INTERNATIONAL TELECOMMUNICATION UNION

ITU-T Q.29

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GENERAL RECOMMENDATIONS ON TELEPHONE SWITCHING AND SIGNALLING

INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING

CAUSES OF NOISE AND WAYS OF REDUCING NOISE IN TELEPHONE EXCHANGES

ITU-T Recommendation Q.29

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.29 was published in Fascicle VI.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.

Recommendation Q.29

CAUSES OF NOISE AND WAYS OF REDUCING NOISE IN TELEPHONE EXCHANGES

Circuit noise may be classified as follows:

1) power supply noise,

2) noise generated in the speech path circuit,

3) noise induced in the speech path circuit.

1 Power supply noise

1.1 *Power sources*

The interference resulting from the harmonics, ripple and current fluctuation of machines, rectifiers and batteries.

This noise may be reduced by d.c. generators with low harmonics and good regulation and rectifiers with good regulation, effective filters, and batteries with large capacity (i.e. with low internal impedance).

1.2 *Supply leads*

The interference in the speech circuits of an exchange due to power supply equipment originates mainly in the common impedances of the supply paths of speech and switching circuits, and is caused mainly by the sudden fluctuation of the current resulting from the sudden operation and release of the different relays, magnets and contacts.

These common impedances may be reduced by:

a) the use of common power supply leads of sufficiently low resistance, the use of large capacitors fitted at apparatus ends of supply leads with minimum impedances, e.g. minimum distance between bus bars, or coaxial feeders. Another method employs close-spaced cables with alternate polarity;

b) the use of a common battery with separate power supply leads for speech and switching circuits. Better results may be obtained at an increased cost by independent batteries adequately separated;

c) the arrangement of the cells of the battery in a U formation.

1.3 *Earth returns*

Independent earth returns should be used for signalling-frequency supply circuits.

2 Noise generated in the speech circuit

2.1 *Contact noise caused by vibration*

This kind of noise is caused by contact resistance variations of the various commutator, switch and relay contacts due to mechanical vibration.

This contact noise may be reduced by:

a) the use of damping devices to reduce the generation of vibration caused in particular by relay sets, mechanical and electromagnetic clutches;

b) the use of multiple brushes, spring or resilient mountings to reduce the transmission of vibration;

c) a suitable choice of contact materials;

d) the use of the best contact shape and of twin contacts;

e) maintaining atmospheric conditions at an appropriate relative humidity and the use of air filters; use of dust covers on equipment, arranging design of columns, window sills, radiators and floor to avoid harbouring dust;

f) careful maintenance cleaning and lubrication in accordance with specifications.

2.2 *Frying noise*

In speech circuits some contact materials are liable to cause frying noise.

This noise may be reduced by the use of suitable contact materials and by keeping an appropriate relative humidity.

2.3 *Contact noise caused by wetting currents*

Speech circuits without d.c. currents are liable to fading due to contact resistance fluctuations. Fading may be reduced by wetting. However, wetting currents may introduce frying noise on the lines.

2.4 *Charge and discharge clicks*

Clicks may frequently be caused by the charging or discharging of capacities (cable capacity) by switches when rotating over occupied and non-occupied terminals.

Objectionable clicks are also likely to result from sudden battery reversals, dialling and other abrupt changes in the current flowing in the speech circuits.

These effects may be reduced:

a) by disconnecting the speech circuits from the brushes during the hunting period of the switch;

b) by the use of twisted pairs, by limiting the length of cabling and also by locating relays as close as possible to the selectors they control.

2.5 *Unsound contacts*

Objectionable noise may be due to unsound contacts on distribution frames, particularly when work is in progress such as adding or changing jumpers, etc. Such unsound contacts may be due to "dry" contacts inadequately soldered, poorly wrapped joints, or to the use of distribution frame equipment having inadequate contact pressure. It is suspected that this type of trouble is responsible for most of the "hits" and "misses" and usually for an increase in noise.

2.6 *Tapping losses*

When lines are tapped for service interception, observation, etc., the tapping circuit should be designed to give the minimum of unbalance to earth and the transmission loss introduced should be a minimum. Semi-permanent connections should be used in preference to base-metal sliding connections at the tapping point.

2.7 *Reduction of the number of switching contacts*

Circuits should be designed so that at each switching stage there is a minimum number of contacts in the speech circuit in order to reduce the risk of microphonic noise from "dry" contacts.

3 Noise induced in the speech circuit

3.1 *Noise induced in the speech circuit may be due to:*

a) speech crosstalk;

b) signalling frequency crosstalk;

c) induction from tone supplies;

d) direct current pulses;

e) clicks caused by abrupt changes in inductive and capacitive circuits.

Clicks may be reduced at the source by the use of spark quench devices or other means to reduce the steepness of the interfering wave-front concerned. In addition, noise may be reduced by balancing, by using twisted pairs and/or by screening.

3.2 *Noises due to unbalanced transmission bridge circuits*

A well-balanced circuit is necessary for the transmission bridge to avoid noise interference. This can be achieved by:

a) the use of balanced components;

b) the separation of components used for speech from those used for control and switching;

c) the separation of individual transmission bridges by screening or spacing;

d) the addition of balancing components, e.g. balancing transformers of retardation coils;

e) taking the precautions listed at the end of § 3.1 above.

3.3 *Low-level speech circuits*

Low-level electronic speech circuits are particularly susceptible to noise induction and should therefore be screened.

3.4 *Longitudinal interference*

Such noise may be induced into the speech circuit from the line by power distribution systems and traction circuits or by earth potential differences.

These may be reduced by balancing the line or by the addition of transformers.

Note - Interference which is sufficiently severe to cause unwanted operation of relays, etc., may be overcome by the use of loop circuits which should also reduce noise.