INTERNATIONAL TELECOMMUNICATION UNION

# ITU-T G.102

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

## TRANSMISSION SYSTEMS AND MEDIA

## GENERAL CHARACTERISTICS OF INTERNATIONAL TELEPHONE CONNECTIONS AND INTERNATIONAL TELEPHONE CIRCUITS

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# TRANSMISSION PERFORMANCE OBJECTIVES AND RECOMMENDATIONS

## ITU-T Recommendation G.102

(Extract from the *Blue Book*)

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**NOTES**

1 ITU-T Recommendation G.102 was published in Fascicle III.1 of the *Blue Book*. This file is an extract from the *Blue Book.* While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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**Recommendation G.102**

## TRANSMISSION PERFORMANCE OBJECTIVES AND RECOMMENDATIONS

*(Geneva, 1980)*

### 1 General

The CCITT has drawn up (or is in the process of studying) Recommendations concerning transmission impairments and their permissible magnitude with the object of achieving satisfactory performance of the network. Such impairments include for example:

a) loudness rating (LR) and loss,

b) noise,

c) attenuation distortion,

d) crosstalk,

e) single tone interference,

*f)* spurious modulation,

g) effects of errors in digital systems.

Some Recommendations state objectives for an impairment with the implicit assumption that other impairments are at their maximum value (e.g. noise and loss).

In many instances the objectives are based primarily on telephony; this however may require special measures to he applied when other, more demanding services (e.g. sound-programme transmission) are to be incorporated within the network or constituent parts thereof.

The following distinctions may be made between different types of objectives:

1) performance objectives for networks,

2) performance objectives for circuits, transmission and switching equipment,

3) design objectives for transmission and switching equipment,

4) commissioning objectives for circuits, transmission and switching equipment,

5) maintenance/service limits for circuits, transmission and switching equipment.

### 2 Explanation of a performance objective

The performance objective for a measurable transmission impairment for networks, entire connections, national systems forming part of international connections, international chains of circuits, individual circuits etc. often describes in statistical terms (mean value, standard deviation, or probability of exceeding stated value, etc.) the value to be aimed at in transmission network and systems planning. It describes the performance which, based for example on subjective or other performance assessment tests, it is desirable to aim at in order to offer the user a satisfactory service.

The items (circuits, systems, equipments) making up the network are normally assumed to have a performance related to that recommended by the performance objectives. Traffic weighting will, in some cases, be applied to calculations.

A powerful set of tools which may be used in analyses concerning network objectives and compliance therewith are the hypothetical reference connections described in Recommendation G.103.

## 3 Explanation of a design objective

The "design objective" for a measurable transmission impairment (e.g. noise, error-rate, attenuation-distortion) for an item of equipment (e.g. a line system, a telephone exchange) is its value when the item is operating in certain electrical/physical environments which might be defined by such parameters as power supply voltage, signal load, temperature, humidity, etc. Some of these parameters may be the subject of CCITT Recommendations and some may not, and it is for the Administrations to assign values to them when they prepare specifications. A suitable allowance may also be made for aging. The most adverse combination of the specified parameters is often assumed.

The purpose of a "design objective" is to provide a basis for the design of an item with respect to the quantity concerned. The significance of the design objective for an item, and examples of the relative frequency of impairment values, are illustrated in Figures 1/G.102 and 2/G.102 respectively.

Design objectives will in many cases directly form the basis of a specification clause for the development and/or the purchase of equipments.

A powerful set of tools used in connection with applying design objectives are the hypothetical reference (HR) circuits and hypothetical reference (HR) digital paths (see relevant Recommendations in the G.100 and G.700 Series).

## 4 Explanation of a commissioning objective

The conditions encountered on real circuits and installed equipment may differ from the assumptions valid for the HR circuits and for the design of equipment. Therefore the performance to be expected at the time of commissioning cannot be deduced uniquely from Recommendations relating to HR circuits. Suitable allowances may have to be made for such matters as circuits being made up of equipments of different design, line systems differing substantially in length from a homogeneous section, etc. (see for example Recommendation G.226 [1] for noise on real links).

Commissioning objectives are not normally the subject of CCITT Recommendations.

## 5 Explanations of limits for maintenance purposes

In service, the performance of an item or assembly of items may deteriorate for various reasons: aging, excessive loading, excessive environmental conditions, operations errors, components failures, etc. and there is an economic penalty in service costs if such deterioration is always to be kept negligibly small. Therefore design objectives are chosen to confer as great a margin as possible to assure a satisfactory in-service performance.

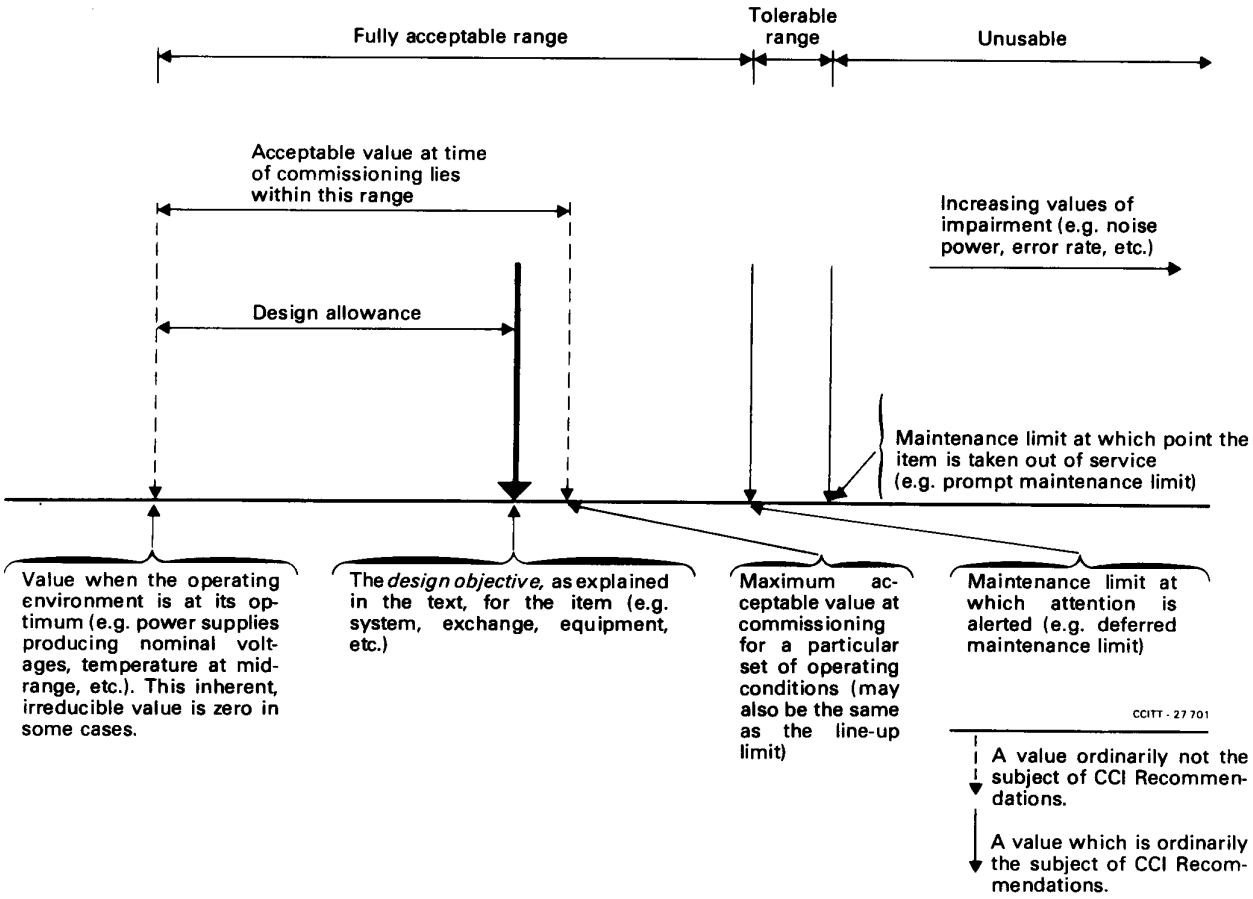



FIGURE 1/G.102

**Illustration of the significance of design objective for an item**

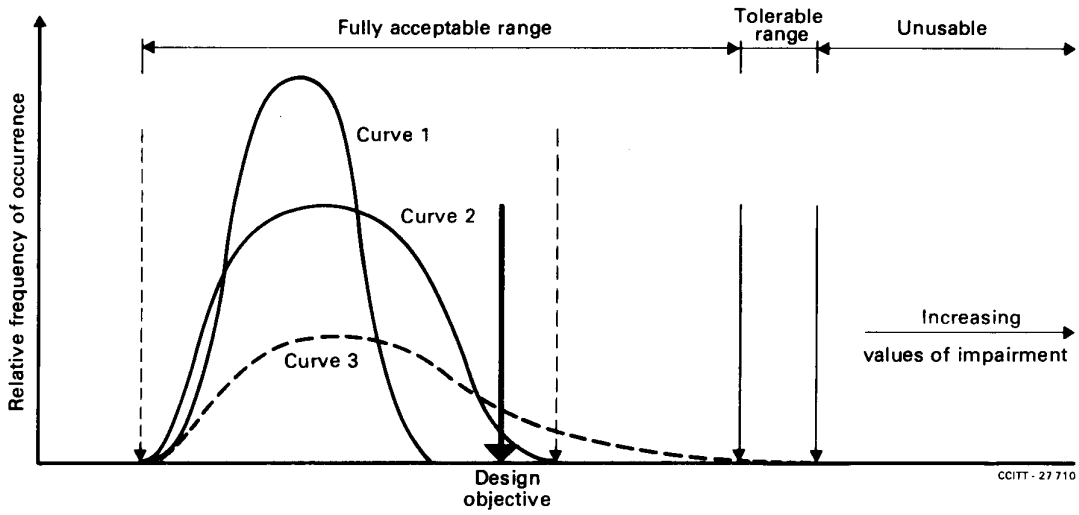
With transmission impairments, there is often no value which represents a clear boundary between "tolerable" and "unusable" performance and in practice a range of impairments in excess of those provided by design objectives will give satisfactory service to customers. This is the case for telephony but for other services may be different.

Nevertheless it is often expedient to define a particular value of impairment above which the item is deemed to be "unusable" and at which the item will be withdrawn from service at the first opportunity so that remedial action can be taken to restore the performance to comply with some defined limit (e.g. limit for prompt maintenance action).

It is often useful to define a performance limit at which attention is alerted but (perhaps) no action is taken immediately (e.g. limit for deferred maintenance action).

These limits are usually independent of the type of service carried by that particular entity. However, it is sometimes necessary to define a performance limit for a particular type of service, beyond which the customer is no longer offered a satisfactory service quality. This limit may differ for various services; some may coincide with a prompt maintenance limit (service limit).

These limits (and others, if necessary) would fall above the design objective. These limits are illustrated in Figure 1/G.102 and a generic title for them is "maintenance limits".




Such curves may be obtained for ensembles of items of equipment at the time of commissioning.

Alternatively curves may be plotted representing the performance of an item during its lifetime.

Curve 1 - Example of relative frequency of occurrence of impairments at time of commissioning in which the design value is met with some margin. A similar distribution might be achieved in service throughout the lifetime of an item of equipment if the effect of environmental conditions etc. is negligible. An example might be the attenuation distortion of transformers.

Curve 2 - Example of the relative frequency of occurrence of impairments at time of commissioning in which the design value is exceeded with some agreed probability because the item of equipment is used in a way which is more demanding than that in the design objectives. An example might be the effect of a repeater spacing of a radio or line system greater than anticipated.

Curve 3 - Example of the relative frequency of occurrence of impairments in service in which the working environment has parameters more onerous than or additional to those specified. Examples might be the effect of excessive loading, component failure or operational errors.

FIGURE 2/G.102

**Examples of the relative frequency of impairment values**

**Reference**

[1] CCITT Recommendation *Noise on a real link,* Vol. III, Rec. G.226.