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Translation

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Technical regulations concerning international railway telephone circuits

*Prescriptions techniques relatives aux communications téléphoniques ferroviaires internationales
Technische Vorschriften für internationale Eisenbahn-Fernsprechverbindungen*



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Summary

This leaflet defines the elements used for international telephone communications and the rules to be observed in establishing international circuits. The technical characteristics of the analogue and digital transmission systems constituting these circuits are also specified. Reference is further made to specifications relating to line systems, such as the overhead line, cables and directional radio links. Finally, the maintenance procedures to be applied are dealt with.

NB : this leaflet forms part of a set, including:

- *UIC Leaflet 750,*
- *UIC Leaflet 753-2.*

There is also a reference, in point 2.3.4, to *UIC Leaflet 911-4* "Standard provisions for modems and transmission lines used in data links with a binary throughput of 600 to 9 600 bits/s".

1 - General

Preliminary note

This text is based largely on ITU-T (see [List of abbreviations - page 33](#)) regulations, and references are to the most recent edition of the ITU-T Recommendations. It specifies and summarizes the main regulations with which international railway telephone connection circuits must comply, using the units defined in [Appendix A - page 31](#).

Some of these regulations are mandatory. Operating aspects are dealt with in *UIC Leaflet 750* (see [Bibliography - page 34](#)).

1.1 - Definitions

1.1.1 - International railway circuits

The following shall be considered as international telephone circuits:

1. Inter-railway circuits proper, i.e. international telephone circuits affording direct connections between the telephone systems of any two countries and suitable for international railway telephone transit calls.

Lines connecting stations directly adjacent to frontiers, and which are only used for local purposes, are not therefore taken into account here.

2. Railway internal 4-wire circuits affording direct communication with the main exchanges of inter-railway circuits, which are used for establishing international transit calls between two non-adjacent countries.

1.1.2 - National circuits

National circuits are those which do not fall into either of the above categories. They include extension circuits, local circuits, and user lines.

1.1.3 - International exchanges

International circuits are those terminating at main exchanges of inter-railway circuits. When considered from the point of view of international connections, such exchanges can be either of a terminal or transit nature. In the case of the latter, they must be designed for connecting international circuits.

1.1.4 - International connections

International connections are established through the equipment linking together the two subscriber stations belonging to different networks and having access to international circuits.

It includes therefore the two subscriber stations, a chain of international and national circuits, and the relevant switch gear (manual or automatic).

1.2 - International railway telephone service

International railway telephone connections cannot be set up except by agreement with the railways and observance of certain technical specifications given in this leaflet. These specifications could prove inadequate in the event of the system of circuits becoming too complex. It may then prove worthwhile to provide very-long-distance direct inter-railway circuits.

A data base established by the responsible panel of experts is kept updated by the UIC on the basis of information furnished by the Railways. This data is accessible from the Internet at the UIC Site under the following address <http://ernst.uic.asso.fr/>.

2 - Technical regulations concerning transmission

2.1 - General features of an end-to-end international connection

2.1.1 - Reference equivalent

2.1.1.1 - In any international railway telephone connection, the reference equivalent between two users (telephones included) is not strictly limited, since the number of sections that can be connected end-to-end in the international chain is unlimited.

2.1.1.2 - However, in practice, the reference equivalent of the international chain should not exceed 3 dB with the result that the total reference equivalent for the longest international connection should not exceed 36 dB, taking into account the directives given below (21 dB + 3 dB + 12 dB).

○ **2.1.1.3** - The reference equivalent of the national transmitting system (counted from the telephone to the original international circuit as defined in point 1.1.1 - page 2) must not exceed 21 dB (telephone included).

○ **2.1.1.4** - The reference equivalent of the national receiving system (counted from the ends of the international circuit to the telephone) shall not exceed 12 dB (telephone included).

2.1.1.5 - The equivalent should in theory have the same value for both directions of transmission.

2.1.1.6 - Figure 1 below gives an example of the distribution of equivalents for an end-to-end international connection.

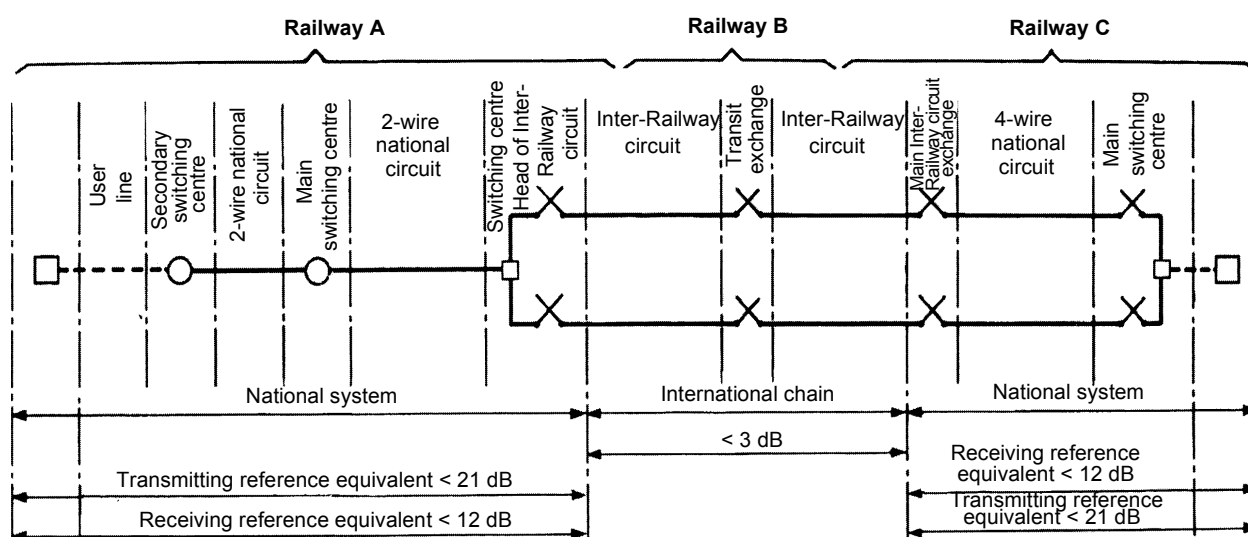


Fig. 1 - International telephone circuits - Example of distribution of equivalents

2.1.2 - Articulation indices

2.1.2.1 - The transmitting and receiving reference equivalents for user telephone sets in international connections are not fixed. The values fixed for the national system in point 2.1.1 - page 4 should be observed.

2.1.2.2 - The response curve of the user telephone set should be as even as possible with a slight rise near the high frequencies (e.g. 2 dB per octave). The difference between the limit values should not be greater than 10 dB (in the 300 to 3 400 Hz range).

2.1.3 - Phase delay

- **2.1.3.1** - To cut down echo effects, phase delay between two users in an end-to-end international connection should be limited to:

- 150 ms where possible,
- 400 ms in all cases, with echo suppressors,

measured at a frequency of about 800 Hz.

- **2.1.3.2** - To achieve this, phase delay on each of the national transmitting or receiving systems must not exceed 18 ms and phase delay on the international circuit must not exceed 25 ms.

2.1.3.3 - Only high-speed transmission circuits should be used as international circuits and, preferably, digital multiplex system links.

2.1.4 - Envelope delay distortion

To allow "Telematics" applications at lower average speeds, the envelope delay distortion must come within the template shown in Figure 2 below.

Nota : "Telematics" applications are data processing functions that use subscriber telephone lines.

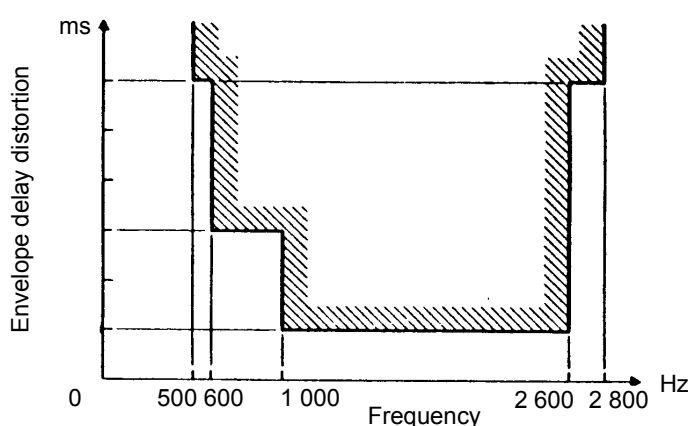


Fig. 2 - Template of envelope delay distortion in relation to the minimum value for an end-to-end international circuit

2.2 - General characteristics of the international circuit chain and national extension circuits

2.2.1 - Types of circuit and interconnection of circuits

- 2.2.1.1 - The arrangement known as the 4-wire system shall be used for international circuits.
- 2.2.1.2 - 4-wire connections must be used for junctions between two international circuits.
- 2.2.1.3 - The 4-wire interconnections should be carried out by direct connection of the transmitting and receiving lines. In actual fact, although indirect connection by means of differential transformers is in theory equivalent to a direct connection, this latter expedient should be avoided since unbalance is likely to result from abnormal conditions, and have undesirable effects upon the signals.
- 2.2.1.4 - The junction between an international circuit and a 4-wire national extension circuit shall be done by means of the 4-wire connection.

2.2.2 - Permissible equivalents for national circuits

The minimum equivalent for national circuits shall be arrived at by calculating:

- the minimum value of the permissible equivalent from the point of view of echo (in respect of the person speaking);
- the minimum value of the permissible equivalent from the point of view of stability (risk of singing point oscillations).

The higher of the two values is the relevant figure.

The maximum equivalent of national circuits shall be based on the values laid down in point 2.1.1 - page 4, and on the equivalent values for transmission and reception of the telephones used.

2.2.3 - Echo effects

- 2.2.3.1 - The minimum permissible values for attenuation of echo currents at 800 Hz are given in Figure 3 - page 7 below. The curves only apply to circuits without echo suppressors only, this being the normal case on the railways.

2.2.3.2 - Echo currents result from unavoidable imperfections in impedance matching between circuits, terminating sets, amplifiers, etc. The magnitude of the echo can be calculated by taking into account the return loss at the terminating sets and, at the distant end, the gains encountered in the circuits, and the propagation time on the various sections of line used. This calculation, which is not usually necessary when multiplex equipment interconnected with 4-wire circuits is used, is carried out in accordance with the method recommended by the ITU-T (*Recommendation G.131*, see Bibliographie - page 34).

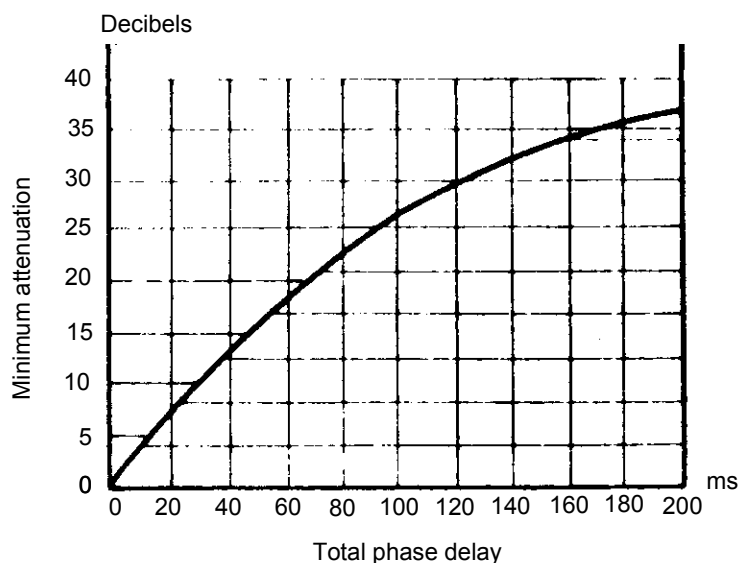


Fig. 3 - Curve giving the minimum permitted echo attenuation value for circuits without echo suppressors in relation to total phase delay on echo current paths

2.2.4 - Transmission stability

- 2.2.4.1 - The stability of the chain of national and international circuits between the two local exchanges, when these are insulated, must be at least 3 dB.

2.2.4.2 - To enable this condition to be fulfilled, a minimum value should be fixed for attenuation, measured at the international exchange in which the international circuit between the national transmitting and receiving extension system ends. This value should be equal to or higher than $(6+n)$ dB, "n" being the number of 4-wire circuits in the national chain. The 2-wire circuit terminals must be insulated while the measurement is being carried out.

2.2.4.3 - The calculation shall be made according to the method recommended by the ITU-T (*Recommendation G.131*).

2.2.4.4 - As the equivalent variation increases with the number of circuits, it should be kept to a minimum by carrying out maintenance at carefully selected intervals.

- 2.2.4.5 - A limit value of ± 1 dB shall be observed for the deviation in time of each international circuit in relation to the rated value.

2.2.5 - Cross-talk between the different circuit chains

2.2.5.1 - The cross-talk ratio between the two 4-wire circuit chains shall be limited by the following conditions laid down for each element in the chain:

- 2.2.5.2 - The far or near-end cross-talk measured between two 4-wire circuits shall not be less than 58 dB.
- 2.2.5.3 - The cross-talk ratio between the two connections established in an international exchange shall not be less than 70 dB.

2.2.6 - Cross-talk between the outward and return channels of a 4-wire circuit chain

2.2.6.1 - The cross-talk ratio between outward and return channels of a 4-wire circuit shall be limited by the following conditions laid down for each element in the chain:

- **2.2.6.2** - The near-end cross-talk ratio measured between the two transmission directions of a 4-wire circuit shall be at least 43 dB.
- **2.2.6.3** - The cross-talk ratio between the two connections which constitute the outward and return channels of a 4-wire circuit path in an international exchange must not be less than 60 dB.

2.2.7 - Circuit impedance

- **2.2.7.1** - All circuits leading to the same exchange must possess the same rated impedance value at the switches, both for 2-wire and 4-wire circuits. This rated value must be 600 Ω .

2.2.7.2 - The return-current coefficient should remain below 0,10.

2.2.8 - Envelope delay distortion

Envelope delay distortion in the circuit chain is determined by observing the condition laid down in point **2.1.4 - page 5** for each circuit in the chain. In this way, it is hoped that the lower mean data transmission speeds (e.g. 1 200 bits per second) will function correctly.