its as Administrations may set.

Note 6 - Fuses, fuse cables, etc, may be left in circuit during these tests. The current conducted by wiring shall not constitute a fire hazard within the premises where the equipment is located.

8.Tests related to electrostatic discharges

The requirements of IEC Publication 801-2 should be followed. The equipment should meet criterion A of this Recommendation when tested to both severity levels 2 and 4 of IEC Publication 801-2 .These two severity levels have been chosen because at severity level 2, the rise time is much faster than that at severity level 4. This fast rise time may cause coupling into sensitive circuits to take place and will require an assessment for misoperation due to software corruption rather than just for energy dissipation.

However, when deemed appropriate by an Administration, alternative severity levels of testing may be used. In addition, an Administration may choose to relax the conditions of criterion A to a limited extent.

9.Tests related to mains voltage powered equipment

The following tests are made on mains-powered equipment to ensure that the equipment can adequately resist high voltage surges which may arise on power conductors from lightning or other causes such as load switching.

The equipment under test should be tested with normal operating power applied and with the telecommunication line parts terminated in such a manner as to simulate the conditions in each state of operation of significant duration.

Equipment not complying with a) below should meet Criterion A of this Recommendation when tested with surge tests applied between phase, neutral and protective earth terminals of the equipment in accordance with b) below.

a) Insulation coordination

IEC Publication 664 (Insulation coordination within low-voltage systems, including clearances and creepage distances for equipment) describes over-voltage categories for mains-powered equipment including telecommunications equipment, in respect of over-voltages arising in the supply network. Most subscribers equipment is expected to be installed in over-voltage category 11 in which the maximum surge voltage arriving at its mains terminals is 2.5 kV peak. Given this and certain other assumptions about atmospheric pollution (e.g. dust) and the quality of insulation, IEC 664 gives guidance to IEC standards committees on coordinated creepage distances and clearances that can be expected to give adequate performance during the lifetime of the equipment.

Note 1 - An earthed connection may prevent the establishment of normal operation conditions when the test is made. In these cases, alternative testing procedures should be followed to meet the requirements of this test (e.g. a low voltage spark gap or other variation in the earth connection should be used).

Note 2 - Administrations may choose other values of U_c(max) to suit local circumstances, e.g. to avoid the use of protectors or to align with the impulse spark-over voltage of protectors that are normally used.

Note 3 - Administrations may vary U_c(max) to meet their local requirements.

Note 4 - Administrations may specify lower values of U_{ac} (max) and may vary the duration of the test to meet their local requirements (e.g. local mains voltages).

Note 5 - Voltages and durations should be in accordance with CCITT Directives or such other lim-

The equipment should be tested according to Table 1.

fitted.

Protectors having characteristics within the agreed range should be used where specified in Table 1. A new set of protectors may be used after the completion of each test sequence. Alternatively, some Administrations may choose to omit the external protectors but to modify the applied voltages and durations so that the conditions applied to the equipment are the same as could reasonably be expected to occur under the conditions of Table 1.

5.7 In all cases where a maximum voltage is specified, tests should also be made at lower voltages if this is necessary to confirm that the equipment will resist any voltage up to the maximum value specified.

5.8Each test should be applied the number of times indicated in the relative Table. The time interval between applications should be one minute and, in the case of pulse tests, the polarity should be reversed between consecutive pulses.

5.9Power induction and power contact tests should be made at the frequencies of the ac mains or electric railways used in the country of application.

6.Permitted malfunction or damage

Two levels of malfunction or damage are recognized:

Criterion A - Equipment shall withstand the test without damage or other disturbance (such as corruption of software or misoperation of fault- protection facilities) and shall operate properly within the specified limits after the test. (It is not required to operate correctly while the test condition is present). If specifically permitted by the Administration, the test may cause the operation of fuses or other devices which have to be replaced or reset before normal operation is restored.

Criterion B - A fire hazard should not arise in the equipment as a result of the tests. Any damage or permanent malfunction occuring should be confined to a small number of external line interface circuits.

The conditions likely to give rise to criterion B are considered to be so rare that complete protection against them is not economical.

7.Tests related to lightning surges, power induction and contacts

The test circuits used for the three overvoltage or overcurrent conditions are as follows:

Figure 1 - Lightning surges,

Figure 2 - Power induction,

Figure 3 - Power contacts.

usually when these lines or systems develop faults;

- direct contacts between telecommunications lines and power lines, usually of a low voltage nature;

-electrostatic discharges generated by users touching the equipment or adjacent plant;

- transient surges on mains-voltage power supplies to the equipment.

4.Equipment boundary

The variations in equipment make it necessary for each unit to be seen as a "black-box" having three or more terminals, A, B, ..., etc. and Earth. Some protective devices may have already been provided within the equipment, e.g.,distributed on cards, or connected to internal terminals. For the purposes of these tests manufacturers are expected to define the boundaries of the "black-box" and any protective device which is thereby included must be considered as an immutable part of the equipment. Where any auxillary telecommunications lead is provided, e.g. to an extension, or as a signalling earth, these wires should be seen to extend the number of terminals to be tested, e.g. A, B, C, D, ..., etc. and Earth.

5.Test conditions

The following general conditions apply to all the tests specified in §§7, 8 and 9 except where otherwise stated.

5.1All tests are type tests.

5.2The input terminals at which tests on the equipment are to be applied should be identified by the manufacturer and labelled A, B, C, D, ..., etc. and Earth.

5.3For the tests specified in § 7 and § 9 only, the equipment should be enclosed in a foil shroud over areas likely to be contacted during use and the foil connected to the E terminal.

5.4The equipment should be tested in any operating state of significant duration.

5.5The equipment should pass the tests listed in §§ 7 and 9 throughout the ranges of temperature and humidity of its intended use.

5.6Some of the tests in Table 1 require the addition of agreed primary protection. It is current practice to protect exposed subscribers' lines with some surge protectors such as gas-discharge tubes. Recognizing that some such device is likely to be needed in most cases to handle high surge currents, and that the operation of these protectors exposes subscribers' equipment to other modified conditions, the characteristics of the external protectors to be used should be agreed between the equipment supplier and the Administration. Administrations applying the tests included in this Recommendation are free to select such protectors with any characteristics within the range acceptable for these nominated devices when carrying out tests with external protection

The Recommendation assumes that line protectors are fitted externally to the equipment in exposed areas. Administrations individually will decide their policies for protection. The guidance of Recommendation K.11 should be followed when making this judgement and should take account of the routing of lines to the equipment in addition to its location.

2. Scope

This Recommendation deals principally with desk-borne equipment. Recommendation K.20 deals with switching equipment powered by central-battery. For the more complex subscriber equipment, Administrations should use either K.20 or K.21 as appropriate.

The Recommendation relates to type tests only. Recognizing the difficulty in testing a complex item of subscribers equipment, the Recommendation concentrates on a series of tests made principally at the line and mains input terminals. The tests should be applied at any chosen stage during the normal use of the equipment.

As the equipment may be used in either an exposed or unexposed environment, tests are made with and without line protectors fitted.

The tests for lightning surges assume that electrical connection between the power system earth terminal and the telecommunications equipment earth can be effected. A study of special test requirements for situations where this is not possible is being made.

The tests for power induction apply only to longitudinal effects and a further study is being made of test requirements for transverse surges.

Some aspects of rise of earth potential, such as may arise from a power line system fault, are not at present covered but are being studied.

Electrical fast transient requirements are not yet included and a study is being made of test requirements for both the signal and mains power lines.

The Recommendation deals primarily with reliability of equipment and although it may provide some level of safety, it is not sufficient itself to fully protect the user on its own. National standards for electrical safety should be followed in each country where the equipment is used. Furthermore, this Recommendation is not intended to establish whether equipment could produce harmful effects to the network when connected. Interference from low frequency induced voltages or radio frequency interference to the operation of the equipment is not included.

3. Overvoltage and overcurrent conditions

Aspects of overvoltage or overcurrent covered by this Recommendation are:

- surges due to direct or indirect lightning strokes on or near to the line plant;

- short-term induction of 50/60 Hz voltages from adjacent power lines or railway systems,

Recommendation K.21

RESISTIBILITY OF SUBSCRIBERS TERMINALS TO OVERVOLTAGES AND OVERCURRENTS

Introduction

This Recommendation has been produced by CCITT Study Group V to meet the urgent requirements of Administrations and manufacturers who are using or designing subscriber's equipment. The attention of the reader is drawn to the following subjects which CCITT is studying further:

- rise of earth potential
- electrical fast transients
- operational tests for barriers between mains ports and telecommunication ports
- high frequency mains voltage surges
- short duration interruptions of mains voltages.

When these studies have been completed, this Recommendation may be expanded.

1. Purpose of the Recommendation

When modern telecommunications equipment is connected to local subscribers' lines, the equipment may be damaged as a result of overvoltages or overcurrents which occur on these lines under occasional conditions. The probability and magnitude of these conditions vary due to many factors, e.g. geography, climate, construction methods, shielding effects. Overvoltage or overcurrent surges arising from electro-static discharges or transients which occur in mains voltages supplies may also damage equipment or cause its misoperation. This Recommendation seeks to establish fundamental testing methods which may be varied in detail to suit particular local circumstances and which help to predict the likelihood of survival when the equipment is exposed to these overvoltages or overcurrents.

In its present form, the Recommendation describes tests that should be applied to equipment which is metallically connected directly to balanced pairs. Further studies relating to equipment connected to coaxial and optical fibre cables are being made.

Note - In this document, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.