing international exchange operator wants the help of an operator at the incoming international exchange.

The signal will normally serve to bring an assistance operator into the circuit if the call is automatically set up at that exchange. When a call is completed via an operator (incoming operator or delay operator) at the incoming international exchange, the signal will cause this operator to be recalled.

1.13 *Diagrams showing signal sequence*

The sequence of signals in semi-automatic and automatic working is shown in Tables 1 and 2 of Annex 1 to Part I.

Tables of Annex 2 to Part II give a description of the operations corresponding to the various normal and abnormal conditions which may arise in setting up a call.

See the definition of assistance operator in § 1.1.6 of Recommendation Q.101.

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CHAPTER II

SIGNAL CODE

Recommendation Q.121

2. SIGNAL CODE

2.1 *General*

The signals of System No. 4 are:

— signal called ‘‘line signals’’ for the so-called supervisory functions;

— signals (binary code signals and their acknowledgement signals) used for the transmission of numerical information.

2.2 *Transit working*

In transit operation, the line equipment at the transit exchange shall record that the condition is transit; this will facilitate, in particular, the parallel reception of the clear-forward signal at the transit and incoming international exchanges. (See Recommendation Q.120, item 1.9).

2.3 *Line signals*

2.3.1 *Line signal code*

The line signal code is given in Table 1.

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

The compound signal prefix element is much less likely to be imitated by speech currents than a single-frequency element of the same duration and serves to prepare 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 at the receiving end to prevent the remaining part of the signal from passing out of the section in which it is intended to be operative.

2.3.2 *Sending duration of line signal elements*

The elements of each of the voice-frequency line signals shown in Table 1 have a duration of:

P 150 | (+- | 0 ms X and Y 100 | (+- | 0 ms XX and YY 350 | (+- | 0 ms.

TABLE [1], p.

(The durations of the signal elements P, X and Y, XX and YY are multiples of 50 ms with a tolerance of ± | 0 ms.)

Once the sending of a signal has begun it must be sent completely. If two signals have to be sent one immediately after the other in the same direction, a silent interval must separate the two successive signals. The duration of this interval must not be less than 100 milliseconds but it must not be so long as to cause an unreasonable delay in signalling.

This 100 ms interval must also occur between the sending of a numerical signal including the acknowledgement signal and a subsequent line signal.

Sending of the proceed-to-send or busy-flash signal by an incoming or transit exchange should not take place until 50 ms after the end of the receipt of the corresponding seizing 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 instants 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 is separated from it by an interval of silence 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.

2.3.3 *Recognition time of line-signal elements at the receiving end*

At the output of the signal receiver, the duration of the direct current signal elements produced by the line signals is determined in terms of the sending duration of the voice-frequency signal elements and the distortion due to the line and to the signal receiver.

This overall distortion due to the line and the signal receiver is taken to be 10 ms maximum for a prefix-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 must recognize a signal only after a certain time, called the recognition time, from the beginning of the receipt of the direct current signal, so that risk of recognizing false signals is reduced and so that signals of different length can be distinguished.

The recognition times of the line signal elements are:

P: 80 | | 0 ms X e Y: 40 | | 0 ms XX e YY: 200 | | 0 ms.

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

2.4 *Numerical signals*

2.4.1 *Binary numerical signal code*

The numerical signal code is given in Table 2. This code is a binary code of four elements each separated from the next by a short interval of silence *s* ; each element consists of the sending of one or other of the signalling frequencies.

The symbols used in Table 2 and in Figure 2/Q.121 have the following significance:

x short element of the single frequency *x*

y short element of the single frequency *y* .

See definition of recognition time in § 2.5 hereafter.

TABLE [2], p. 2

2.4.2 *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 | (+- | ms.

The sending duration of the interval of silence *s* between signal elements of the same digit shall have the same value of 35 | (+- | ms.

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

2.4.3 *Recognition time of the x, y and s elements at the receiving end*

The recognition time by the incoming switching equipment:

a) of the direct current signal elements *x* and *y* ;

b) of intervals of silence *s* ;

received from the output of the signal receiver is: 10 ± 5 ms.

2.4.4 *Acknowledgement signals*

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

At the outgoing international exchange a numerical signal will be sent only if a signal is received from the incoming and 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 is recognized* .

Two types of acknowledgement signals are provided, one constituted by the signal element *x* defined above and the other constituted by the signal element *y* defined above.

The acknowledgement signal *x* has two meanings:

— after a terminal proceed-to-send signal has been received by the outgoing register: ‘‘digit received; send next digit’’;

— after a transit proceed-to-send signal, but before a terminal proceed-to-send signal has been received: ‘‘digit received; stop the sending of digits’’.

The acknowledgement signal *y* has one meaning only, i.e. after a transit proceed-to-send signal has been received: ‘‘digit received; send next digit’’.

2.5 *Signalling timing diagrams*

Figures 1/Q.121 and 2/Q.121 give diagrams showing for line signal elements (Figure 1) and for numerical signal elements *x* and *y* (Figure 2):

See definition of recognition time in § 2.5 |) above.

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

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

c) the safety margins that allow for equipment not being in adjustment, etc.;

d) the recognition time of the receiving switching equipment; this time assumes an operating margin is defined between a lower limit t and an upper limit T . The switching equipment must *not* recognize a signal element *before t* but must *certainly* have recognized it *at the end of time T* .

2.6 *General note on the operation of signalling and switching equipment*

The tolerances defined in §§ 2.3 and 2.4 concerning the sending duration of signal and their recognition times at the receiving end must be strictly observed in all circumstances and especially under all conditions of battery voltage variation likely to arise in working conditions.

FIGURE 1/Q.121, p. 3

FIGURE 2/Q.121, p. 4

CHAPTER III

SIGNAL SENDER AND SIGNAL RECEIVER

Recommendation Q.122

3.1 SIGNAL SENDER | u1)

3.1.1 *Signalling frequencies*

The signalling frequencies shall be:

2040 | (+- | Hz (‘‘*x* ’’ frequency); and

2400 | (+- | Hz (‘‘*y* ’’ frequency),

these frequencies being applied separately or in combination.

3.1.2 *Absolute power level transmitted*

The absolute power level of the unmodulated signal frequencies at a zero relative level point shall be —9 dBm with a tolerance of ± | dB.

These levels also apply to each signal frequency in a signal element made up of a combination of the two frequencies (compound signal element) but the two signalling frequencies making up such a signal must not differ in level by more than 0.5 dB.

Note 1 — The noise as measured at the output of the line signal sender shall be as low as practicable, but in any event, at least 40 dB below signal level. This noise includes all extraneous power in the frequency band beteen 300 Hz and 3400 Hz including power resulting from non-linear distortion of the signal.

Note 2 — The level of the leak current which might be transmitted to line, for example when static modulators are used for signal transmission, should be at least 50 dB below signal level per frequency.

Recommendation Q.123

3.2 SIGNAL RECEIVER

3.2.1 *Operating limits of the signal receiver*

See also Recommendation Q.112.

The signal receiver shall operate in the conditions specified under 3.2.5 to received signals that meet the following three conditions.

a) The signal frequencies shall be within the following limits:

‘‘*x* ’’ frequency: 2040 | (+- | 5 Hz

‘‘*y* ’’ frequency: 2400 | (+- | 5 Hz.

b) The absolute power level *N* of each unmodulated received signal frequency shall be within the limits:

—18 | | fIn *N* ≥" *n* dBm;

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

These limits give a margin of ± | dB on the nominal absolute level of each received signal at the input to the signal receiver.

c) The absolute level of the two unmodulated signal frequencies may differ from each other, but the received level of the 2400 Hz signal shall not be more than 3 dB above, nor more than 6 dB below the received level of the 2040 Hz signal.

The tolerances given in §§ a, b and c above are to allow for variations at the sending end and for variations in line transmission.

3.2.2 *Non-operate conditions for the signal receiver*

a) *Selectivity*

The signal receiver shall not operate to a signal having an absolute power level at the receiving end within the limits specified in § 3.2.1 when the frequency differs by more than 150 Hz from the nominal value of 2040 Hz or of 2400 Hz.

b) *Maximum sensitivity of the receiver*

The signal receiver shall not operate to a signal of 2040 | (+- | 5 Hz or 2400 | (+- | 5 Hz whose absolute power level at the point of connection of the receiver is (—26 — 9 + *n*) dBm, *n* being the relative power level at this point.

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

3.2.3 *Efficiency of the guard circuit*

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

The purpose of the guard circuit is to prevent:

a) signal imitation (signals are imitated if the duration of the resulting direct current pulses at the output of the signal receiver is long enough to be recognized as signals by the switching equipment);

b) operation of the splitting device from interfering with speech.

To minimize signal imitation by speech currents it is advisable that the guard circuit be tuned.

To minimize signal interference by low frequency noise, it is advisable that the response of the guard circuit falls off towards the lower fequencies and that the sensitivity of the guard circuit at 200 Hz be at least 10 dB less than that at 1000 Hz.

An indication of the efficiency of the guard circuit is given by the following:

a) during 10 hours of speech, normal speech currents should not, on the average, cause more than one simultaneous operation of the receiver relays for each of the two signalling frequencies lasting more than 55 ms (the minimum recognition time of a compound signal element is 60 ms);

b) the number of false splits of the speech path caused by speech currents should not cause an appreciable reduction in transmission quality of the circuit.

3.2.4 *Guard circuit limits*

See 2.1.2 of Recommendation Q.112.

A. — *Steady noise*

Considering :

a) that when there is noise on a circuit an over-sensitive guard circuit might give rise to signalling difficulties and, in particular, inhibit the response of the signal receiver;

b) that unweighted noise of a level —40 dBm0 (100 000 pW) and uniform spectrum energy may arise during end-to-end signalling over a multilink chain of System No. 4 circuits;

it is recommended that, for either one or two signalling currents (each being within the limits of the level specified in § 3.2.1) the signal receiver should satisfy the conditions indicated in § 3.2.5 for the distortion of signals in the presence of noise of a level of —40 dBm0 and uniform spectrum energy over the frequency range 300 to 3400 Hz.

B. — *Surges*

A guard circuit with an excessive hangover time may cause difficulties in receiving a signal, for example when it has been immediately preceded by surges, and it is therefore recommended that the following condition should 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 (—10 + *n*) dBm at the relative level point *n* where the receiver is connected, ceases 30 ms before the application of a signal satisfying the limits defined in § 3.2.1, the lengths of the received signals must remain within the limits specified in § 3.2.5.

3.2.5 *Distortion of received signals*

When the signal frequencies and levels are within the limits specified in § 2.3.1, the following conditions should be met:

1. a) the delay in the start of a received pulse consisting of one of the two signalling frequencies should be less than 20 ms;

b) the delay in reproducing the beginning of a signal consising of a combination of the two frequencies *x* and *y* (compound signal) should be less than 20 ms; this delay is defined as the interval between the moment when the beginning of the compound signal arrives at the signal receiver input and the moment of the beginning the reproduction of the two frequencies *x* and *y* as a direct current signal output of the signal receiver;

2. the change of signal length in the presence of the noise defined in § 2.3.4 should be less than:

a) 5 ms when the signal receiver receives an *isolated pulse at one frequency only* , with a minimum duration of 25 ms;

b) 8 ms when the signal receiver receives a *compound pulse* of the two frequencies with a minimum duration of 50 ms; this change is defined as the difference between the simultaneous reception of the two received frequencies at the input of the receiver and the simultaneous reproduction of the two components as a direct current signal at the output of the signal receiver;

See the definition of prefix and suffix signals under § 2.3.1 of Recommendation Q.121.

c) 6 ms when the signal receiver receives a pulse of current of a *single frequency* with 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 change in the duration of a signal suffix , measured from the moment when the prefix signal mentioned under b), will be less than 6 + 8 = 14 ms.

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CHAPTER IV

SWITCHING CONDITIONS

Recommendation Q.124

4.1 SPLITTING ARRANGEMENTS

Sending line split

4.1.1 According to Recommendation Q.25, § 2, sending split arrangements have to be provided.

4.1.2 The exchange side of the international circuit shall be

disconnected 30 to 50 ms before a voice-frequency signal is sent over the circuit.

4.1.3 The exchange side of the international circuit will not be reconnected for 30 to 50 ms following the end of the sending of a voice-frequency signal over the circuit.

Receiving line split

4.1.4 The international circuit should be split (completely cut) at outgoing and incoming international exchanges when a compound signal is received, to ensure that no fraction of the combination of the two frequencies exceeding 55 ms duration may pass out of the international circuit.

The splitting time of 55 ms may be reduced by each Administration concerned, in order to help to protect its national network against the effect of signals coming from the international circuit. It should be noted, however, that a shorter splitting time can lead to an increase in the number of false operations of the splitting device by speech currents, and impair speech transmission.

4.1.5 The split 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 operate.

For the correct operation of the splitting device, it is necessary to take into account the delay in the reproduction of the compound signal caused by the signal receiver for which the conditions are described in Recommendation Q.123, § 3.2.5.1 |).

4.1.6 The splitting of the line must not give rise to surges which might cause interference with signalling over the international circuit or with other signalling systems associated with it for setting up an international call.

See Recommendation Q.25.

Recommendation Q.125

4.2 SPEED OF SWITCHING IN INTERNATIONAL EXCHANGES

4.2.1 It is recommended that the equipment in international exchanges (terminal or transit) shall have a high switching speed so that the switching time may be as short as possible.

4.2.2 It is also recommended that the incoming register at the incoming international exchange should begin to set up 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 subscriber.

4.2.3 At the outgoing international exchange:

— with semi-automatic operation it may be desirable for the outgoing register to start sending numerical signals to line

without waiting to receive all the digits of the called subscriber's number. However, this may depend on national conditions,

— with 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 subscriber's number because the outgoing register will not generally know how many digits there are going to be.

4.2.4 At international exchanges, use may be made of the advantages of continuous hunting (of circuits or common equipment), i.e. economy in the number of outgoing circuits to be provided or improvement in the quality of service for a given number of circuits. However, at incoming and transit exchanges, the return of a busy-flash signal must take place within the following delay times, specified in particular so that the release conditions of registers can be laid down:

— a maximum delay of 5 s following recognition of a seizing signal at an incoming or transit exchange if a free register and/or link circuit is not found;

— a maximum delay of 10 s following receipt, at an incoming exchange, of the information necessary for determining the required route, if congestion is encountered;

— a maximum delay of 10 s following receipt of the digits necessary to determine the routing at a transit exchange, if congestion is encountered.

Recommendation Q.126

4.3 ANALYSIS AND TRANSFER OF DIGITAL INFORMATION

(see Recommendation Q.107 **|** fIbis in Fascicle VI.1)

Recommendation Q.127

4.4 RELEASE OF REGISTERS

4.4.1 *Outgoing register*

4.4.1 (1) *Normal release conditions*

The outgoing register shall release in either of the following two cases:

Case 1 — The register has sent forward all the numerical signals *and* has received a local sending-finished 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 exchange indicating that all the digits comprising the complete national number have been received;

— or a busy-flash signal (this assumes that a busy-flash signal does not initiate re-routing

4.4.1 (2) *Abnormal release conditions*

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

1) With semi-automatic operation if, after a delay of 10 to 20 s from the seizure of the register or the receipt of the last digit, no further digit or local sending-finished signal is received.

See definition of ‘‘re-routing’’ in Recommendation E.170 (Recommendation Q.12).

2) With automatic operation if, after a delay of 15 to 30 s from the seizure of the register or the receipt of the last digit, the register is in one of the following conditions:

— seized, but no further digit received from the calling subscriber;

— not all the digits necessary to determine the routing received;

— correct number of digits to determine the routing received, but no further digit from the calling subscriber;

— no busy-flash or a number received signal has been received although the complete national (significant) number or part of it has been sent.

In the first two cases, a shorter delay may nevertheless be adopted by certain Administrations.

In the last two cases, release of the outgoing register is made to accompany release of the international circuit by sending the clear-forward signal.

The method of indicating the above normal conditions to the calling subscriber will depend on the practice followed in the various countries: a tone may be sent or, better, a recorded announcement will ask the caller to recommence his call after having checked the number to be dialled. (See also Recommendations Q.116 and Q.118.)

The delay of 15 to 30 s provided for in the above conditions is considered sufficient to cover the maximum period for receiving a number-received signal under the most unfavourable conditions.

a) Numerical information received for which no routing has been provided.

b) Proceed-to-send signal or busy-flash signal not received within:

— 10 to 30 s following the sending of a seizing signal;

— 15 to 30 s following the sending to a transit centre of the digits necessary to determine the routing.

c) An acknowledgement signal not received with 5 to 10 s following the sending of a digit.

d) More than the appropriate number of transit proceed-to-send signals is received (see Recommendation Q.112, § 2.1.2, for the maximum number of circuits switched in tandem).

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

4.4.2 *Transit register*

4.4.2 (1) *Normal release conditions*

The transit register shalll release as soon as it has selected an outgoing circuit and sent forward a seizing signal on the circuit.

However, a different procedure may be used, in which release of the register is delayed until either a proceed-to-send signal or a busy-flash signal, is received from the next exchange. It may be judged more convenient to make use of the transit register when it is desired to give an alarm to show that a proceed-to-send signal has not been received. In this case, the circuit should be switched to the speech condition in both directions of transmission immediately following the operations mentioned above so as to allow the proceed-to-send signal and the following numerical signals to pass through the transit exchange.

If there is outgoing congestion from the transit exchange, the register will release after it has returned a busy-flash signal, and made connection to a recorded announcement.

4.4.2 (2) *Abnormal release conditions*

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

a) the digits necessary for determining the routing not received within 5 to 10 s following the sending of a proceed-to-send signal to the outgoing exchange;

b) numerical information received for which no routing has been provided.

On the other hand, if release of the transit register is deferred until a proceed-to-send signal is received, in accordance with the alternative method mentioned in § 4.4.2.1, it will release if a proceed-to-send signal or busy-flash signal is not received within 10 to 30 s following the sending of a seizing signal to the next exchange.

4.4.3 *Incoming register*

4.4.3 (1) *Normal release conditions*

The incoming register will release when all the numerical information necessary to set up the connection in the incoming country has been sent and after a number-received signal has been returned over the international circuit. The register will determine when the complete national (significant) number has been received under the conditions defined in Recommendation Q.120, § 1.5.5.

If the incoming register finds that there is congestion within or outgoing from the incoming international exchange, it will release after returning a busy-flash signal.

4.4.3 (2) *Abnormal release conditions*

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

a) No further digit is received after a delay of 30 to 60 s from receipt of the last digit and it is not possible to determine by one of the methods described in § 1.5 of Recommendation Q.120 that the number which is received is a complete number.

b) No digit is received within 5 to 10 s 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 (code 15).

In cases a) and b), no signal is returned because the outgoing register remains in circuit and can itself detect any abnormal condition in the establishment of the call.

In case c), before the incoming register releases, a number-received signal will be returned, followed, if possible, by a recorded announcement, a number-unobtainable tone or by the intervention of an interception operator.

Recommendation Q.128

4.5 SWITCHING TO THE SPEECH POSITION

4.5.1 *Outgoing international exchange*

The circuit shall be switched to the speech position when the outgoing register release (see § 4.4.1).

4.5.2 *International transit exchange*

The circuit shall be switched to the speech position immediately after the transit register has sent the seizing signal (see § 4.4.2).

4.5.3 *Incoming international exchange*

The circuit shall be switched to the speech condition immediately the incoming register:

— has sent back the number-received signal and sent forward the numerical information to the national network equipment;

— or has sent back the busy flash-signal;

or, if these signals are not sent, when the register releases under abnormal conditions (see § 4.4.3.2).

Recommendation Q.129

4.6 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 more than about 5 minutes.

Recommendation Q.130

4.7 SPECIAL ARRANGEMENTS IN CASE OF FAILURES IN THE SEQUENCE OF SIGNALS

4.7.1 *Blocking an outgoing circuit*

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

The alarm may be immediate or delayed depending upon the desire of the Administration concerned.

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

2) The outgoing circuit should be blocked and an alarm given if a proceed-to-send signal or a busy-flash signal is not received within 15 to 30 s of the sending to a transit exchange of the digits necessary to determine the routing.

3) If, after sending a clear-forward signal, a release-guard signal is not received within 5 to 10 s, the outgoing end of the circuit should be blocked and an alarm given.

At the incoming end of the circuit, the clear-forward signal should be recognized at any time even if the circuit is in the idle state; the incoming line circuit must therefore be able to recognize a clear-forward signal and to return a release-guard signal even of the clear-forward signal has not been preceded by a seizing signal.

4.7.2 *Abnormal recognition of a release-guard signal at an international transit exchange*

In the case where a release-guard signal is recognized at an international transit exchange without a clear-forward signal having been

recognized, arrangements should be made at the transit exchange to:

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

— immediately release the circuit outgoing from the transit exchange.

This prevents the receipt of the release-guard signal from giving a wrong indication that the circuit to the transit exchange is cleared.

Recommendation Q.131

4.8 ABNORMAL RELEASE CONDITIONS OF THE OUTGOING REGISTER CAUSING RELEASE OF THE INTERNATIONAL CIRCUIT

In automatic operation, the international circuit should be released when the following abnormal conditions arise:

a) if, after receiving the digits necessary to determine the routing, the outgoing register receives no further digit within a period of 15 to 30 s;

b) if no busy-flash or number-received signal is received by the outgoing register within a period of 15 to 30 s although the national (significant) number (or part of it) has been sent.

The release of the outgoing register under these abnormal conditions is dealt with in § 4.4.1 (2) of Recommendation Q.127.

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CHAPTER V

See ATME No. 2 specification in Recommendation Q.49 (O.22).
TESTING ARRANGEMENTS

Recommendation Q.133

5.1 NUMBERING FOR ACCESS TO AUTOMATIC MEASURING AND TESTING DEVICES

5.1.1 Automatic measuring and testing devices situated in the ITMCs and the ISMCs of other countries will be obtainable from the access point defined in Recommendation Q.75 by means of the following digit sequence:

a) terminal seizing signal;

b) code 13 replacing the language digit;

c) code 12;

d) digit 0;

e) two digits which will be associated with the type of testing or measuring device required;

f) end-of-pulsing signal (code 15).

Note — The allocation of the digits in e) above will enable access to be given to a number of different types of measuring or testing equipment. Combination 51 to combination 59 are allocated to automatic transmission measuring devices standardized by the CCITT for ATME No. 1. Combination 00 is used for access to the automatic testing device specified in Recommendation Q.137. Combinations 61 to 63 are allocated to the automatic transmission measuring and signalling testing equipment No. 2

Recommendation Q.134

5.2 ROUTINE TESTING OF EQUIPMENT (LOCAL MAINTENANCE)

5.1.1 Routine testers for testing individual items of equipment such as circuit equipment, connecting circuits, operator’s line calling equipment, selectors, registers, etc., must be provided in every international exchange equipped for automatic switching. These routine testers will be provided in accordance with the practice followed in each country for the local maintenance of the switching equipment.

5.2.2 The testing equipment must conform to the following principles:

a) An item of equipment must not be taken for test until it is free; a signal will show the exchange staff that a piece of apparatus has not been taken for test because it was engaged on a call; it will then be possible to test this piece of apparatus later.

b) An item of equipment 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 will be sent to the outgoing exchange (see Recommendation Q.129).

5.2.3 Testing of the circuit and signalling equipment should include a check that the specifications of System No. 4 are met in regard to the following:

Signalling frequencies;

Transmitted signal levels;

Signal frequency leak;

Receiver operate and non-operate limits;

Receiving-end line split;

Sending-end line split;

Line signal codes;

Sending duration of line signal elements;

Recognition time of line signal elements;

Sending duration of numerical signal elements;

Recognition time of numerical signal elements;

Time-out and alarm features.

Recommendation Q.135

5.3 PRINCIPLES OF RAPID TRANSMISSION TESTING EQUIPMENT

Rapid transmission tests can be made by two methods:

a) The first method consists of a loop measurement of the GO and RETURN paths of an international circuit, these paths being looped at the incoming end of a circuit when it is free.

b) The second method consists of sending a special code on the international circuit to be tested so as to obtain access to an automatic testing equipment in the incoming exchange.

The first method requires that the incoming end of all circuits should be equipped as described later in Recommendation Q.136.

The second method assumes the existence of rapid transmission testing equipment in all exchanges between which this method is used. This testing equipment must be designed in accordance with Recommendation Q.137.

Note — The first method provides overall testing on the GO and RETURN paths without being able to differentiate between the conditions of each of the two directions of transmission. The second method enables separate transmission tests in the two directions. (A situation can occur, however, when it is not possible to determine whether a transmission fault is on the GO path or on the RETURN path of the circuit.) Since the second method requires that for access to the incoming testing apparatus signals must be passed over the circuit, there is some check of good signalling conditions.

Recommendation Q.136

5.4 LOOP TRANSMISSION MEASUREMENTS

A permanent loop will be connected between the GO and RETURN paths of an international circuit at its incoming end when the circuit is free, so that transmission tests can be made independently of the signalling conditions.

The loop between the GO and RETURN paths shall be connected in such a manner that the level diagrams of each of the two paths will be respected when the circuit is free (loop established); the loop may therefore include an attenuation pad of the required value.

The loop at the incoming end of the international circuit should be disconnected when a seizing signal is received. The loop must be disconnected

within 35 ms so as to ensure that the part of a seizing signal which passes round the loop and which is returned to the outgoing end cannot be recognized as a signal.

Recommendation Q.137

5.5 AUTOMATIC TESTING EQUIPMENT

The second method for rapid transmission tests consists of extending international circuit, by means of a special code, to an automatic testing equipment at the incoming exchange. For this method, there must be incoming testing equipment at the incoming international exchange and outgoing testing equipment at the outgoing international exchange. This equipment should be designed in accordance with the following conditions:

5.5.1 *Incoming testing equipment*

(1) Connection to incoming testing equipment:

The incoming testing equipment will normally be connected in the four-wire part of the circuit.

Access to this equipment from an outgoing international exchange will be obtained by sending successively on the international circuit, according to Recommendation Q.133:

a) terminal seizing signal;

b) code 13 replacing the language digit;

c) code 12;

d) three digits 000, the last two being the combination for access to the automatic testing equipment;

e) end-of-pulsing signal (code 15).

If the incoming testing equipment is free, the answer signal will be sent 800 to 1200 ms after it is connected.

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

(2) Measuring condition:

When the answer signal has been sent, the incoming testing equipment will pass to the measuring condition, in which the level of the test signal by the outgoing testing apparatus will be measured. The passage to the

measuring condtion will be effected after a period of 600 to 900 ms calculated from the moment when the testing equipment prompts the sending of the answer signal. This delay is necessary to ensure 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 made with an accuracy of ± | dB.

To provide time for the test signal to become stabilized, there should be a delay of 100 to 150 ms after the operation of the detector circuit, before indications on the level of the test signal are given.

The incoming testing equipment will determine whether the level of the test signals is within the prescribed limits; these limits will be predetermined by an adjustment of the equipment to specified values. These limits will provisionally be ± | dB 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 ± | dB from the nominal value), the incoming testing equipment will send a test signal on the RETURN path of the circuit.

This test signal will have a frequency of 800 Hz which is the same as the test frequency sent on the GO path of the circuit by the outgoing testing equipment. The frequency sent should be controlled within ± | %. The test signal sent by the incoming testing equipment will give a power of 1 mW at a zero relative level point of the circuit. The sending level must be maintained to ± | .5 dB.

If, due to the non-reception of a clear-forward signal, the test signal is transmitted for a period of 1 to 2 m, the incoming testing equipment will stop transmitting this test signal and a clear-back signal will be sent. The release of the incoming testing equipment will then be carried out in accordance with the provisions of Recommendation Q.118, § 4.3.3.

(4) Indication of unsatisfactory transmission of the GO path of the circuit:

If the level of the received test signal is outside the prescribed limits or if the incoming testing equipment does not receive the signal, a

clear-back signal will be returned to the outgoing end. This clear-back signal will be sent 5 s after passing to the measuring position and will indicate to the testing officer at the outgoing exchange that the transmission quality of the GO path of the circuit is not up to standard.

5.5.2 *Outgoing testing equipment*

(1) Connection to the outgoing testing equipment:

For future equipments, the test frequency of 800 Hz will be replaced by 1020 Hz with a tolerance of +2 Hz and —7 Hz.

The outgoing testing equipment will be designed to send automatically the numerical information mentioned under (1) in § 5.5.1 above.

(2) Sending condition:

The receipt of an answer signal sent by the incoming testing equipment will cause the sending of the test signal by the outgoing testing equipment. This test signal will be sent for a period of 500 to 800 ms. To allow the incoming testing equipment to pass into the measuring condition, this test signal should not be sent immediately after the answer signal but should be delayed for a period of at least 700 ms.

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 end of the receipt of the answer signal should be between 700 and 900 ms. If the test signal is sent under the control of the operator, the latter should operate quickly, because the clear-back signal can be returned by the incoming testing apparatus after a delay of 5 s.

The frequency of the test signal will be 800 Hz ± | %.

The level of the sent test signal will be adjusted to give a power of 1 mW at a zero relative level point of the circuit. The sent level will be accurate to ± | .5 dB.

(3) Passage to the measuring condition:

As soon as the outgoing testing equipment has sent the test signal, it will pass automatically from the sending condition to the measuring condition. In this condition, the level measuring equipment will measure the level of the test signal received from the incoming end. The operator of the automatic device at the outgoing end will check that the level of the received signal is within the prescribed limits.

Recommendation Q.138

5.6 INSTRUMENTS FOR CHECKING EQUIPMENT AND MEASURING SIGNALS

5.6.1 *General*

For local checks of correct equipment and for readjusting the equipment, international exchanges should have available instruments of the following two types:

a) calibrated signal generator;

b) signal measuring apparatus.

These instruments should have the following characteristics:

5.6.2 *Calibrated signal generator*

Duration of sent signals to be adjustable between the extreme

limits given in the equipment specifications, i.e. 3 to 500 ms.

The accuracy required in the duration of sent signals should be the higher of the following two values:

± 1 ms or ± 1% of the nominal value of the sent signal.

Frequency:

The sent frequency shall not differ by more than ± 5 Hz from the nominal value and shall not vary during the time required for testing.

Level of the sent signals to be variable between the extreme limits given in the equipment specifications and able to be set to a particular fixed value equal to the nominal value as defined in these specifications.

Tolerances on the reading of the level of the sent signalling frequencies to be ± | .2 dB.

5.6.3 *Signal-measuring equipment*

Duration of signals to be measured to be between the extreme limits given in the equipment specifications, i.e. 3 to 500 ms.

The accuracy required in the duration of the measured signals should be the higher of the following two values:

± 1 ms or ± 1% of the nominal value of the received signal.

Signal frequency to be measured to be between the extreme limits set by the specifications, the reading being made with an accuracy of ± | Hz.

Level of the signalling frequencies to be measured to be adjustable between the extreme limits set by the specifications, the reading being made with an accuracy of ± | .2 dB.

Recommendation Q.139

5.7 MANAUL TESTING

5.7.1 *Functional testing of signalling arrangements*

Functional tests from one end of the circuit to the other can be made in the following three ways:

a) The first method consists of a rapid verification of unsatisfactory signal transmission by ensuring that a seizing signal is followed by the return of a proceed-to-send signal, that a clear-forward signal is followed by the return of a release-guard signal and that the circuit is clear.

b) The second method consists of verification of satisfactory signal transmission by initiating a test call:

1) to technical personnel at distant-end international exchange; or

2) to a test call signal testing and answering device, if such equipment is available at the distant-end international exchange.

c) The third method will consist of a complete verification of satisfactory line and register signal transmission. The verification consists of a check of ability to:

1) generate and receive line and register signals;

2) transmit the appropriate acknowledgement signals;

3) complete terminal and transit calls.

5.7.2 *First method: rapid test*

1. Verification of satisfactory signal transmission:

a) Initiate a seizing signal and verify the receipt and recognition of the proceed-to-send signal from the distant end;

b) Initiate a clear-forward signal and verify the receipt and recognition of the release-guard signal from the distant end.

2. In the event of a failure, appropriate steps should be taken to locate and correct the trouble.

3. The above tests are short, simple, and should be performed at least monthly from each end of the circuit as appropriate. This minimum periodicity should be increased to as often as daily if the incidence of trouble encountered is unsatisfactory.

5.7.3 *Second method: test calls*

1. Verification of satisfactory transmission of signals involved in completion of test calls (manual method):

a) Place a call to the technical personnel at the distant international exchange.

Transit test calls are not intended to check the performance or the quality of the circuit beyond the transit exchange; this being entirely the responsibility of the Administration concerned. However, it is important that in principle the transit operations can be checked.

b) On completion of connection:

1. the audible ringing tone should be heard;

2. the answer signal should be received when the call is answered at the distant end.

c) Request distant end to initiate a clear-back signal, followed by an answer signal.

d) A clear-back signal should be received and recognized when the distant end hangs up and a second answer signal should be received and recognized when the distant end re-answers the call.

e) Initiate a forward-transfer signal which should result in bringing the assistance operator at the distant end.

f) Terminate the call and observe that the circuit restores to the idle condition.

2. Verification of satisfactory transmission of signals involved in completion of test calls (semi-automatic method).

If test call signal testing and answering devices are available at the distant international exchange, the signal verification test should be made using this equipment to the extent that the applicable features indicated in 1 above are available.

3. The tests should be made monthly when the manual testing methods prescribed in § 5.7.3.1 are used.

They may be made daily when semi-automatic test arrangements are available.

5.7.4 *Third method: comprehensive tests; terminal and transit calls*

1. Verification of satisfactory signal transmission (frequency, level, duration, etc.) involved in terminal and transit calls.

a) These tests are made in conjunction with:

— verification and location of faults;

— ensuring that new circuits are satisfactory in operation before being brought into service.

b) When establishing new circuits, all of the tests outlined in § 5.2.3 should have been completed at both terminals.

2. *Terminal calls*

Initiate a call to the distant end test centre. Coordinate this test with the distant end so that appropriate test equipment is connected prior to establishing the call. The tests shall proceed as follows:

a) at the originating end, check that a terminal seizing signal is followed by the receipt of a terminal proceed-to-send signal from the distant end;

b) at the distant end, check that the individual signal elements are correctly received and that each digit is acknowledged correctly;

c) at the originating end, check that the number received signal is received;

d) check that the audible ringing tone is heard at the originating end:

e) at the distant end, initiate an answer signal;

f) at the originating end, check that the answer signal is received and recognized;

g) at the distant end, initiate a clear-back signal;

h) at the originating end, check that the clear-back signal is received and recognized;

i) at the originating end, initiate a forward-transfer signal;

j) at the distant end, check the receipt of the forward-transfer signal;

k) at the distant end, arrange to transmit a succession of clear-back and answer signals; first at a slow rate, then at a rate which is faster than the system is capable of following;

l) at the originating end, check during the slow transmission of the switch-hook flashes that each clear-back and answer signal is received and properly recognized. Verify that after the transmission of the fast switch-hook flashes, the equipment indicates the final position of the switch-hook;

m) at the originating end, initiate the release of the circuit;

n) at the distant end, check that the clear-forward signal is received and recognized and that the circuit releases;

o) at the originating end, check that the release-guard signal is received and recognized and that the circuit releases;

p) at the originating end, set up a call to a busy line or to a test call device which provokes the return of a busy-flash signal and check that the busy-flash signal is received and recognized;

q) at the originating end, after receipt of the busy-flash signal, initiate a release of the connection and check that the equipment releases correctly;

r) at the distant end, after sending the busy-flash signal, check that the clear-forward signal releases the equipment;

s) at the distant end, initiate the transmission of a blocking signal;

t at the originating end, check that the blocking signal busies the circuit;

u) at the distant end, initiate the transmission of an unblocking signal;

v) at the originating end, check that the unblocking signal restores the circuit to normal;

w) at the distant end, connect in turn a continuous x tone, a continuous y tone, a continuous $x + y$ tone, with the circuit in the idle state in each case;

x) at the originating end, check that the receipt of a continuous x tone, or a continuous y tone, or a continuous $x + y$ tone busies the circuit;

y) at the originating end, check that the clear-forward signal sent to the incoming equipment in the idle condition results in the return of the release-guard signal and that the equipment restores to the idle condition;

z) at the originating end, check the presence of a transmission test loop with the circuit in an idle condition and then check that within 35 ms of receipt of a seizure signal, the loop is removed.

3. *Transit calls* (System No. 4 to System No. 4)

After securing the cooperation of a third international centre, initiate a transit call to this centre through the international centre, covered in § 2 above, which thus becomes the transit centre. Check the following sequence:

a) at the originating end, check that a transit seizure signal is followed by the receipt of a transit proceed-to-send signal from the transit centre;

b) at the transit centre, check that the necessary routing digits are received and acknowledged correctly and that a circuit to the terminal centre is selected;

c) at the originating end, check that a terminal proceed-to-send signal is received and that the correct digital information is sent to the terminal centre;

d) with the assistance of technical personnel at the terminal centre, check that the number received, answer, clear-back, forward transfer, busy-flash, clear-forward and release-guard are correctly interpreted.

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ANNEXES TO SIGNALLING SYSTEM No. 4

SPECIFICATIONS

ANNEX 1
Signalling sequences

Table 1 — Signalling sequences in terminal traffic

Table 2 — Signalling sequences in transit traffic

In these tables, the arrows have the following meanings:

transmission of a signalling frequency (permanent or pulse emission)

end of transmission of the signalling frequency in the case of its permanent transmission.

transmission of an audible tone.

ANNEX 2
Descriptions of the operations corresponding

to the various normal and abnormal conditions
which may arise in setting up a call

Table 1 — Outgoing exchange — Normal conditions

Table 2 — Outgoing exchange — Abnormal conditions

Table 3 — Incoming exchange — Normal conditions

Table 4 — Incoming exchange — Abnormal conditions

Table 5 — Transit exchange — Normal conditions

Table 6 — Transit exchange — Abnormal conditions

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