

# UL 60950

ISBN 0-7629-0470-4

## Safety of Information Technology Equipment



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CLASSIFIED BY  
UNDERWRITERS LABORATORIES INC.  
IN ACCORDANCE WITH  
IEC PUBLICATION 60950  
FOR USE IN INTERNATIONAL  
APPLICATIONS



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333 Pfingsten Road  
Northbrook, IL 60062-2096

UL Standard for Safety for Information Technology Equipment, UL 60950

Third Edition, Dated December 11, 2000

Revisions: This Standard contains revisions through and including March 15, 2002.

Announcement Bulletin(s): This Standard contains the announcement bulletin(s) dated July 23, 1999. The announcement bulletin is located at the end of the Standard.

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Text that has been changed in any manner is marked with a vertical line in the margin. These changes are effective upon publication.

The revisions dated March 15, 2002 include a reprinted title page (page1) for this Standard.

The revisions dated March 15, 2002 were issued to correct the date of the most recent ANSI approval, to update the UL and CSA Forewords, and to correct typographical errors. These errors include:

- 5.1.8.2 (page 180): The words "known to be lower" were missing from the end of the last paragraph on the page. The last paragraph should read: "It shall be assumed that each telecommunication port receives 0,25 mA ( $I_1$ ) from the other equipment, unless the actual current from the other equipment is known to be lower.
- 5.3.6 (page 189): Removed the D2 Designation for the first paragraph ("Where there are multiple outlets...") since this compliance statement is part of the original IEC text.
- Annex D (page 235): In Figure D.1, replaced incorrect resistor identifier " $R_S$  500 W" with " $R_B$  500 W ."
- Annex P.1 (page 276): Replaced the incorrect sub-clause reference "t3.4" with "3.4."
- Annexes P.1 and P.2 (pages 275-283): All references to IEC Standards should be in the format "IEC 6XXXX". For example, replace "IEC 85" with "IEC 60085" on page 281.

Please note that the UL and CSA versions of this Standard are identical. However, because of differences in publishing systems, UL has issued some pages (68, 131, and 137) with a March 15, 2002 date. In the CSA version of Standard these pages are dated December 1, 2000.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the back side of the title page (page 2) of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the back side of the title page (page 2), this UL Standard for Safety has been adopted by the Department of Defense.

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This Standard consists of pages dated as shown in the following checklist:

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| 280 .....     | December 1, 2000 |
| 281 .....     | March 15, 2002   |
| 282-430 ..... | December 1, 2000 |

No Text on This Page

Canadian Standards Association  
CAN/CSA-C22.2 No. 60950-00  
*Third Edition*

Underwriters Laboratories Inc.  
UL 60950  
*Third Edition*



## Safety of Information Technology Equipment

December 1, 2000

(Title page reprinted: March 15, 2002)

This national standard is based on publication IEC 60950, Third Edition (1999).

Approved  
by  
Standards Council  
of Canada



## Commitment for Amendments

This Standard is issued jointly by the Canadian Standards Association and Underwriters Laboratories Incorporated. Amendments to this Standard will be made only after processing according to the Standards writing procedures by both the Canadian Standards Association and Underwriters Laboratories Incorporated.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

*Approval of UL 60950 as an American National Standard is maintained using the continuous maintenance process. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to the UL-SC Standards Department, 1655 Scott Blvd., Santa Clara, CA 95050.*

*The most recent approval of UL 60950 as an American National Standard (ANSI) occurred on August 25, 2000 and covers the Third Edition including revisions dated March 15, 2002.*

*The U.S. Department of Defense (DoD) has adopted UL 1950 on December 21, 1994. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.*

**ISBN 1-55324-222-X**

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**ISBN 0-7629-0470-4**

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**PREFACE**

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This is the common UL and CSA Standard for Safety of Information Technology Equipment. It is the third edition of CSA Standard CAN/CSA-C22.2 No. 60950 and the third edition of UL 60950. This standard is based on IEC 60950, third edition.

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Previous editions of this Standard were designated CAN/CSA-C22.2 No. 950/UL 1950. This standard CAN/CSA-C22.2 No. 60950/UL 60950, third edition, replaces the previous standard CAN/CSA-C22.2 No. 950/UL 1950, third edition. The standard number and edition number have been aligned to correspond with the equivalent IEC 60950 standard. No first or second edition of CAN/CSA-C22.2 No. 60950/UL 60950 will be published.

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This common standard was prepared by the Canadian Standards Association and Underwriters Laboratories Inc. and the information technology and telecommunication industries. The efforts and support of the Electro Federation Canada (EFC, formerly EEMAC), the Information Technology Association of Canada (ITAC), the Information Technology Industry Council (ITI, formerly CBEMA), and the Telecommunication Industry Association (TIA) are gratefully acknowledged.

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This Standard was reviewed by the CSA Subcommittee on Safety of Information Technology Equipment Including Electrical Business Equipment under the jurisdiction of the Technical Committee on Consumer and Commercial Products and the CSA Strategic Resource Group and was approved by the Technical Committee.

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This Standard has been approved as a National Standard of Canada by the Standards Council of Canada and has been approved by the American National Standards Institute (ANSI) as an American National Standard.

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Note: Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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DE**Level of Harmonization**

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This standard adopts the IEC text with deviations. This standard is published as an equivalent standard.

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An equivalent standard is a standard that is substantially the same in technical content, except as follows. Technical deviations are allowed for Codes and Governmental Regulations and those recognized as being in accordance with NAFTA Article 905, for example because of fundamental, climatic, geographical, technological or infrastructural factors, scientific justification or the level of protection that the country considers appropriate. Presentation shall be word for word except for editorial changes.

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DE**UL Effective Date**

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New product submittals through April 1, 2003 will be evaluated using all the requirements in this standard, or if requested in writing, evaluated using the requirements in UL 1950, Third Edition. After April 1, 2003 all new product submittals are required to use this standard.

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Products that were previously certified by Underwriters Laboratories Inc. to requirements in other existing applicable standards, such as UL 114, UL 478, UL 1459 or UL 1950, First or Second Editions, up to April 1, 2000, and UL 1950, Third Edition, up to April 1, 2003, may

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continue to be certified without further reinvestigation until April 1, 2005, provided no significant changes or revisions are made to such products. Non-significant changes will be evaluated to the original standard. DE  
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As of April 1, 2005, all products, including those previously certified by UL, must comply with this standard in order to continue to have the UL Mark applied after this date. DE  
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### CSA Effective Date DE

The effective date for CSA International will be announced through CSA Informs or CSA Certification Notice. DE  
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### General DE

Deviations from the text of the International Electrotechnical Commission Publication 60950, Safety of Information Technology Equipment, Copyright 1999, are indicated by the following applicable margin notations: DE  
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D1 – deviations based on national regulatory requirements which result in equivalent or more stringent requirements than in IEC 60950. DE  
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D2 – deviations based on other than national regulatory requirements which result in equivalent or more stringent requirements than in IEC 60950. DE  
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DI – deviations based on IEC final draft international standards (FDIS). DI deviations may be less stringent than, equivalent to, or more stringent than requirements in IEC 60950. DE  
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DC – deviations based on UL and CSA component requirements. DC deviations may be less stringent than, equivalent to, or more stringent than component requirements in IEC 60950. DE  
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D3 – deviations based on bi-national requirements which result in less stringent requirements than in IEC 60950. DE  
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DE – editorial deviations that correct typographical errors in IEC 60950 or revise the terminology, but do not alter the technical intent of the requirements. This is also used for informative statements such as the Preface and Foreword. DE  
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D1, D2, D3, DI, DC, and DE deviations have been incorporated into the body of the standard. DE  
If deviations necessitate the deletion of IEC 60950 text, the IEC 60950 text has been retained DE  
but has been ~~lined out~~. Except for tables and figures and annexes, text added as a result of DE  
deviations has been underlined. Text added as the Preface and UL and CSA Forewords is not DE  
underlined. DE

Several annexes are included at the back of the standard. Pointers to these annexes are DE  
provided in the right-hand margin of the body of the standard to direct the user to these DE  
informative/normative annexes. The pointer text is provided in **BOLD ITALICS**. Examples of DE  
such pointers are shown here in the right-hand margin. DE

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The text, figures, and tables of International Electrotechnical Commission Publication 60950, DE  
Safety of Information Technology Equipment, Copyright 1999, are used in this standard with the DE  
consent of the International Electrotechnical Commission. DE

The International Electrotechnical Commission Foreword and Introduction are not a part of the requirements of this standard but are included for information purposes only.

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**FOREWORD (CSA)**

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The Canadian Standards Association (CSA) develops standards under the name Canadian Standards Association, and provides certification and testing under the name CSA International. CSA International provides certification services for manufacturers who, under license from CSA, wish to use the appropriate registered CSA Marks on certain products of their manufacture to indicate conformity with CSA Standards

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CSA Certification for a number of products is provided in the interest of maintaining agreed-upon standards of quality, performance, interchangeability and/or safety, as appropriate. Where applicable, certification may form the basis for acceptance by inspection authorities responsible for enforcement of regulations. Where feasible, programs will be developed for additional products for which certification is desired by producers, consumers, or other interests. In performing its functions in accordance with its objectives, CSA does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of the Association represent its professional judgement given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed.

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Products in substantial accord with this Standard but which exhibit a minor difference or a new feature may be deemed to meet the Standard providing the feature or difference is found acceptable utilizing appropriate CSA International Operating Procedures. Products that comply with this Standard shall not be certified if they are found to have additional features which are inconsistent with the intent of this Standard. Products shall not be certifiable if they are discovered to contravene applicable laws or regulations.

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Testing techniques, test procedures, and instrumentation frequently must be prescribed by CSA International in addition to the technical requirements contained in Standards of CSA. In addition to markings specified in the Standard, CSA International may require special cautions, markings, and instructions that are not specified by the Standard.

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Some tests required by CSA Standards may be inherently hazardous. The Association neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer or the Association, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer or the Association.

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Manufacturers should note that, in the event of the failure of CSA International to resolve an issue arising from the interpretation of requirements, there is an appeal procedure: the complainant should submit the matter, in writing, to the Secretary of the Canadian Standards Association

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If this Standard is to be used in obtaining CSA Certification please remember, when making application for certification, to request all current Amendments, Bulletins, Notices, and Technical Information Letters that may be applicable and for which there may be a nominal charge. For such information or for further information concerning CSA Certification, please address your inquiry to Applications and Customer Service, CSA International, 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3

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**FOREWORD (UL)**

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A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

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B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

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C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

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D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

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E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

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F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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### SAFETY OF INFORMATION TECHNOLOGY EQUIPMENT

#### FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60950 has been prepared by IEC Technical Committee 74: Safety and energy efficiency of IT equipment.

This third edition cancels and replaces the second edition, issued in 1991, and its amendments 1 (1992), 2 (1993), 3 (1995) and 4 (1996) and constitutes a technical revision.

The text of this edition is based on the following documents:

| FDIS        | Report on voting |
|-------------|------------------|
| 74/498/FDIS | 74/504/RVD       |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

Annexes A, B, C, D, E, F, G, H, J, K, L, M, N, P, U and V form an integral part of this standard.

Annexes Q, R, S, T, W and X are for information only.

In this standard, the following print types are used:

- Requirements proper and normative annexes: in roman type.
- *Compliance statements and test specifications: in italic type.*
- Notes and other informative matter: in smaller roman type.
- Normative conditions within tables: in smaller roman type.
- Terms that are defined in 1.2: SMALL CAPITALS.

The numbering system in this standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

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## INTRODUCTION

### 0 Principles of safety

The following principles have been adopted by technical committee 74 in the development of this standard.

These principles do not cover performance or functional characteristics of equipment.

Words printed in SMALL CAPITALS are terms that are defined in 1.2 of this standard.

#### 0.1 General principles of safety

It is essential that designers understand the underlying principles of safety requirements in order that they can engineer safe equipment.

These principles are not an alternative to the detailed requirements of this standard, but are intended to provide designers with an appreciation of the basis of these requirements. Where the equipment involves technologies and materials or methods of construction not specifically covered, the design of the equipment should provide a level of safety not less than those described in these principles of safety.

Designers shall take into account not only normal operating conditions of the equipment but also likely fault conditions, consequential faults, foreseeable misuse and external influences such as temperature, altitude, pollution, moisture, overvoltages on the mains and overvoltages on the telecommunication lines.

The following priorities should be observed in determining what design measures to adopt:

- where possible, specify design criteria that will eliminate, reduce or guard against hazards;
- where the above is not practicable because the functioning of the equipment would be impaired, specify the use of protective means independent of the equipment, such as personal protective equipment (which is not specified in this standard);
- where neither of the above measures is practicable, or in addition to those measures, specify the provision of markings and instructions regarding the residual risks.

There are two types of persons whose safety needs to be considered, USERS (OR OPERATORS) and SERVICE PERSONNEL.

USER is the term applied to all persons other than SERVICE PERSONNEL. Requirements for protection should assume that USERS are not trained to identify hazards, but will not intentionally create a hazardous situation. Consequently, the requirements will provide protection for cleaners and casual visitors as well as the assigned USERS. In general, USERS should not have access to hazardous parts, and to this end, such parts should only be in SERVICE ACCESS AREAS or in equipment located in RESTRICTED ACCESS LOCATIONS.

When USERS are admitted to RESTRICTED ACCESS LOCATIONS they shall be suitably instructed.

SERVICE PERSONNEL are expected to use their training and skill to avoid possible injury to themselves and others due to obvious hazards which exist in SERVICE ACCESS AREAS of the equipment or on equipment located in RESTRICTED ACCESS LOCATIONS. However, SERVICE PERSONNEL should be protected against unexpected hazards. This can be done by, for example, locating parts that need to be accessible for servicing away from electrical and mechanical hazards, providing shields to avoid accidental contact with hazardous parts, and providing labels or instructions to warn personnel about any residual risk.

Information about potential hazards can be marked on the equipment or provided with the equipment, depending on the likelihood and severity of injury, or made available for SERVICE PERSONNEL. In general, USERS shall not be exposed to hazards likely to cause injury, and information provided for USERS should primarily aim at avoiding misuse and situations likely to create hazards, such as connection to the wrong power source and replacement of fuses by incorrect types.

MOVABLE EQUIPMENT is considered to present a slightly increased risk of shock, due to possible extra strain on the supply cord leading to rupture of the earthing conductor. With HAND-HELD EQUIPMENT, this risk is increased; wear on the cord is more likely, and further hazards could arise if the units were dropped. TRANSPORTABLE EQUIPMENT introduces a further factor because it can be used and carried in any orientation; if a small metallic object enters an opening in the ENCLOSURE it can move around inside the equipment, possibly creating a hazard.

## 0.2 Hazards

Application of a safety standard is intended to reduce the likelihood of injury or damage due to the following:

- electric shock;
- energy related hazards;
- fire;
- heat related hazards;
- mechanical hazards;
- radiation;
- chemical hazards.

### 0.2.1 Electric shock

Electric shock is due to current passing through the human body. The resulting physiological effects depend on the value and duration of the current and the path it takes through the body. The value of the current depends on the applied voltage, the impedance of the source and the impedance of the body. The body impedance depends in turn on the area of contact, moisture in the area of contact and the applied voltage and frequency. Currents of approximately half a milliamperere can cause a reaction in persons in good health and may cause injury indirectly due to involuntary reaction. Higher currents can have more direct effects, such as burn or ventricular fibrillation.

Steady state voltages up to 42,4 V peak, or 60 V d.c., are not generally regarded as hazardous under dry conditions for an area of contact equivalent to a human hand. Bare parts which have to be touched or handled should be at earth potential or properly insulated.

Some equipment will be connected to telephone and other external networks. Some TELECOMMUNICATION NETWORKS operate with signals such as voice and ringing superimposed on a steady DC VOLTAGE; the total may exceed the values given above for steady-state voltages. It is common practice for the SERVICE PERSONNEL of telephone companies to handle parts of such circuits bare-handed. This has not caused serious injury, because of the use of cadenced ringing and because there are limited areas of contact with bare conductors normally handled by SERVICE PERSONNEL. However, the area of contact of a part accessible to the USER, and the likelihood of the part being touched, should be further limited (e.g. by the shape and location of the part).

It is normal to provide two levels of protection for USERS to prevent electric shock. Therefore, the operation of equipment under normal conditions and after a single fault, including any consequential faults, should not create a shock hazard. However, provision of additional protective measures, such as protective earthing or SUPPLEMENTARY INSULATION, is not considered a substitute for, or a relief from, properly designed BASIC INSULATION.

#### Hazards may result from:

Contact with bare parts normally at HAZARDOUS VOLTAGES.

Breakdown of insulation between parts normally at HAZARDOUS VOLTAGES and accessible conductive parts.

Contact with circuits connected to TELECOMMUNICATION NETWORKS which exceed 42,4 V peak or 60 V d.c.

Breakdown of USER-accessible insulation.

#### Examples of measures to reduce hazards:

Prevent USER access to parts at HAZARDOUS VOLTAGES by fixed or locked covers, SAFETY INTERLOCKS, etc. Discharge accessible capacitors that are at HAZARDOUS VOLTAGES.

Provide BASIC INSULATION and connect the accessible conductive parts and circuits to earth so that exposure to the voltage which can develop is limited because overcurrent protection will disconnect the parts having low impedance faults within a specified time; or provide a metal screen connected to protective earth between the parts, or provide DOUBLE OR REINFORCED INSULATION between the parts, so that breakdown to the accessible part is not likely to occur.

Limit the accessibility and area of contact of such circuits, and separate them from unearthed parts to which access is not limited.

Insulation which is accessible to the USER should have adequate mechanical and electrical strength to reduce the likelihood of contact with HAZARDOUS VOLTAGES.

### Table Continued

**Hazards may result from:**

TOUCH CURRENT (leakage current) flowing from parts at HAZARDOUS VOLTAGES to accessible parts, or failure of a protective earthing connection. TOUCH CURRENT may include current due to EMC filter components connected between PRIMARY CIRCUITS and accessible parts.

**Examples of measures to reduce hazards:**

Limit TOUCH CURRENT to a specified value, or provide a high integrity protective earthing connection.

### 0.2.2 Energy related hazards

Hazards may result from a short circuit between adjacent poles of high current supplies or high capacitance circuits, causing:

- burns;
- arcing;
- ejection of molten metal.

Even circuits whose voltages are safe to touch may be hazardous in this respect.

Examples of measures to reduce such hazards include:

- separation;
- shielding;
- provision of safety interlocks.

### 0.2.3 Fire

Hazards may result from excessive temperatures either under normal operating conditions or due to overload, component failure, insulation breakdown or loose connections. Fires originating within the equipment should not spread beyond the immediate vicinity of the source of the fire, nor cause damage to the surroundings of the equipment.

Examples of measures to reduce such hazards include:

- providing overcurrent protection;
- using constructional materials having appropriate flammability properties for their purpose;
- selection of parts, components and consumable materials to avoid high temperature which might cause ignition;
- limiting the quantity of combustible materials used;
- shielding or separating combustible materials from likely ignition sources;
- using ENCLOSURES or barriers to limit the spread of fire within the equipment;

- using suitable materials for ENCLOSURES so as to reduce the likelihood of fire spreading from the equipment.

#### 0.2.4 Heat related hazards

Hazards may result from high temperatures under normal operating conditions, causing:

- burns due to contact with hot accessible parts;
- degradation of insulation and of safety-critical components;
- ignition of flammable liquids.

Examples of measures to reduce such hazards include:

- taking steps to avoid high temperature of accessible parts;
- avoiding temperatures above the ignition point of liquids;
- provision of markings to warn USERS where access to hot parts is unavoidable.

#### 0.2.5 Mechanical hazards

Hazards may result from:

- sharp edges and corners;
- moving parts which have the potential to cause injury;
- equipment instability;
- flying particles from imploding cathode ray tubes and exploding high pressure lamps.

Examples of measures to reduce such hazards include:

- rounding of sharp edges and corners;
- guarding;
- provision of SAFETY INTERLOCKS;
- providing sufficient stability to free-standing equipment;
- selecting cathode ray tubes and high pressure lamps that are resistant to implosion and explosion respectively;
- provision of markings to warn USERS where access is unavoidable.

### 0.2.6 Radiation

Hazards to **USERS** and to **SERVICE PERSONNEL** may result from some forms of radiation emitted by equipment. Examples are sonic (acoustic), radio frequency, infra-red, ultraviolet and ionizing radiation, and high intensity visible and coherent light (lasers).

Examples of measures to reduce such hazards include:

- limiting the energy level of potential radiation sources;
- screening radiation sources;
- provision of **SAFETY INTERLOCKS**;
- provision of markings to warn **USERS** where exposure to the radiation hazard is unavoidable.

### 0.2.7 Chemical hazards

Hazards may result from contact with some chemicals or from inhalation of their vapours and fumes.

Examples of measures to reduce such hazards include:

- avoiding the use of constructional and consumable materials likely to cause injury by contact or inhalation during intended and normal conditions of use;
- avoiding conditions likely to cause leakage or vaporization;
- provision of markings to warn **USERS** about the hazards.

## 0.3 Materials and components

Materials and components used in the construction of equipment should be so selected and arranged that they can be expected to perform in a reliable manner for the anticipated life of the equipment without creating a hazard, and would not contribute significantly to the development of a serious fire hazard. Components should be selected so that they remain within their manufacturers' ratings under normal operating conditions, and do not create a hazard under fault conditions.

## SAFETY OF INFORMATION TECHNOLOGY EQUIPMENT –

### 1 General

#### 1.1 Scope

##### 1.1.1 Equipment covered by this standard

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This standard is applicable to mains-powered or battery-powered information technology equipment, including electrical business equipment and associated equipment, with a **RATED VOLTAGE** not exceeding 600 V and designed to be installed in accordance with the Canadian Electrical Code, Part I, CSA C22.1; CSA C22.2 No. 0; and the National Electrical Code, NFPA 70.

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The standard is also applicable to equipment, unless otherwise identified by a marking or instructions, designed to be installed in accordance with Article 645 of the National Electrical Code, NFPA 70, and the Standard for the Protection of Electronic Computer Data-Processing Equipment, NFPA 75.

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See annex NAE for examples of and references to regulatory requirements that may apply to this equipment.

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This standard is also applicable to such information technology equipment designed and intended to be connected directly to a **TELECOMMUNICATION NETWORK**, regardless of the source of power.

It is also applicable to such information technology equipment designed to use the **AC MAINS SUPPLY** as a telecommunication transmission medium (see note 4 of clause 6).

This standard specifies requirements intended to reduce risks of fire, electric shock or injury for the **OPERATOR** and layman who may come into contact with the equipment and, where specifically stated, for **SERVICE PERSONNEL**.

This standard is intended to reduce such risks with respect to installed equipment, whether it consists of a system of interconnected units or independent units, subject to installing, operating and maintaining the equipment in the manner prescribed by the manufacturer.

Examples of equipment which is in the scope of this standard are:

|                                                                                          |                                                                   |
|------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| accounting machines                                                                      | motor operated files                                              |
| bookkeeping machines                                                                     | PABX's                                                            |
| calculators                                                                              | paper jogging machines                                            |
| cash registers                                                                           | paper trimmers (punchers cutting machines,<br>separators)         |
| copying machines                                                                         | pencil sharpeners                                                 |
| data circuit terminating<br>equipment                                                    | personal computers                                                |
| data preparation equipment                                                               | photoprinting equipment                                           |
| data processing equipment                                                                | plotters                                                          |
| data terminal equipment                                                                  | point of sale terminals including<br>associated electronic scales |
| dictation equipment                                                                      | postage machines                                                  |
| document shredding machines                                                              | public information terminals                                      |
| duplicators                                                                              | staplers                                                          |
| electrically operated drawing<br>machines                                                | telephone answering machines                                      |
| erasers                                                                                  | telephone sets                                                    |
| facsimile equipment                                                                      | text processing equipment                                         |
| key telephone systems                                                                    | typewriters                                                       |
| magnetic tape handlers                                                                   | visual display units                                              |
| mail processing machines                                                                 |                                                                   |
| micrographic office equipment                                                            |                                                                   |
| modems                                                                                   |                                                                   |
| monetary processing machines including<br>automated<br>teller (cash dispensing) machines |                                                                   |

This list is not intended to be comprehensive, and equipment that is not listed is not necessarily excluded from the scope.

Equipment complying with the relevant requirements in this standard is considered suitable for use with process control equipment, automatic test equipment and similar systems requiring information processing facilities. However, this standard does not include requirements for performance or functional characteristics of equipment.

### 1.1.2 Additional requirements

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Requirements additional to those specified in this standard may be necessary for:

- equipment intended for operation in special environments, for example, extremes of temperature; excessive dust, moisture or vibration; flammable gases; and corrosive or explosive atmospheres;
- electromedical applications with physical connections to the patient;
- equipment intended to be used in vehicles, on board ships or aircraft, in tropical countries, or at altitudes greater than 2 000 m;
- equipment intended for use where ingress of water is possible; for guidance on such requirements and on relevant testing, see annex T.

NOTE – Attention is drawn to the fact that authorities of some countries impose additional requirements.

### 1.1.3 Exclusions

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This standard does not apply to:

- support equipment, such as air conditioning, fire detection or fire extinguishing systems;
- power supply systems, such as motor-generator sets, battery backup systems and transformers, which are not an integral part of the equipment;
- building installation wiring;
- devices requiring no electrical power.

## 1.2 Definitions

For the purpose of this International Standard the following definitions apply. Where the terms "voltage" and "current" are used they imply the r.m.s. values, unless otherwise specified.

### Definitions in alphabetical order of nouns

|                               |           |
|-------------------------------|-----------|
| AREA, OPERATOR ACCESS         | 1.2.7.1   |
| AREA, SERVICE ACCESS          | 1.2.7.2   |
| BODY                          | 1.2.7.5   |
| CABLE, INTERCONNECTING        | 1.2.11.6  |
| CIRCUIT, ELV                  | 1.2.8.5   |
| CIRCUIT, LIMITED CURRENT      | 1.2.8.7   |
| CIRCUIT, PRIMARY              | 1.2.8.2   |
| CIRCUIT, SECONDARY            | 1.2.8.3   |
| CIRCUIT, SELV                 | 1.2.8.6   |
| CIRCUIT, TNV                  | 1.2.8.9   |
| CIRCUIT, TNV-1                | 1.2.8.10  |
| CIRCUIT, TNV-2                | 1.2.8.11  |
| CIRCUIT, TNV-3                | 1.2.8.12  |
| CLEARANCE                     | 1.2.10.1  |
| CONDUCTOR, PROTECTIVE BONDING | 1.2.13.11 |

|                                        |           |
|----------------------------------------|-----------|
| CONDUCTOR, PROTECTIVE EARTHING         | 1.2.13.10 |
| CORD, DETACHABLE POWER SUPPLY          | 1.2.5.4   |
| CORD, NON-DETACHABLE POWER SUPPLY      | 1.2.5.5   |
| CREEPAGE DISTANCE                      | 1.2.10.2  |
| CURRENT, PROTECTIVE CONDUCTOR          | 1.2.13.13 |
| CURRENT, RATED                         | 1.2.1.3   |
| CURRENT, TOUCH                         | 1.2.13.12 |
| CUT-OUT, THERMAL                       | 1.2.11.3  |
| CUT-OUT, THERMAL, AUTOMATIC RESET      | 1.2.11.4  |
| CUT-OUT, THERMAL, MANUAL RESET         | 1.2.11.5  |
| EARTHING, FUNCTIONAL                   | 1.2.13.9  |
| ENCLOSURE                              | 1.2.6.1   |
| ENCLOSURE, ELECTRICAL                  | 1.2.6.4   |
| ENCLOSURE, FIRE                        | 1.2.6.2   |
| ENCLOSURE, MECHANICAL                  | 1.2.6.3   |
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## 1.2.1 Equipment electrical ratings

**1.2.1.1** RATED VOLTAGE: The supply voltage (for a three-phase AC MAINS SUPPLY, the line-to-line voltage) as declared by the manufacturer.

**1.2.1.2** RATED VOLTAGE RANGE: The supply voltage range as declared by the manufacturer, expressed by its lower and upper RATED VOLTAGES.

**1.2.1.3** RATED CURRENT: The input current of the equipment as declared by the manufacturer.

**1.2.1.4** RATED FREQUENCY: The supply frequency as declared by the manufacturer.

**1.2.1.5** RATED FREQUENCY RANGE: The supply frequency range as declared by the manufacturer, expressed by its lower and upper RATED FREQUENCIES.

## 1.2.2 Operating conditions

**1.2.2.1** NORMAL LOAD: The mode of operation which approximates as closely as possible the most severe conditions of normal use in accordance with the operating instructions. However, when the conditions of actual use can obviously be more severe than the maximum recommended load conditions, a load is used that is representative of the maximum that can be applied.

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NOTE – NORMAL LOAD conditions for some types of electrical business equipment are given in annex L.

**1.2.2.2** RATED OPERATING TIME: The operating time assigned to the equipment by the manufacturer.

**1.2.2.3** CONTINUOUS OPERATION: Operation under NORMAL LOAD for an unlimited period.

**1.2.2.4** SHORT-TIME OPERATION: Operation under NORMAL LOAD for a specified period, starting from cold, the intervals after each period of operation being sufficient to allow the equipment to cool down to room temperature.

**1.2.2.5** INTERMITTENT OPERATION: Operation in a series of specified identical cycles, each composed of a period of operation under NORMAL LOAD followed by a rest period with the equipment switched off or running idle.

### 1.2.3 Equipment mobility

**1.2.3.1** MOVABLE EQUIPMENT: Equipment which is either:

- 18 kg or less in mass and not fixed, or
- equipment with wheels, castors or other means to facilitate movement by the OPERATOR as required to perform its intended use.

NOTE – MOVABLE EQUIPMENT includes wall-mounted equipment whose mounting means permits removal by an OPERATOR.

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**1.2.3.2** HAND-HELD EQUIPMENT: MOVABLE EQUIPMENT, or a part of any kind of equipment, that is intended to be held in the hand during normal use.

**1.2.3.3** TRANSPORTABLE EQUIPMENT: MOVABLE EQUIPMENT that is intended to be routinely carried by a USER.

NOTE – Examples include laptop personal computers, pen-based tablet computers, and their portable accessories such as printers and CD-ROM drives.

**1.2.3.4** STATIONARY EQUIPMENT: Equipment that is not MOVABLE EQUIPMENT.

**1.2.3.5** EQUIPMENT FOR BUILDING-IN: Equipment intended to be installed in a prepared recess, such as in a wall, or similar situation.

NOTE – In general, EQUIPMENT FOR BUILDING-IN does not have an ENCLOSURE on all sides, as some of the sides will be protected after installation.

**1.2.3.6** DIRECT PLUG-IN EQUIPMENT: Equipment that is intended to be used without a power supply cord; the mains plug forms an integral part of the equipment ENCLOSURE so that the weight of the equipment is taken by the socket-outlet.

## 1.2.4 Classes of equipment – Protection against electric shock

NOTE – Some information technology equipment cannot be identified as conforming to one of the following classes.

### 1.2.4.1 CLASS I EQUIPMENT: Equipment where protection against electric shock is achieved by:

- using BASIC INSULATION, and also
- providing a means of connecting to the PROTECTIVE EARTHING CONDUCTOR in the building wiring those conductive parts that are otherwise capable of assuming HAZARDOUS VOLTAGES if the BASIC INSULATION fails.

NOTE – CLASS I EQUIPMENT may have parts with DOUBLE INSULATION OR REINFORCED INSULATION.

**1.2.4.2 CLASS II EQUIPMENT:** Equipment in which protection against electric shock does not rely on BASIC INSULATION only, but in which additional safety precautions, such as DOUBLE INSULATION OR REINFORCED INSULATION are provided, there being no reliance on either protective earthing or installation conditions.

**1.2.4.3 CLASS III EQUIPMENT:** Equipment in which protection against electric shock relies upon supply from SELV CIRCUITS and in which HAZARDOUS VOLTAGES are not generated.

NOTE – For CLASS III EQUIPMENT, although there is no requirement for protection against electric shock, all other requirements of the standard apply.

## 1.2.5 Connection to the supply

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**1.2.5.1 PLUGGABLE EQUIPMENT TYPE A:** Equipment which is intended for connection to the building installation wiring via a non-industrial plug and socket-outlet or a non-industrial appliance coupler, or both.

NOTE – 1-15, 2-15, 2-20, 5-15 and 5-20 plugs and outlets as specified in IEC 60083 are considered to be non-industrial within the meaning of this standard.

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**1.2.5.2 PLUGGABLE EQUIPMENT TYPE B:** Equipment which is intended for connection to the building installation wiring via an industrial plug and socket-outlet or an appliance coupler, or both, complying with IEC 60309, or with a comparable national standard.

**1.2.5.3 PERMANENTLY CONNECTED EQUIPMENT:** Equipment which is intended for connection to the building installation wiring using screw terminals or other reliable means.

**1.2.5.4 DETACHABLE POWER SUPPLY CORD:** A flexible cord, for supply purposes, intended to be connected to the equipment by means of a suitable appliance coupler.

**1.2.5.5 NON-DETACHABLE POWER SUPPLY CORD:** A flexible cord, for supply purposes, fixed to or assembled with the equipment.

Such a cord may be:

Ordinary: A flexible cord which can be easily replaced without special preparation of the cord or special TOOLS, or

**Special:** A flexible cord which is specially prepared or requires the use of specially designed TOOLS for replacement, or is such that it cannot be replaced without damage to the equipment.

The term "specially prepared" includes provision of an integral cord guard, the use of cable lugs, formation of eyelets, etc., but not the re-shaping of the conductor before introduction into a terminal or the twisting of a stranded conductor to consolidate the end.

## 1.2.6 Enclosures

**1.2.6.1** ENCLOSURE: A part of the equipment providing one or more of the functions described in 1.2.6.2, 1.2.6.3, or 1.2.6.4.

NOTE – One type of ENCLOSURE can be inside another type (e.g. an ELECTRICAL ENCLOSURE inside a FIRE ENCLOSURE or a FIRE ENCLOSURE inside an ELECTRICAL ENCLOSURE). Also, a single ENCLOSURE can provide the functions of more than one type (e.g. those of both an ELECTRICAL ENCLOSURE and a FIRE ENCLOSURE).

**1.2.6.2** FIRE ENCLOSURE: A part of the equipment intended to minimize the spread of fire or flames from within.

**1.2.6.3** MECHANICAL ENCLOSURE: A part of the equipment intended to reduce the risk of injury due to mechanical and other physical hazards.

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**1.2.6.4** ELECTRICAL ENCLOSURE: A part of the equipment intended to limit access to parts that may be at HAZARDOUS VOLTAGE OR HAZARDOUS ENERGY LEVELS OR ARE IN TNV CIRCUITS.

**1.2.6.5** DECORATIVE PART: A part of the equipment, outside the ENCLOSURE, which has no safety function.

## 1.2.7 Accessibility

**1.2.7.1** OPERATOR ACCESS AREA: An area to which, under normal operating conditions, one of the following applies:

- access can be gained without the use of a TOOL, or
- the means of access is deliberately provided to the OPERATOR, or
- the OPERATOR is instructed to enter regardless of whether or not a TOOL is needed to gain access.

The terms "access" and "accessible", unless qualified, relate to OPERATOR ACCESS AREA as defined above.

**1.2.7.2** SERVICE ACCESS AREA: An area, other than an OPERATOR ACCESS AREA, where it is necessary for SERVICE PERSONNEL to have access even with the equipment switched on.

**1.2.7.3** RESTRICTED ACCESS LOCATION: A location for equipment where both of the following paragraphs apply:

- access can only be gained by SERVICE PERSONNEL or by USERS who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and

- access is through the use of a TOOL or lock and key, or other means of security, and is controlled by the authority responsible for the location.

NOTE – The requirements for equipment intended for installation in RESTRICTED ACCESS LOCATIONS are the same as for OPERATOR ACCESS AREAS, except as given in 1.7.17, 2.1.3 and ~~4.5.1~~ 4.4.3.

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**1.2.7.4** TOOL: A screwdriver or any other object which may be used to operate a screw, latch or similar fixing means.

**1.2.7.5** BODY: All accessible conductive parts, shafts of handles, knobs, grips and the like, and metal foil in contact with all accessible surfaces of insulating material.

**1.2.7.6** SAFETY INTERLOCK: A means either of preventing access to a hazardous area until the hazard is removed, or of automatically removing the hazardous condition when access is gained.

## 1.2.8 Circuits and circuit characteristics

P

**1.2.8.1** AC MAINS SUPPLY: The external a.c. power distribution system supplying power to the equipment. These power sources include public or private utilities and, unless otherwise specified in the standard (e.g. 1.4.5), equivalent sources such as motor-driven generators and uninterruptible power supplies.

NOTE – See annex V for typical examples of a.c. power distribution systems.

**1.2.8.2** PRIMARY CIRCUIT: A circuit which is directly connected to the AC MAINS SUPPLY. It includes, for example, the means for connection to the AC MAINS SUPPLY, the primary windings of transformers, motors and other loading devices.

NOTE – Conductive parts of an INTERCONNECTING CABLE may be part of a PRIMARY CIRCUIT as stated in 1.2.11.6.

**1.2.8.3** SECONDARY CIRCUIT: A circuit which has no direct connection to a PRIMARY CIRCUIT and derives its power from a transformer, converter or equivalent isolation device, or from a battery.

NOTE – Conductive parts of an INTERCONNECTING CABLE may be part of a SECONDARY CIRCUIT as stated in 1.2.11.6.

**1.2.8.4** HAZARDOUS VOLTAGE: A voltage exceeding 42,4 V peak, or 60 V d.c., existing in a circuit which does not meet the requirements for either a LIMITED CURRENT CIRCUIT or a TNV CIRCUIT.

**1.2.8.5** ELV CIRCUIT: A SECONDARY CIRCUIT with voltages between any two conductors of the circuit, and between any one such conductor and earth (see 1.4.9), not exceeding 42,4 V peak, or 60 V d.c., under normal operating conditions, which is separated from HAZARDOUS VOLTAGE by BASIC INSULATION, and which neither meets all of the requirements for an SELV CIRCUIT nor meets all of the requirements for a LIMITED CURRENT CIRCUIT.

**1.2.8.6** SELV CIRCUIT: A SECONDARY CIRCUIT which is so designed and protected that under normal operating conditions and single fault conditions, its voltages do not exceed a safe value.

NOTE 1 – The limit values of voltages under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.2. See also table 1A.

NOTE 2 – This definition of an SELV CIRCUIT differs from the term “SELV system” as used in IEC 61140<sup>1</sup>.

**1.2.8.7 LIMITED CURRENT CIRCUIT:** A circuit which is so designed and protected that, under both normal operating conditions and single fault conditions, the current which can be drawn is not hazardous.

NOTE – The limit values of currents under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.4.

**1.2.8.8 HAZARDOUS ENERGY LEVEL:** A stored energy level of 20 J or more, or an available continuous power level of 240 VA or more, at a potential of 2 V or more.

**1.2.8.9 TNV CIRCUIT:** A circuit which is in the equipment and to which the accessible area of contact is limited and that is so designed and protected that, under normal operating conditions and single fault conditions (see 1.4.14), the voltages do not exceed specified limit values.

A TNV CIRCUIT is considered to be a SECONDARY CIRCUIT in the meaning of this standard.

NOTE 1 – The specified limit values of voltages under normal operating conditions and single fault conditions (see 1.4.14) are given in 2.3.1. Requirements regarding accessibility of TNV CIRCUITS are given in 2.1.1.1.

TNV CIRCUITS are classified as TNV-1, TNV-2 and TNV-3 CIRCUITS as defined in 1.2.8.10, 1.2.8.11, and 1.2.8.12.

NOTE 2 – The voltage relationships between SELV and TNV CIRCUITS are shown in table 1A.

NOTE 3 – Conductive parts of an INTERCONNECTING CABLE may be part of a TNV CIRCUIT as stated in 1.2.11.6.

**Table 1A – Voltage ranges of SELV and TNV circuits**

| Overvoltages from<br>TELECOMMUNICATION<br>NETWORKS possible? | Normal operating voltages  |                                                                |
|--------------------------------------------------------------|----------------------------|----------------------------------------------------------------|
|                                                              | Within SELV CIRCUIT limits | Exceeding SELV CIRCUIT limits<br>but within TNV CIRCUIT limits |
| Yes                                                          | TNV-1 CIRCUIT              | TNV-3 CIRCUIT                                                  |
| No                                                           | SELV CIRCUIT               | TNV-2 CIRCUIT                                                  |

**1.2.8.10 TNV-1 CIRCUIT:** A TNV CIRCUIT:

- whose normal operating voltages do not exceed the limits for an SELV CIRCUIT under normal operating conditions, and
- on which overvoltages from TELECOMMUNICATION NETWORKS are possible.

**1.2.8.11 TNV-2 CIRCUIT:** A TNV CIRCUIT:

- whose normal operating voltages exceed the limits for an SELV CIRCUIT under normal operating conditions, and

<sup>1</sup>A list of informative references is given in annex Q: “Bibliography”.

- which is not subject to overvoltages from TELECOMMUNICATION NETWORKS.

#### **1.2.8.12** TNV-3 CIRCUIT: A TNV CIRCUIT:

- whose normal operating voltages exceed the limits for an SELV CIRCUIT under normal operating conditions; and
- on which overvoltages from TELECOMMUNICATION NETWORKS are possible.

### **1.2.9 Insulation**

**1.2.9.1** FUNCTIONAL INSULATION: Insulation that is necessary only for the correct operation of the equipment.

NOTE – FUNCTIONAL INSULATION by definition does not protect against electric shock. It may, however, reduce the likelihood of ignition and fire.

**1.2.9.2** BASIC INSULATION: Insulation to provide basic protection against electric shock.

**1.2.9.3** SUPPLEMENTARY INSULATION: Independent insulation applied in addition to BASIC INSULATION in order to reduce the risk of electric shock in the event of a failure of the BASIC INSULATION.

**1.2.9.4** DOUBLE INSULATION: Insulation comprising both BASIC INSULATION and SUPPLEMENTARY INSULATION.

**1.2.9.5** REINFORCED INSULATION: A single insulation system which provides a degree of protection against electric shock equivalent to DOUBLE INSULATION under the conditions specified in this standard.

NOTE – The term “insulation system” does not imply that the insulation has to be in one homogeneous piece. It may comprise several layers which cannot be tested as SUPPLEMENTARY OR BASIC INSULATION.

**1.2.9.6** WORKING VOLTAGE: The highest voltage to which the insulation or the component under consideration is, or can be, subjected when the equipment is operating under conditions of normal use.

**1.2.9.7** PEAK WORKING VOLTAGE: The highest peak or d.c. value of a WORKING VOLTAGE, including repetitive peak impulses generated in the equipment, but not including external transients.

**1.2.9.8** REQUIRED WITHSTAND VOLTAGE: The peak voltage that the insulation under consideration is required to withstand.

**1.2.9.9** MAINS TRANSIENT VOLTAGE: The highest peak voltage expected at the power input to the equipment, arising from external transients on the AC MAINS SUPPLY.

**1.2.9.10** TELECOMMUNICATION NETWORK TRANSIENT VOLTAGE: The highest peak voltage expected at the TELECOMMUNICATION NETWORK connection point of the equipment, arising from external transients on the network.

### 1.2.10 Clearances and creepage distances

**1.2.10.1** **CLEARANCE:** The shortest distance between two conductive parts, or between a conductive part and the **BOUNDING SURFACE** of the equipment, measured through air.

**1.2.10.2** **CREEPAGE DISTANCE:** The shortest path between two conductive parts, or between a conductive part and the **BOUNDING SURFACE** of the equipment, measured along the surface of the insulation.

**1.2.10.3** **BOUNDING SURFACE:** The outer surface of the **ELECTRICAL ENCLOSURE**, considered as though metal foil were pressed into contact with accessible surfaces of insulating material.

### 1.2.11 Components

**1.2.11.1** **THERMOSTAT:** A cycling temperature-sensing control, which is intended to keep a temperature between two particular values under normal operating conditions and which may have provision for setting by the **OPERATOR**.

**1.2.11.2** **TEMPERATURE LIMITER:** A temperature-sensing control which is intended to keep a temperature below or above one particular value during normal operating conditions and which may have provision for setting by the **OPERATOR**.

NOTE – A **TEMPERATURE LIMITER** may be of the automatic reset or of the manual reset type.

**1.2.11.3** **THERMAL CUT-OUT:** A temperature-sensing control intended to operate under abnormal operating conditions and which has no provision for the **OPERATOR** to change the temperature setting.

NOTE – A **THERMAL CUT-OUT** may be of the automatic reset or of the manual reset type.

**1.2.11.4** **THERMAL CUT-OUT, AUTOMATIC RESET:** A **THERMAL CUT-OUT** which automatically restores the current after the relevant part of the equipment has cooled down sufficiently.

**1.2.11.5** **THERMAL CUT-OUT, MANUAL RESET:** A **THERMAL CUT-OUT** which requires resetting by hand, or replacement of a part, in order to restore the current.

**1.2.11.6** **INTERCONNECTING CABLE:** A cable that is external to the equipment and that is used to electrically connect an accessory to a unit of information technology equipment, to interconnect units in a system or to connect a unit to a **TELECOMMUNICATION NETWORK**; such a cable may carry any type of circuit from one unit to another.

## 1.2.12 Flammability

**A P**

**1.2.12.1** FLAMMABILITY CLASSIFICATION OF MATERIALS: The recognition of the burning behaviour of materials and their ability to extinguish if ignited. Materials are classified as in 1.2.12.2 to 1.2.12.9 when tested in accordance with annex A.

NOTE 1 – When applying the requirements in this standard, HF-1 CLASS FOAMED MATERIALS are regarded as better than those of CLASS HF-2, and CLASS HF-2 better than HBF.

NOTE 2 – Similarly, other MATERIALS, including rigid (engineering structural) foam of CLASSES 5V or V-0 are regarded as better than those of CLASS V-1, V-1 better than V-2, and V-2 better than HB.

**1.2.12.2** V-0 CLASS MATERIAL: A material that, when tested in accordance with A.6, may flame or glow but will meet certain criteria for times to extinguish; glowing particles or flaming drops released do not ignite surgical cotton.

**1.2.12.3** V-1 CLASS MATERIAL: A material that, when tested in accordance with A.6, may flame or glow but will meet certain criteria for times to extinguish; glowing particles or flaming drops released do not ignite surgical cotton.

**1.2.12.4** V-2 CLASS MATERIAL: A material that, when tested in accordance with A.6, may flame or glow but will meet certain criteria for times to extinguish; glowing particles or flaming drops released may ignite surgical cotton.

**1.2.12.5** 5V CLASS MATERIAL: A material that, when tested in accordance with A.9, may flame or glow but will extinguish within a prescribed period of time; glowing particles or flaming drops released do not ignite surgical cotton.

**1.2.12.6** HF-1 CLASS FOAMED MATERIAL: A foamed material that, when tested in accordance with A.7, may flame or glow but will extinguish within a prescribed period of time; flaming or glowing particles, or flaming drops released do not ignite surgical cotton.

**1.2.12.7** HF-2 CLASS FOAMED MATERIAL: A foamed material that, when tested in accordance with A.7, may flame or glow but will extinguish within a prescribed period of time; flaming or glowing particles, or flaming drops released may ignite surgical cotton.

**1.2.12.8** HB CLASS MATERIAL: Material that, when tested in accordance with A.8, does not exceed a specified maximum burning rate.

**1.2.12.9** HBF CLASS FOAMED MATERIAL: A foamed material that, when tested in accordance with A.7, does not exceed a specified maximum burning rate.

**1.2.12.10** EXPLOSION LIMIT: The lowest concentration of a combustible material in a mixture containing any of the following: gases, vapours, mists or dusts, in which a flame is able to propagate after removal of the ignition source.

### 1.2.13 Miscellaneous

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**1.2.13.1** TYPE TEST: A test on a representative sample of the equipment with the objective of determining if the equipment, as designed and manufactured, can meet the requirements of this standard.

**1.2.13.2** SAMPLING TEST: A test on a number of samples taken at random from a batch. [IEV 151-04-17, modified]<sup>1)</sup>

**1.2.13.3** ROUTINE TEST: A test to which each individual sample is subjected during or after manufacture to check if the sample complies with certain criteria [IEV 151-04-16, modified].

**1.2.13.4** DC VOLTAGE: The average value of a voltage (as measured by a moving coil meter) having a peak-to-peak ripple not exceeding 10 % of the average value.

NOTE – Where peak-to-peak ripple exceeds 10 % of the average value, the requirements related to peak voltage are applicable.

**1.2.13.5** SERVICE PERSONNEL: Persons having appropriate technical training and experience necessary to be aware of hazards to which they may be exposed in performing a task and of measures to minimize the risks for themselves or other persons.

**1.2.13.6** USER: Any person, other than SERVICE PERSONNEL. The term USER in this standard is the same as the term OPERATOR and the two can be interchanged.

**1.2.13.7** OPERATOR: See USER (1.2.13.6).

**1.2.13.8** TELECOMMUNICATION NETWORK: A metallically terminated transmission medium intended for communication between equipment that may be located in separate buildings, excluding:

- the mains system for supply, transmission and distribution of electrical power, if used as a telecommunication transmission medium;
- television distribution systems using cable;
- SELV CIRCUITS connecting units of data processing equipment.

NOTE 1 – The term TELECOMMUNICATION NETWORK is defined in terms of its functionality, not its electrical characteristics. A TELECOMMUNICATION NETWORK is not itself defined as being either an SELV CIRCUIT or a TNV CIRCUIT. Only the circuits in the equipment are so classified.

NOTE 2 – A TELECOMMUNICATION NETWORK may be

- publicly or privately owned;
- subject to transient overvoltages due to atmospheric discharges and faults in power distribution systems;
- subject to longitudinal (common mode) voltages induced from nearby power lines or electric traction lines.

NOTE 3 – Examples of TELECOMMUNICATION NETWORKS are:

- a public switched telephone network;
- a public data network;
- an Integrated Services Digital Network (ISDN);
- a private network with electrical interface characteristics similar to the above.

<sup>1)</sup>A list of normative references is given in annex P.

**1.2.13.9 FUNCTIONAL EARTHING:** The earthing of a point in equipment or in a system, which is necessary for a purpose other than safety. [IEV 195-01-13, modified]

**1.2.13.10 PROTECTIVE EARTHING CONDUCTOR:** A conductor in the building installation wiring, or in the power supply cord, connecting a main protective earthing terminal in the equipment to an earth point in the building installation.

NOTE – In some countries, the term “grounding conductor” is used instead of “PROTECTIVE EARTHING CONDUCTOR”.

**1.2.13.11 PROTECTIVE BONDING CONDUCTOR:** A conductor in the equipment, or a combination of conductive parts in the equipment, connecting a main protective earthing terminal to a part of the equipment that is required to be earthed for safety purposes.

**1.2.13.12 TOUCH CURRENT:** Electric current through a human body when it touches one or more accessible parts. [IEV 195-05-21, modified]<sup>1)</sup>

NOTE – TOUCH CURRENT was previously included in the term “leakage current”.

**1.2.13.13 PROTECTIVE CONDUCTOR CURRENT:** Current flowing through the PROTECTIVE EARTHING CONDUCTOR under normal operating conditions.

NOTE – PROTECTIVE CONDUCTOR CURRENT was previously included in the term “leakage current”.

## **1.3 General requirements**

### **1.3.1 Application of requirements**

The requirements detailed in this standard shall be applied only if safety is involved.

In order to establish whether or not safety is involved, the circuits and construction shall be carefully investigated to take into account the consequences of possible failures.

### **1.3.2 Equipment design and construction**

Equipment shall be so designed and constructed that, under all conditions of normal use and under likely abnormal use or single fault conditions (see 1.4.14), protection is provided to reduce the risk of personal injury from electric shock and other hazards, and against spread of fire originating in the equipment.

*Compliance is checked by inspection and by the relevant tests.*

<sup>1)</sup>To be published.

### 1.3.3 Supply voltage

Equipment shall be designed to be safe at any supply voltage to which it is intended to be connected.

*Compliance is checked by inspection and by carrying out the relevant tests of this standard under the conditions specified in 1.4.5.*

### 1.3.4 Constructions not specifically covered

Where the equipment involves technologies and materials or methods of construction not specifically covered in this standard, the equipment shall provide a level of safety not less than that generally afforded by this standard and the Principles of Safety contained herein.

NOTE – The need for additional detailed requirements to cope with a new situation should be brought promptly to the attention of the appropriate committee.

### 1.3.5 Equivalent materials

Where the standard specifies a particular grade of insulation, the use of a better grade of insulation is permitted. Similarly, where the standard requires material of a particular FLAMMABILITY CLASS, the use of a better class is permitted.

### 1.3.6 Orientation during transport and use

Where it is clear that the orientation of use of equipment is likely to have a significant effect on the application of the requirements or the results of tests, all orientations of use permitted in the installation or USER instructions shall be taken into account. For TRANSPORTABLE EQUIPMENT, all orientations of transport and use shall be taken into account.

NOTE – The above may apply to 4.1, 4.5, 4.6 and 5.3.

### 1.3.7 Choice of criteria

Where the standard permits a choice between different criteria for compliance, or between different methods or conditions of test, the choice is specified by the manufacturer.

### 1.3.8 Examples mentioned in the standard

Where examples of equipment, parts, methods of construction, design techniques and faults are given in the standard, prefaced by "e.g." or "such as", other examples are not excluded.

### 1.3.9 Conductive liquids

For the electrical requirements of this standard, conductive liquids shall be treated as conductive parts.

## 1.4 General conditions for tests

### 1.4.1 Application of tests

*NAD*

The tests detailed in this standard shall be carried out only if safety is involved.

If it is evident from the design and construction of the equipment that a particular test is not applicable, the test is not made.

Unless otherwise stated, upon conclusion of the tests, the equipment need not be operational.

### 1.4.2 Type tests

Except where otherwise stated, the tests specified in this standard are TYPE TESTS.

### 1.4.3 Test samples

Unless otherwise specified, the sample or samples under test shall be representative of the equipment the USER would receive, or shall be the actual equipment ready for shipment to the USER.

As an alternative to carrying out tests on the complete equipment, tests may be carried out separately on circuits, components or subassemblies outside the equipment, provided that inspection of the equipment and circuit arrangements indicates that the results of such testing will be representative of the results of testing the assembled equipment. If any such test indicates a likelihood of non-conformance in the complete equipment, the test shall be repeated in the equipment.

If a test specified in this standard could be destructive, it is permitted to use a model to represent the condition to be evaluated.

NOTE 1 – The tests should be carried out in the following order:

- component or material pre-selection;
- component or subassembly bench tests;
- tests where the equipment is not energized;
- live tests:
  - under normal operating conditions;
  - under abnormal operating conditions;
  - involving likely destruction.

NOTE 2 – In view of the amount of resource involved in testing and in order to minimize waste, it is recommended that all parties concerned jointly consider the test programme, the test samples and the test sequence.

#### 1.4.4 Operating parameters for tests

Except where specific test conditions are stated elsewhere in the standard and where it is clear that there is a significant impact on the results of the test, the tests shall be carried out under the most unfavourable combination within the manufacturer's operating specifications of the parameters:

- supply voltage (see 1.4.5);
- supply frequency (see 1.4.6);
- physical location of equipment and position of movable parts;
- operating mode;
- adjustment of THERMOSTATS, regulating devices or similar controls in OPERATOR ACCESS AREAS, which are:
  - adjustable without the use of a TOOL; or
  - adjustable using a means, such as a key or a TOOL, deliberately provided for the OPERATOR.

#### 1.4.5 Supply voltage for tests

In determining the most unfavourable voltage for the power to energize the equipment under test (EUT), the following variables shall be taken into account:

- multiple RATED VOLTAGES;
- tolerances on RATED VOLTAGE as specified below;
- extremes of RATED VOLTAGE RANGES.

If the equipment is intended for direct connection to an AC MAINS SUPPLY, the tolerances on RATED VOLTAGE shall be taken as +6 % and -10 %, unless:

- the RATED VOLTAGE is 230 V single-phase or 400 V three-phase, in which case the tolerance shall be taken as +10 % and -10 %; or
- a wider tolerance is declared by the manufacturer, in which case the tolerance shall be taken as this wider value.

If the equipment is intended only for connection to an a.c. mains equivalent source, such as a motor-driven generator or an uninterruptible power supply (see 1.2.8.1), or a source other than an AC MAINS SUPPLY, the tolerances on RATED VOLTAGE shall be declared by the manufacturer.

When testing equipment designed for d.c. only, the possible influence of polarity shall be taken into account.

#### 1.4.6 Supply frequency for tests

In determining the most unfavourable frequency for the power to energize the EUT, different RATED FREQUENCIES within the RATED FREQUENCY RANGE shall be taken into account (e.g. 50 Hz and 60 Hz) but consideration of the tolerance on a RATED FREQUENCY (e.g. 50 Hz  $\pm$  0,5 Hz) is not normally necessary.

#### 1.4.7 Electrical measuring instruments

Electrical measuring instruments shall have adequate bandwidth to provide accurate readings, taking into account all components (d.c., AC MAINS SUPPLY frequency, high frequency and harmonic content) of the parameter being measured. If the r.m.s. value is being measured, care shall be taken that measuring instruments give true r.m.s. readings of non-sinusoidal waveforms as well as sinusoidal waveforms.

#### 1.4.8 Normal operating voltages

For the assessment of voltages in ELV CIRCUITS, SELV CIRCUITS and TNV CIRCUITS:

- consideration shall be given both to normal operating voltages generated internally in the equipment and to those generated externally; and
- voltages other than normal operating voltages, such as earth potential rises and induced voltages from power lines and from electric traction lines, shall not be considered.

#### 1.4.9 Measurement of voltage to earth

Where the standard specifies a voltage between a conductive part and earth, all of the following earthed parts are considered:

- the protective earthing terminal (if any); and
- any other conductive part required to be connected to protective earth (for example, see 2.6.1); and
- any conductive part that is earthed within the equipment for functional reasons.

Parts that will be earthed in the application by connection to other equipment, but are unearthed in the equipment as tested, shall be connected to earth at the point by which the highest voltage is obtained. When measuring a voltage between earth and a conductor in a circuit that will not be earthed in the intended application of the equipment, a non-inductive resistor of 5 000  $\Omega \pm 10 \%$  shall be connected across the voltage measuring instrument.

Voltage drop in the PROTECTIVE EARTHING CONDUCTOR of the power supply cord, or in an earthed conductor in other external wiring, is not included in the measurements.

#### 1.4.10 Loading configuration of the EUT

In determining the input current, and where other test results could be affected, the following variables shall be considered and adjusted to give the most unfavourable results:

- loads due to optional features, offered or provided by the manufacturer for inclusion in or with the EUT;
- loads due to other units of equipment intended by the manufacturer to draw power from the EUT;
- loads which could be connected to any standard supply outlets in OPERATOR ACCESS AREAS on the equipment, up to the value indicated in the marking required by 1.7.5.

It is permitted to use artificial loads to simulate such loads during testing.

#### 1.4.11 Power from a telecommunication network

For the purpose of this standard, the power available from a TELECOMMUNICATION NETWORK is considered to be limited to 15 VA.

#### 1.4.12 Temperature measurement conditions

*P*

Where a maximum temperature ( $T_{\max}$ ) or a maximum temperature rise ( $\Delta T_{\max}$ ) is specified for compliance with tests, it is based on the assumption that the room ambient air temperature will be 25 °C when the equipment is operating. However, the manufacturer is permitted to specify a higher ambient air temperature.

It is not necessary to control the ambient temperature ( $T_{\text{amb}}$ ) at a specific value during tests, but it shall be monitored and recorded.

Temperatures measured on the equipment shall conform with one of the following conditions, all temperatures being in °C.

If  $T_{\max}$  is specified:  $(T - T_{\text{amb}}) \leq (T_{\max} - T_{\text{mra}})$

If  $\Delta T_{\max}$  is specified:  $(T - T_{\text{amb}}) \leq (\Delta T_{\max} + 25 - T_{\text{mra}})$

where:

$T$  is the temperature of the given part measured under the prescribed test conditions;

$T_{\text{mra}}$  is the maximum room ambient temperature permitted by the manufacturer's specification or 25 °C, whichever is greater.

During the test, the room ambient temperature should not exceed  $T_{\text{mra}}$  unless agreed by all parties involved.

#### 1.4.13 Temperature measurement methods

*E*

Unless a particular method is specified, the temperatures of windings shall be determined either by the thermocouple method or by the resistance method (annex E). The temperatures of parts other than windings shall be determined by the thermocouple method. Any other suitable method of temperature measurement which does not noticeably influence the thermal balance and which achieves an accuracy sufficient to show compliance is also permitted. The choice of and position of temperature sensors shall be made so that they have minimum effect on the temperature of the part under test.

#### 1.4.14 Simulated faults and abnormal conditions

Where it is required to apply simulated faults or abnormal operating conditions, these shall be applied in turn and one at a time. Faults which are the direct consequence of a simulated fault or abnormal operating condition are considered to be part of that simulated fault or abnormal operating condition.

When applying simulated faults or abnormal operating conditions, parts, supplies, consumable materials, media and recording materials shall be in place if they are likely to have an effect on the outcome of the test.

Where there is a specific reference to a single fault, the single fault consists of a single failure of any insulation (excluding DOUBLE INSULATION OR REINFORCED INSULATION) or a single failure of any component (excluding components with DOUBLE INSULATION OR REINFORCED INSULATION).

The equipment, circuit diagrams and component specifications are examined to determine those fault conditions that might reasonably be expected to occur. Examples include:

- short circuits and open circuits of semiconductor devices and capacitors;
- faults causing continuous dissipation in resistors designed for intermittent dissipation;
- internal faults in integrated circuits causing excessive dissipation;
- failure of BASIC INSULATION between current-carrying parts of the PRIMARY CIRCUIT and
  - accessible conductive parts;
  - earthed conductive screens;
  - parts of SELV CIRCUITS;
  - parts of LIMITED CURRENT CIRCUITS.

## 1.5 Components

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### 1.5.1 General

Where safety is involved, components shall comply either with the requirements of this standard or with the safety aspects of the relevant IEC component standards.

NOTE 1 – An IEC component standard is considered relevant only if the component in question clearly falls within its scope.

In this standard, certain IEC component standard requirements are replaced by the relevant requirements of component standards as listed in annex P.1. DC  
DC

In this standard, certain requirements (such as flammability tests) are alternatively satisfied by complying with relevant requirements of component standards as listed in annex P.2. DC  
DC

A component which is to be connected to an SELV CIRCUIT and also to an ELV CIRCUIT or to a part at HAZARDOUS VOLTAGE shall comply with the requirements of 2.2.

NOTE 2 – An example of such a component is a relay with different supplies connected to different elements (coils and contacts).

### 1.5.2 Evaluation and testing of components

*Evaluation and testing of components shall be carried out as follows:*

K P

- *a component that has been demonstrated to comply with a standard harmonized with the relevant IEC component standard shall be checked for correct application and use in accordance with its rating. It shall be subjected to the applicable tests of this standard as part of the equipment with the exception of those tests which are part of the relevant IEC component standard;*
- *a component that has not been demonstrated to comply with a relevant standard as above shall be checked for correct application and use in accordance with its specified rating. It shall be subjected to the applicable tests of this standard, as part of the equipment, and to the applicable tests of the component standard, under the conditions occurring in the equipment;*

NOTE – The applicable test for compliance with a component standard is, in general, carried out separately.

- *where no relevant IEC component standard exists, or where components are used in circuits not in accordance with their specified ratings, the components shall be tested under the conditions occurring in the equipment. The number of samples required for test is, in general, the same as required by an equivalent standard.*