

UL1244

ADOPTION NOTICE

UL1244, "Electrical and Electronic Measuring and Test Equipment," was adopted on October 3, 1994, for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Commander, Defense Personnel Support Center, ATTN: DPSC-MSE, 2800 South 20th Street, Philadelphia, PA 19145. DoD activities may obtain copies of this standard from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. The private sector and other Government agencies may purchase copies from the Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062.

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Subject 3111-1 (1244)

1285 Walt Whitman Road
 Melville, NY 11747
 June 5, 1996

TO: Electrical Council of Underwriters Laboratories Inc.,
 Subscribers to UL's Listing Services for
 Measuring, Testing and Signal Generation Equipment (PICQ)
 Electrical and Electronic Measuring and Testing Equipment (FHCW)

SUBJECT: Announced Test and Follow-Up Service Requirements for Listed Field Test Instruments
 Also Classified (Verified) in Accordance With Level I or II of TSB-67

This bulletin should be kept with your copy of the standard.

Appendix A of this bulletin shows the current Guide Information for Measuring, Testing and Signal Generation Equipment (PICQ).

Questions regarding interpretation of requirements should be directed to the responsible UL Staff. Please see Appendix B of this bulletin regarding designated responsibility for the subject product category.

This program has resulted from requests by industry for Underwriters Laboratories to qualify Listed field test instruments that determine the transmission performance of LAN cable systems.

Test methods and requirements will be in accordance with Level I or II of the performance specification TSB-67, Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems.

CLASSIFICATION MARKING

The Classification Marking for these testers consists of the Listing Mark and the statement: "ALSO CLASSIFIED (VERIFIED) LEVEL I (or II) TSB-67".

Classification Markings are an option for UL-Listed field test instruments. Exercise of this option by a test instrument manufacturer will not require a review or retesting to maintain the current basic Listing of these instruments.

Before being authorized to apply a Classification Marking to UL-Listed field test instruments, manufacturers are to have their Listed test instruments qualified under this program.

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ANNOUNCED EFFECTIVE DATE

The UL program for verifying the performance of field test instruments to TSB-67 is currently in effect.

Suggestions and comments regarding the attached program are welcome at any time and should be made to the UL Engineering Services personnel named in Appendix B. Inquiries concerning measurement details should be directed to Robert Schick (Extension 22893) or Bob DeLisi (Extension 22452) at Melville (516-271-6200).

UNDERWRITERS LABORATORIES INC.

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SR:SB

3111BUL.D01;DL;mc

A P P E N D I X AGUIDE INFORMATION FOR
MEASURING, TESTING AND SIGNAL GENERATING EQUIPMENT, PICQ

This listing covers equipment intended primarily for the metering and testing of electrical and electronic circuits such as ammeters, voltmeters, power meters, frequency counters, chart recorders, oscilloscopes and related accessories, kits and probes. This listing also covers equipment designed to provide electrical or electronic signals for test purposes such as signal generators or injectors, and frequency synthesizers.

It does not cover medical and dental or process control metering and testing equipment. Listings of equipment which measures the functional performance (nonelectrical or nonelectronic) of other equipment, the physical or chemical properties of materials or qualitative or quantitative constituent analysis of materials and preparation of materials for further analysis or measurement may be found under "Laboratory Use Electrical Equipment" (OGTK) or "Laboratory Equipment" (OGGS).

Additional Listings may be found under "Electrical and Electronic Measuring and Testing Equipment" (FHCW).

These products have been investigated with respect to risk of fire, electric shock, and personal injury. Where such equipment is included in systems which involve other pieces of equipment or mechanical operations, the investigation of the risk of fire, electric shock and personal injury has included only the equipment specifically Listed in the individual listings. The accuracy of the equipment has not been investigated.

The basic standard used to investigate products in this category is UL 3111-1 "Measuring and Testing Equipment".

In addition, this category covers Listed testers, that are also Classified in accordance with Level I or II of Annex A of the performance specification TSB-67, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems". The Classification Marking for these testers consists of the Listing Mark described below and the statement: "ALSO CLASSIFIED (VERIFIED) LEVEL I (or II) TSB-67".

The Listing Mark of Underwriters Laboratories Inc. on the product is the only method provided by UL to identify products manufactured under its Listing and Follow-Up Service. The Listing Mark for these products includes the name and/or symbol of Underwriters Laboratories Inc. (as illustrated in the introduction to this directory) together with the word "LISTED", a control number and one of the following product names as appropriate "Measuring and Testing Equipment", "Measuring Equipment", "Testing Equipment", "Signal Generation Equipment" or the name of the specific type of product as shown in the individual Listings, or combinations of the preceding identities.

APPENDIX B

DESIGNATED RESPONSIBILITY FOR UL PRODUCT CATEGORIES PICQ, MEASURING, TESTING AND SIGNAL GENERATION EQUIPMENT FHCW, ELECTRICAL AND ELECTRONIC MEASURING AND TESTING EQUIPMENT

The individuals shown in the following table are involved with the investigation of products covered under the subject categories. The Primary Designated Engineer (**shown in UPPERCASE letters**) coordinates the establishment and uniform interpretation of UL requirements applicable to the product category. The Designated Engineers (**shown in lowercase letters**) work with the Primary Designated Engineer to interpret requirements and maintain standards.

Should you have questions regarding any adopted requirements that affect your product, you are encouraged to contact the individual at the office to which you normally submit your products.

The Industry Advisory Group (IAG) Chairman for the subject categories is Steve Hewson at UL's Northbrook office. The IAG Chairman oversees the significant interpretations made by the Primary Designated Engineer and arbitrates any differences regarding interpretation of UL requirements.

CCN	Office/Subsidiary	Responsible Engineer	Extension
PICQ FHCW	Camas	Ed Lemos	55610
	Melville	ROBERT J. SCHICK	22893
	Northbrook	James Feth	42671
	RTP	Robert Spears	11633
	Santa Clara	Kent Jones	32371
	Europe	Dan Bejnarowicz	--
	Japan	James Kurtz	--



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May 18, 1995

Revision pages for

Standard for

Electrical and Electronic Measuring and Testing Equipment

UL 1244, Third Edition

Attached to this transmittal notice is a reprinted title page for the Third edition of UL 1244.

Attention is directed to the note on the title page of this standard identifying that the Department of Defense has adopted the text of UL 1244.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	November 30, 1993 (Reprinted May 18, 1995)
2	—
3 – 95	November 30, 1993
A1 – A5	November 30, 1993
B1 – B12	November 30, 1993

NOVEMBER 30, 1993

(Title Page Reprinted: May 18, 1995)

1

UL 1244

Standard for

Electrical and Electronic Measuring and Testing Equipment

First Edition – July, 1978

Second Edition – July, 1980

Third Edition

November 30, 1993

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

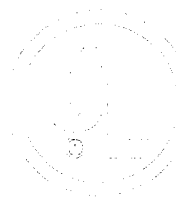
The Department of Defense (DoD) has adopted UL 1244 on July 4, 1994. The publication of revised pages or a new edition of this standard will not invalidate the DoD adoption.

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 published set of revision pages.

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Electrical and Electronic Measuring and Testing Equipment



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UL Standards for Safety are developed under a procedure which provides for participation and comment from the affected public as well as industry. The procedure takes into consideration a survey of known existing standards and the needs and opinions of a wide variety of interests concerned with the subject matter of the standard. Thus manufacturers, consumers, individuals associated with consumer-oriented organizations, academicians, government officials, industrial and commercial users, inspection authorities, insurance interests and others provide input to UL in the formulating of UL Standards for Safety, to keep them consonant with social and technological advances.

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November 30, 1993

Standard for

Electrical and Electronic Measuring and Testing Equipment

UL 1244, Third Edition

Accompanying this transmittal notice is a copy of the Third edition of UL 1244.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

Revised and/or additional pages may be issued from time to time.

Subscribers to UL's services in the area covered by this standard will receive these revised and/or additional pages automatically. Others may receive such pages by subscribing to UL's subscription service for revisions. See UL's CATALOG OF STANDARDS FOR SAFETY for a description of the revision subscription service, the cost of the service for this standard, and ordering information.

NOVEMBER 30, 1993

1

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(1 – 11/30/93 – 11/30/93)

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Appendix A

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Appendix B – MANUFACTURING AND PRODUCTION TESTS (ROUTINE TESTS)

Index	B1
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In this standard:

- requirements proper are printed in roman type.
- explanatory matter regarding the requirements is printed in smaller roman type.
- *test specifications are printed in italic type.*
- *explanatory matter regarding test specifications is printed in smaller italic type.*

FOREWORD

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.

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.

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.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

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.

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.

1 General

1.1 Scope

1.1.1 Electrical or electronic measuring or testing equipment

This standard applies to electrical, electronic, or electromechanical measuring or testing equipment designed:

- | | | |
|----|------------------------------------|------------------------|
| a) | to | |
| | —measure, or | |
| | —observe, and | |
| | indicate quantities of | |
| | —electrical, or | Measuring
Equipment |
| | —electronic | |
| | phenomena, or | |
| b) | to supply | |
| | —electrical, or | Testing
Equipment |
| | —electronic | |
| | quantities for measuring purposes. | |

(Inclusion of equipment that measures or indicates electrical analogs of other phenomena is under consideration.)

1.1.2 Auxiliary or accessory equipment

This standard also applies to auxiliary equipment and accessories rated for use with electrical, electronic, or electromechanical measuring and testing equipment wherein auxiliary and accessory equipment is separate and does not itself perform the desired function but is used in addition to or as a supplement to equipment according to 1.1.1.

1.1.3 Equipment covered

Electrical, electronic, and electromechanical measuring and testing equipment includes, but is not necessarily restricted to:

- a) indicating and recording measuring equipment,
- b) electrical or electronic measuring equipment,
- c) signal generators and other equipment supplying electrical quantities (voltage, current, and/or waveforms) for measuring or testing purposes.
- d) measurement standards, potentiometers, and measuring bridges,
- e) substitute power supplies used in addition to or as a supplement to equipment according to this Sub-clause.

1.1.4 Constraints

This standard applies to equipment that:

- a) is rated for connection to an unlimited voltage or power-supply source, according to Clause 16, (ac or dc or both), but does not exceed
 - i) 480 V rms (root-mean-square) between phases for 3-phase supply circuits,
 - ii) 250 V rms for single-phase supply circuits;
- b) is rated for connection to a voltage-limited or power-limited supply source and internally derives from that source either unlimited voltage or unlimited power according to Clause 16;
- c) is rated for measuring, testing, or other connection to an unlimited-voltage or unlimited-power circuit.

1.1.5 Environmental conditions

Equipment according to this standard is intended for use in enclosed locations where air temperature is controlled and normally only nonconductive pollution occurs.

The basic climatic conditions for heated or cooled enclosed locations are:

- a) temperature from 5°C (41°F) to 40°C (104°F)
Equipment may occasionally be used temporarily or for short time periods at -10°C (14°F) to +5°C (41°F).
- b) altitude up to 2,200 m (7,218 ft)
- c) relative humidity up to 80 percent with wet bulb temperature not to exceed 27°C (81°F).

1.1.6 Equipment not covered

This standard does not apply to equipment:

- a) intended primarily for identifying, examining, and investigating materials and making measurements and tests such as might be associated with manufacturing processes and quality-control procedures.

This type of equipment is categorized as "Inspection and Measuring Equipment".

b) intended primarily for technological activities including the measurement of physical or chemical properties of materials, functional performance (nonelectrical or nonelectronic) of equipment, qualitative or quantitative constituent analysis of substances, and the preparation of materials.

This type of equipment is categorized as "Laboratory Equipment".

c) intended primarily for use in medical diagnostic and therapeutic applications.

This type of equipment is categorized as "Medical and Dental Equipment".

d) watt-hour meters and similar revenue-related equipment for use and installation by electric utility companies for measuring electric energy and related quantities.

e) intended primarily for use as a general-use battery charger, auxiliary supply source, substitute power, or general-use power supply not specifically intended for use with measuring or testing equipment.

This type of equipment is categorized as "Battery Chargers and Power Supplies".

Specifically intended is defined as being:

- 1) packaged with the equipment, or
- 2) referenced in an equipment marking, or
- 3) referenced in the operating instructions packed with the equipment.

f) intended primarily for use of its measuring or testing functions exclusively for control purposes.

This type of equipment is categorized as "Process-Control equipment".

2 Definitions

For the purposes of this standard, the following definitions apply.

2.1 ACCESSIBLE PART – A part that can be touched during normal use or operator servicing. See 10.1.

2.2 ATTACHMENT PLUG – A connecting device for a flexible cord that, by insertion into a receptacle, establishes supply-circuit connections between the flexible cord and the receptacle.

2.3 BENCH-TOP EQUIPMENT – Equipment intended to be used on and supported by a bench, table, stand, or similar surface, but is neither fixed nor hand-carried as determined by the following:

- a) It has at least one handle and exceeds 20 kg mass (44 lb mass).
- b) It has no handle and exceeds 5 kg mass (11 lb mass).
- c) It is not mobile (does not have casters, wheels, rollers, and the like nor is it provided with a cart).

- 2.4 **CIRCUIT-TO-GROUND VOLTAGE** – The rated value of voltage with respect to earth ground.
- 2.5 **CLEARANCE DISTANCE** – The shortest distance measured in air between conductive parts.
- 2.6 **CREEPAGE DISTANCE** – The shortest distance measured over the surface of insulation between conductive parts. Air gaps shorter than 1.0 mm (0.04 inch) are not considered to interrupt the surface path.
- 2.7 **CONDUCTIVELY CONNECTED** – A part is conductively connected to another part if the current between the parts, with the equipment at reference test conditions, exceeds the limit for leakage current.
- 2.8 **CORD-CONNECTED EQUIPMENT** – Equipment that connects to a supply circuit by means of a permanently attached flexible power-supply cord and attachment plug or by means of a detachable power-supply cord.
- 2.9 **ELECTRONIC DEVICE** – A part or an assembly of parts that employs electron or hole conduction in a semiconductor or electron conduction in a vacuum or gas.
- 2.10 **EQUIPMENT** –
- a) **Hand-Held** – Any piece of equipment either intended to be or indicated by the manufacturer that it can be (that is, in advertising literature or in the operating instructions) held in one hand during any phase of normal operation, regardless of its weight.
 - b) **Permanently connected** – Equipment that is fastened or otherwise secured to the building at a specific location.
 - c) **Portable** – Cord and plug connected equipment that (1) has no provision for permanent mounting, and (2) can be moved from one place to another for use.
 - d) **Stationary** – Cord and plug connected equipment that is intended to be fastened in place or located in a dedicated space.
 - e) **Hand-Carried** – Note: This is different from "Hand-Held Equipment" which is intended to be used and carried in one hand rather than carried by hand from one location to another. Equipment specifically intended to be easily carried by hand from one location to another as determined by the following:
 - i) It is provided with at least one handle and is not greater than 20 kg mass (44 lb mass).
 - ii) It has no handle and is not greater than 5 kg mass (11 lb mass).
- 2.11 **GAUGES** – Wherever it appears in this Standard, the abbreviation AWG means American Wire Gauge.
- 2.12 **GROUND** – A conducting connection, whether international or otherwise, between an electrical circuit or electrical equipment and either the earth or some conducting body that serves in place of the earth.
- 2.13 **GROUNDING** – The act of establishing a conductive connection, whether intentional or otherwise, between an electrical circuit or electrical equipment and the earth or some conducting body that serves in place of the earth.

2.14 INSULATION –

- a) **Double** – A system of insulation comprising both basic and supplementary insulation
- b) **Functional/Basic** – Insulation necessary for the proper functioning of equipment and for basic protection against electric shock.
- c) **Reinforced** – Improved basic insulation with mechanical and electrical qualities providing the same degree of protection against electric shock as double insulation.
- d) **Supplementary** – Independent insulation provided in addition to the basic insulation to protect in the case of physical or electrical breakdown of the basic insulation (see item b).

2.15 ISOLATED CIRCUIT – A circuit in which the current, with the equipment at reference test conditions, to any other circuit or conductive part does not exceed the limit for leakage current.

2.16 MEASURING OR TESTING TERMINAL – The external terminal or connector of the equipment to which connection is made to serve the equipment function.

2.17 OPERATOR – The person using or operating the equipment.

2.18 OPERATOR CONTROL – An operator-accessible control – usually operated by a knob, pushbutton, lever, or the like – provided to enable the operator to cause the equipment to perform its intended function.

2.19 POWER-SUPPLY CORD – The cord provided to connect the equipment to the branch circuit.

2.20 PROBE ASSEMBLY, MEASURING OR TESTING – An assembly consisting of a probe(s), a remote terminal(s), and a connecting lead(s) or shielded cable for conveniently extending the equipment input or output circuits to the external circuit in which measurement or testing is desired. Refer to Figure 2.1 for a typical example.

The leads may be permanently connected to the equipment or may be terminated with a connector(s) to mate with the equipment measuring or testing terminals.

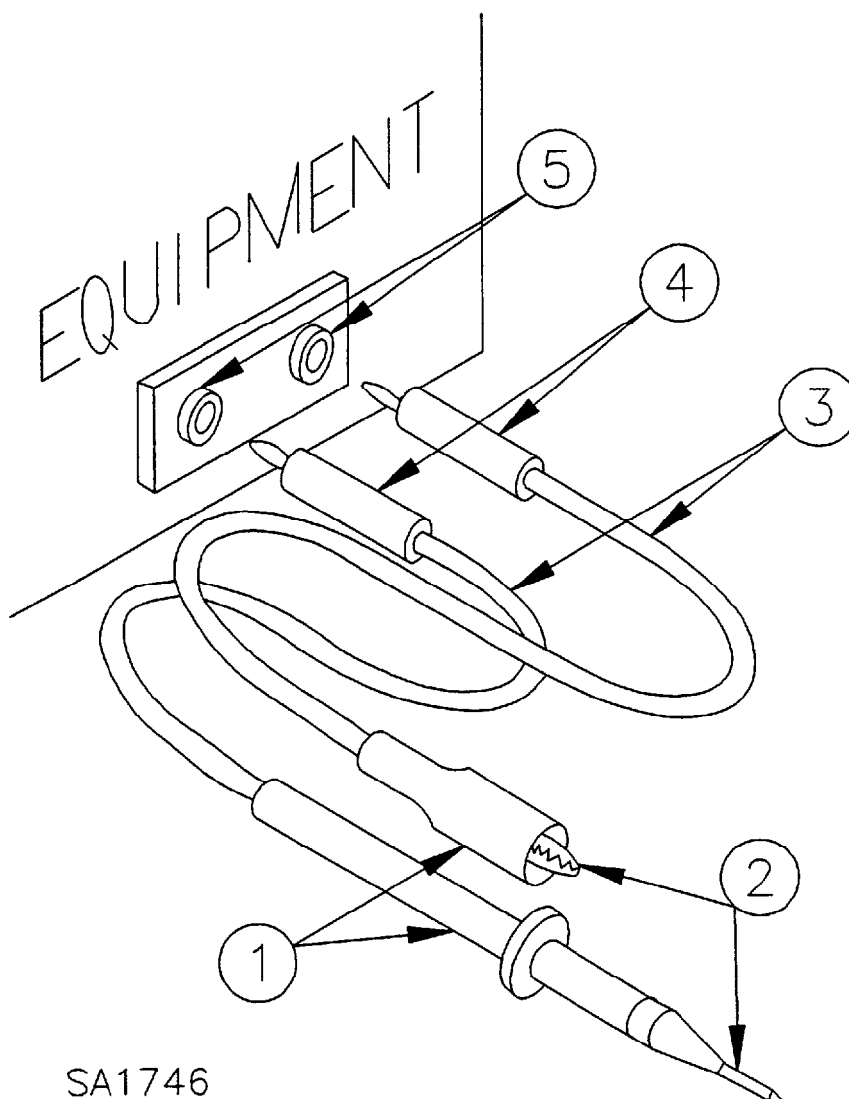
The probe assembly may contain components or circuits that modify the characteristics of the voltage or current passing through the probe assembly or the input or output characteristics of the equipment.

2.21 RATED SUPPLY VOLTAGE – The supply voltage, or range of voltages, for which the manufacturer has constructed the equipment.

2.22 RATED VALUE – The value, or one of the values, assigned by the equipment manufacturer.

2.23 RECEPTACLE – A connector device permanently connected to the supply circuit (usually a branch circuit) into which an attachment plug is inserted.

Figure 2.1
Typical probe assembly (illustration only
for defining generic parts)



- 1 PROBE – The handle, body, boot, etc. used to support and insulate the remote terminal and to facilitate its application to the circuit in which measurement or testing is desired.
- 2 REMOTE TERMINAL – The clip, pin, grip, or other connecting or contacting device that makes the electromechanical connection to the external circuit in which measurement or testing is desired.
- 3 LEADS – The insulated leads or shielded cable interconnecting the remote terminal(s) with the equipment input or output circuit.
- 4 CONNECTOR – The connector device, if any, that terminates the leads or cable with a means to make the electromechanical connection to the equipment input or output terminals or connector.
- 5 MEASURING OR TESTING TERMINALS – See 2.17.

- 2.24 REMOTE-CONTROL DEVICE – A device for controlling equipment from a distance.
- 2.25 SAFETY SWITCH – A switch employed for the purpose of providing protection according to this standard.
- 2.26 SUBSTITUTE POWER SUPPLY – Supply equipment that may be used instead of a battery supply for the equipment.
- 2.27 SUPPLY CIRCUIT – The circuit supplying electrical energy to the equipment from a branch circuit.
- 2.28 SUPPLY EQUIPMENT – Equipment that takes energy from an electrical supply, generally a branch circuit, and supplies it in a modified form to energize other equipment.
- 2.29 TERMINAL DEVICE – A part used to facilitate the making of one or more electrical connections. It may contain several terminal contacts (a connector).
- 2.30 TESTS –
- a) Routine Test – A test that is carried out on each piece of equipment during the production process.
 - Continuity of grounding connection test (see 10.5.1)
 - Polarization test (see 10.8.6).
 - Production-line dielectric voltage-withstand test (see 10.11.1 b).
 - b) Type Test – A test that is carried out on one or more pieces of equipment, representative of a type, to determine whether the construction and manufacturing methods comply with the requirements according to this standard.
- 2.31 FIELD-WIRING TERMINAL – Any terminal to which a supply wire can be connected by an installer in the field is a field-wiring terminal unless the wire is provided as part of the equipment and a connector, soldering lug, soldered loop, crimped eyelet, pressure terminal, or other means for making the connection is factory-assembled to the wire.

3 General Information

3.1 Purposes of this standard

The purposes of this standard are to establish minimum requirements for protection and to specify means of measurement for determining compliance.

These requirements include specific protections identified in the various Clauses.

These requirements do not, in general, concern other properties of the equipment such as effectiveness, accuracy, or reliability.

Equipment depended upon for indication of acceptable performance of other equipment – for example, a leakage-current meter – shall also be evaluated for effectiveness, accuracy, and ability to perform the intended function according to the manufacturer's ratings.

Should it be technically impractical to determine the effectiveness of such equipment, markings pertaining to the characteristic(s) in question shall be prominently displayed on the equipment.

3.2 Compliance

Compliance with the requirements is determined by performing inspections and tests according to the Clauses applicable to the particular equipment.

3.3 Components

Where component or material ratings are required in this standard, such ratings shall be according to applicable component or material requirements.

Exception: Component and material requirements may be modified.

3.4 Units of measurement

If a value for measurement as given in this standard is followed by a value in parentheses in other units, the second value may be only approximate. The first-stated value is the requirement.

Example: 25 mm

(1 inch)



requirements

approximate equivalent value

4 General Requirements

4.1 The equipment construction shall be such that:

- a) Fire, electric shock, or injury to persons is not likely to occur during normal use or operator servicing; and
- b) the components and materials are used within their rated value(s), such as electrical, mechanical, and temperature limits, and other limitations of use; and

(Note: Also see 3.3.)

- c) the components, wiring, and other internal parts are protected from being displaced or damaged.

4.2 The components, parts, and materials to which reference is made in 4.1 and elsewhere in this Standard are those involving or associated with

- the risk of fire; or
- the risk of electric shock; or
- the risk of injury to persons.

Exception: Where indicated otherwise.

5 General Type–Test Requirements

5.1 Conduct of tests

5.1.1 *Tests specified in this standard are type tests.*

Exception: Where indicated otherwise.

If in this standard it is required that tests on components or parts of equipment are to be made in accordance with their individual relevant specifications, such tests need not necessarily be performed during the type test specified in this standard.

5.1.2 *Type tests shall be carried out on one and the same piece of equipment or on identical multiple samples.*

Type tests specified in this standard shall be carried out on equipment in the condition as shipped from the factory or as repaired to the same condition.

Where it is necessary to perform destructive tests, additional samples of identical components or equipment may be used.

5.1.3 *For voltage measurements, the voltmeter sensitivity shall not be less than 20,000 ohms per volt dc or 5,000 ohms per volt ac for potentials of 500 V or less and the resistance shall not be less than 10 megohms for a–c or d–c potentials of more than 500 V. Voltmeters having a higher input resistance shall be used wherever it is warranted by the resistance of the circuit under test.*

Exception: Where indicated otherwise.

5.1.4 *Cheesecloth specified in this standard shall be untreated cotton cloth running 26 — 28 m²/kg (14 — 15 yd²/lb) and having what is known to the trade as a count of 13 by 11 — that is, (for any square centimeter, 13 threads in one direction and 11 threads in the other direction (for any square inch, 32 threads in one direction and 28 threads in the other direction)).*

Test involving cheesecloth shall be made in a room free of drafts.

5.1.5 *The terms "voltage" and "current" indicate rms or d-c values.*

Exception: Where specified otherwise.

5.2 Reference test conditions (reference conditions for test purposes)

The following conditions shall prevail in the location in which the equipment is being tested:

- Temperature within the range of 15 — 35°C (59 — 95°F).
- Relative humidity of less than 80 percent,
- Atmospheric air pressure (absolute) within the range of 86 — 106 kPa (12.5 — 15.4 psi),
- Environment free of hoarfrost, dew, percolating water, rain, solar radiation, and the like.

Exception: Where specified otherwise.

5.2.1 *Each test shall be carried out under the most unfavorable combination of:*

a) *Position*

The equipment shall be in any position of normal use and mounted according to the instructions. Normal ventilation shall not be impeded by artificial means.

b) *Applied supply-circuit voltage*

The applied supply-circuit voltage shall be the maximum "utilization" voltage of the intended "nominal" supply circuit voltage.

The maximum "utilization voltage for various "nominal" supply circuits are shown in Table 4.1.

If the equipment supply rating exceeds the maximum "utilization" voltage of intended "nominal" supply circuit, the applied supply-circuit voltage shall be the maximum supply-voltage rating of the equipment.

The applied supply-circuit frequency shall be any rated supply frequency of the equipment.

The applied supply voltage for a-c and d-c rated equipment shall be ac or dc.

Equipment that may be operated either from an a-c or d-c supply, may be connected to the worst-case d-c input specified if such operation imposes more severe conditions than if operated from the a-c supply.

The applied supply voltage for single-phase a-c rated equipment may be polarized as intended or reversed.

c) *Measuring circuits*

Measuring circuits shall be energized by any value between zero and the rated input.

Isolated measuring circuits shall be connected to any Potential between zero and the rated circuit-to-ground voltage.

d) *Ground terminals*

Protective-grounding terminals shall be connected to ground.

Exception: Where specified otherwise in the test clauses.

Measuring-circuit ground terminals shall be connected to ground when specified by the manufacturer.

Exception: Where specified otherwise in the test clauses.

e) Operating controls

Accessible controls shall be set to any position.

Exception: Supply-circuit voltage-setting devices shall be set according to the manufacturer's instructions.

Remote-control (operating) devices shall either be connected or not.

This condition should not cause the operating device to be set to cause abnormal operation of the equipment.

f) Normal use

The equipment shall be used for its intended purpose, or not connected for any use whatsoever.

g) Motors and motor-driven parts

Motors and motor-driven parts of the equipment shall be loaded according to the intended purpose.

When testing motor-driven parts, other parts of the equipment that are intended to operate at the same time should remain connected.

h) Testing (output) circuits

Equipment supplying electrical quantities (voltage, current, and/or waveshapes) shall:

i) Be operated in such a way as to provide the maximum rated output; and

ii) If isolated, be connected to any potential between zero and the rated circuit-to-ground voltage.

i) Substitute power supplies

Substitute power supplies shall be tested in or with the equipment for which they are intended, and according to the manufacturer's instructions.

j) Accessories

Noninterchangeable accessories shall be connected according to the manufacturer's instructions, or not connected.

Interchangeable accessories and accessories of limited interchangeability shall be subjected to separate tests relating to their own characteristics.

5.3 Fault conditions

Testing under fault conditions denotes that, in addition to the reference test conditions mentioned in 5.2, the breakdown of particular components is simulated one after the other. Testing under fault conditions is according to 11.

When performing tests under simulated fault conditions, multiple concurrent faults are not initially induced but are considered if they result from the initial induced fault.

Table 5.1
Minimum and maximum "utilization"
voltages for "nominal" supply
circuits^a

Supply – circuit system and "nominal" voltage	Minimum "utilization" voltage	Maximum "utilization" voltage applied supply – circuit voltage: 5.2.1(b)
X-wire, E-volts	0.9E V	1.05 V
2-wire, 100 V	90 V	105 V
2-wire, 115 V	103.5 V	120.75 V
2-wire, 120 V	108 V	126 V
2-wire, 127 V	114.3 V	133.35 V
3-wire, 100/200 V	90/180 V	105/210 V
3-wire, 120/208 V	108/187.2 V	126/218.4 V
3-wire, 120/220 V	108/198 V	126/231 V
3-wire, 115/230 V	103.5/207 V	120.75/241.5 V
3-wire, 120/240 V	108/216 V	126/252 V

^a "Utilization" voltage is the voltage at the line terminals of the equipment. The "nominal" voltage of a supply circuit is a value assigned to the circuit (or system) for the purpose of conveniently designating its voltage class.

6 Marking

The equipment shall be marked according to this Clause.

6.1 General requirements

The marking required in this Clause shall:

- resist the deleterious effects of handling, cleaning agents as specified by the manufacturer, and the like expected in normal use; and,
- make the information clear and legible under conditions of normal use.

Compliance is checked by inspection.

6.2 Equipment—identification markings

Equipment shall bear identification markings on the exterior, excluding the bottom, according to this Sub—clause.

For handed—held equipment, such identification markings may be on the bottom.

The markings may be located where it is visible upon removing a cover or opening a door that is intended to be removed or opened by an operator without the use of tools.

Compliance is checked by inspection.

6.2.1 Manufacturer's identification

The equipment shall bear the name, trade name, or trademark of the manufacturer or private labeler, or other distinctive marking by means of which the organization responsible for the equipment can be readily identified.

Compliance is checked by inspection.

6.2.2 Model identification

The equipment shall bear a distinctive designation, such as a model number, that distinguishes it from other equipment made by the same organization.

Compliance is checked by inspection.

6.2.3 Factory identification

If equipment bearing the same distinctive designation (model number) is manufactured at more than one location, equipment from each manufacturing location shall bear in identification on such location.

Such identification may be in code and need not be on the equipment exterior.

Compliance is checked by inspection.

6.2.4 Accessory, plug—in module, and auxiliary—equipment identification

Equipment intended to work with a specific accessory, plug—in module, or auxiliary equipment shall bear markings or be provided with a means for identifying each such accessory, plug—in module, or auxiliary equipment.

Accessory, plug—in module, and auxiliary equipment intended to work with specific equipment shall bear marking or be provided with a means for identifying each such equipment.

The identification markings may be located on the equipment, on the accessory, plug—in module, or auxiliary equipment, or in the literature packed with either.

Compliance is checked by inspection.

6.2.5 Separate Grounding Conductor

Equipment that requires a separate grounding conductor (see 19.3) as part of the (wiring) installation, shall provide a marking on the unit. The marking shall indicate the need for such grounding and shall make reference to the installation instruction.

Exception: The marking need not reference the installation instructions when complete instructions are provided on the equipment.

Compliance is checked by inspection.

6.3 Equipment-rating markings

Equipment shall bear rating marking visible from the exterior, excluding the bottom, according to this Sub-clause (see 2.22).

A rating is a value assigned to the equipment by the manufacturer.

For hand-held equipment, such rating markings may be on the bottom.

The markings may be located where they are visible upon removing a cover or opening a door that is intended to be removed or opened by an operator without the use of tools.

Compliance is checked by inspection.

6.3.1 Supply-circuit type and frequency rating

- a) Equipment intended to operate from a direct-current supply shall bear markings indicating that the supply shall be direct current.

The symbol  (IEC Publication 417, Symbol no. 5031; see Appendix) may be used for this marking.

- b) Equipment intended to operate from an alternating-current supply shall bear markings indicating that the supply shall be alternating current.

The symbol  (IEC Publication 417, Symbol no. 5032; see Appendix) may be used for this marking.

The markings shall include the equipment supply-circuit frequency or supply-circuit frequency-range rating (cycles per second, cycles/second, hertz, c/s, cps, or Hz).

- c) Equipment intended to operate from either direct- or alternating-current supplies shall bear markings indicating that the supply may be either direct current or alternating current.

The symbol  (IEC Publication 417, Symbol no. 5033; see Appendix) may be used for this marking.

The markings shall include the equipment supply-circuit frequency or supply-circuit frequency-range rating (cycles per second, cycles/second, hertz, c/s, cps, or Hz).

Compliance is checked by inspection.

6.3.2 Polyphase supply – circuit rating

Equipment intended for operation on a polyphase supply circuit shall bear markings designating the number of phases and number of wires, including the grounded conductor and excepting the protective ground conductor, if any.

Compliance is checked by inspection.

6.3.3 Supply – circuit voltage rating

Equipment shall bear markings designating the supply – circuit voltage(s) or voltage – range(s) rating(s) of the equipment that can be applied without the adjustment of a voltage – setting device.

Multiple – voltage equipment shall bear markings indicating the supply – circuit voltage or voltage range for which the equipment is set.

If the equipment is constructed so that the supply – circuit voltage – selector setting can be changed by the operator, the action of changing the voltage – selector setting shall also change the supply – circuit voltage indication.

Compliance is checked by inspection.

6.3.4 Supply – circuit current or power rating

Equipment shall bear markings designating the equipment supply – circuit current or power rating in amperes, volt – amperes, or watts (A, VA, or W). Such rating shall include the maximum current or power of any accessory or auxiliary equipment that is supplied through and operated simultaneously with the equipment.

The measured supply – circuit current or power shall not exceed 110 percent of the marked supply – circuit current or power rating.

Compliance is checked by inspection and by measuring the equipment supply – circuit current or power consumption under reference test conditions.

6.3.5 Supply – circuit receptacle rating

Equipment incorporating operator – accessible supply – circuit receptacles for supplying operating energy to other equipment shall bear markings adjacent to such receptacles indicating the available voltage, frequency, and either current or power.

Compliance is checked by inspection.

6.3.6 Fuse ratings

Equipment incorporating fuses providing protection against the likelihood of fire shall bear markings adjacent to the fuse or fuseholder designating the fuse current and voltage ratings.

The fuse ratings may be incorporated into a fuse – replacement caution marking (see 6.4.1).

Compliance is checked by inspection.

6.3.7 Equipment duty-cycle rating

Equipment intended for short-term or intermittent use, and, if operated continuously, would exceed the temperature rises according to Clause 7 shall bear a duty-cycle rating.

Such duty-cycle rating shall be visible from the operating position and, if applicable, shall be adjacent to or otherwise related to the duty-cycle controls.

Compliance is checked by inspection.

6.4 Warning and caution markings

Equipment shall bear warning and caution markings according to this Sub-clause.

A warning or caution marking required in this Sub-clause shall

- i) be permanently attached; and
- ii) not be attached to parts likely to be replaced during maintenance or servicing;

Exception: If the marking is integral with the replacement part, part ii) is not applicable.

- iii) have lettering in which

—the precautionary signal word shall be at least 2.75 mm or 7/64 inch high;

—the text shall be at least 1.5 mm or 1/16 inch high and contrasting in color to the background; and

—if molded or stamped in a material, the text shall be at least 2.0 mm or 5/64 inch high and, if not contrasting in color, a depth or raised height of at least 0.5 mm or 0.02 inch.

Warning and caution markings may be combined under the signal word "WARNING".

Compliance is checked by inspection.

6.4.1 Operator-replaceable fuse-replacement caution marking

Equipment incorporating an operator-replaceable fuse providing protection against the likelihood of fire shall bear a replacement caution marking.

The marking shall be prefaced by the signal word "CAUTION" and

- a) state that the fuse provides protection against fire, and
- b) instruct that replacement shall be only with a fuse of the specified voltage and current ratings.

For example:

"CAUTION—FOR CONTINUED PROTECTION AGAINST FIRE, REPLACE ONLY WITH FUSE OF THE SPECIFIED VOLTAGE AND CURRENT RATINGS."

The marking shall:

- i) be located on the equipment so that it is visible during fuse replacement.

A fuse-rating marking (6.3.6) may be incorporated into the fuse-replacement caution marking provided that the replacement marking is adjacent to the fuse or fuseholder, or

- ii) be prominently displayed in the operating instruction manual; provided the symbol for a fuse (IEC Publication 417, symbol no. 5016 a. See appendix) and its electrical rating enclosed in an equilateral triangle (as shown) is located adjacent to the fuse. The fuse rating may be adjacent to the fuse — in place of it appearing within the triangle.

The overall symbol shall be at least 3.2 mm (1/8 inch) high. The electrical rating of the fuse shall be in letters not less than 1.6 mm (1/16 inch) high.

Compliance is checked by inspection.

6.4.2 Operator-servicing warning marking

Equipment in which parts conductively connected to the measuring circuit are accessible under conditions of operator servicing, such as replacing batteries and fuses or any other part intended for operator replacement, shall bear a service warning marking.

The marking shall be prefaced by the signal word "WARNING" and

- i) state that parts could render an electric shock, and
- ii) instruct that the measuring terminals are to be disconnected from external circuits prior to operator servicing.

Such marking shall be located where visible prior to operator access to such parts.

For example:

"WARNING—TO AVOID ELECTRIC SHOCK, DISCONNECT MEASURING TERMINALS BEFORE REMOVING (OR REPLACING, OR OPENING, OR THE LIKE.) _____."

Compliance is checked by inspection.

6.4.3 Implosion-protection warning marking

Equipment incorporating an operator-replaceable vacuum device with a face plate exceeding 160 mm (6-5/16 inches) in diameter, or equivalent face area, (over 20,000 mm² or 31 inches²), shall bear a warning marking.

The marking shall be prefaced by the signal word "WARNING" and

- i) state that the device is dangerous to handle, and
- ii) instruct that servicing should be performed by qualified personnel.

Such marking shall be visible during operator servicing of the device.

For example:

"WARNING – CATHODE – RAY TUBE DANGEROUS TO HANDLE REFER SERVICING TO QUALIFIED PERSONNEL."

An implosion – protection warning marking may be incorporated into the cathode – ray – tube – replacement warning marking (6.4.4).

Compliance is checked by inspection.

6.4.4 Cathode – ray – tube – replacement warning marking

Equipment incorporating a cathode – ray tube having integral implosion protection and that can be replaced with a cathode – ray tube without integral implosion protection shall bear a replacement warning marking.

The marking shall be prefaced by the signal word "WARNING" and

- i) state that the cathode – ray tube incorporates integral implosion protection, and
- ii) instruct that the tube shall be replaced only with a tube having integral implosion protection.

Such marking shall be visible during replacement of the cathode – ray tube.

For example:

"WARNING – CATHODE – RAY TUBE EMPLOYS INTEGRAL IMPLOSION PROTECTION. REPLACE WITH SAME TYPE NUMBER FOR CONTINUED PROTECTION."

A cathode – ray – tube – replacement warning marking may be incorporated with the implosion – protection warning marking (6.4.3).

Compliance is checked by inspection.

6.4.5 X – radiation warning marking

Parts of equipment producing X – radiation exceeding the limits specified in 7.1.1 and employing supplemental protective covers or shields shall bear a warning marking.

The marking shall

- i) State that such covers or shields provide protection from X – radiation, and
- ii) instruct that personnel shall wear protective clothing when operating equipment with such covers or shields removed.

Such marking shall be located on the cover or shield, or where visible during servicing of parts behind such cover or shield.

Compliance is checked by inspection.

6.4.6 High – leakage – current warning marking cord – connected equipment incorporating an electro – magnetic – radiation – suppression filter and having a leakage current (see 10.5.8 and 10.10.1) exceeding 0.5 mA shall bear a warning marking.

The marking shall be prefaced by the signal word "WARNING" and shall

- i) state that the protective earth-grounding conductor provides protection from electric shock, and
- ii) instruct that the equipment must be earth-grounded.

Such marking shall be located either adjacent to the attachment-plug grounding terminal or on the equipment.

Compliance is checked by inspection.

6.5 Operator-control and terminal markings

Operator controls and terminals shall be identified such that the equipment may be connected and operated as intended by the manufacturer, so that electric shock, fire, or injury to persons are not likely.

6.5.1 Terminal and control identification

If the equipment controls or terminals are not expressly identified on the equipment, the controls and terminals shall be identified in the operator instructions or literature packaged with the equipment.

Compliance is checked by inspection.

6.5.2 Terminal markings and ratings requiring explanations

If, to preserve the protection afforded by the equipment, further explanations beyond the terminal identification and ratings marked on the equipment are necessary, the marking shall include a reference to the operating instructions.

The symbol  may be used for this purpose.

The reference shall be adjacent to or related to the marking or rating requiring explanation.

Compliance is checked by inspection.

6.5.3 Terminal function, use, or ratings

If the equipment terminals are not expressly marked with function, use, or ratings; the terminal function, use or ratings, whichever is appropriate to the intent of the terminals, shall be in the operator instructions or literature packaged with the equipment. A terminal or terminal set used for more than one function shall be marked to identify the function use or rating appropriate for each function.

Abbreviations and symbols may be incorporated in such markings.

Such markings may include other function, use, or ratings pertinent to equipment operation.

Terminal function, use, or ratings may be incorporated into operator-control markings.

Compliance is checked by inspection.

6.5.4 Isolated terminal ratings

An isolated terminal or terminal set that is intended to be connected to an energized external source shall be marked with an isolated rating.

Compliance is checked by inspection.

6.5.5 Unlimited voltage terminal identification

A terminal or terminal set rated for unlimited voltage shall be identified by a marking on the equipment, adjacent to or otherwise related to the terminal or terminal set. Alternatively, control or terminal markings, indicators, equipment configuration or name, or other identifiers shall imply the terminal functional identification.

Compliance is checked by inspection.

6.5.6 Voltage terminal ratings

A terminal or terminal set intended for connection to an external voltage source or that supplies unlimited voltage shall bear a rating marking adjacent to or otherwise related to the terminal or terminal set. Alternatively, the related controls, indicators, or other identifiers shall specify the terminal rating or use, whichever is appropriate to the intent of the terminal.

Compliance is checked by inspection.

6.5.7 High-voltage-terminal marking

A measuring or testing terminal to which or from which a voltage equal to or exceeding 1000 V may be applied or supplied shall be marked with the flash symbol in red (IEC Publication 417, Symbol No. 5036; see Appendix).

For example:

—The flash symbol pointing to individual terminal(s) intended to be marked.

—The flash symbol located equidistant from two or more terminals intended to be marked.

—The flash symbol located in the terminal area but not adjacent to any particular terminal or terminals in such a manner that it applies to all the terminals.

The markings (symbol) may be incorporated into a rating marking.

Compliance is checked by inspection.

6.5.8 Current terminal rating

A terminal or terminal set intended for connection to an external current source or that supplies current shall bear a rating marking adjacent to or otherwise related to the terminal or terminal set. Alternatively, the related controls, indicators, or other identifiers shall specify the terminal rating or use, whichever is applicable to the intent of the terminal.

Compliance is checked by inspection.

6.5.9 Protective-grounding terminal

A protective-grounding terminal for equipment not having supply-circuit connections shall be identified.

The symbol  (IEC Publication 417, Symbol No. 5019; see Appendix) may also be marked adjacent to any protective-grounding terminal. When used, the symbol shall be defined in the operating instructions provided with the equipment.

The marking shall be adjacent to the terminal.

Compliance is checked by inspection.

6.6 On/off switch

The on position, or the off position, or both, of the principal supply-circuit switch controlling equipment operating energy shall be identified. (See 14.2.1 and 14.2.2.)

The symbols  and  (IEC publication 417, symbol Nos. 5008 and 5007; see Appendix) may be used for this purpose.

Identification by illumination alone is not acceptable.

Switches that appear to be in the same position when on or off shall not be used for the principal supply-circuit switch.

Compliance is checked by inspection.

6.7 Field wiring connection temperature markings

Equipment having wires or terminals within a terminal box or compartment, intended for branch circuit supply connections, that attain a temperature higher than 60°C (140°F) when tested in accordance with Clause 7, shall be marked with a field wiring temperature marking. The marking shall include the following statement: "For supply connections, use wires rated for at least ____" (see Table 6.1 for values).

Compliance is checked by inspection.

Table 6.1
Temperature for marking

Temperature attained in terminal box or compartment	Temperature marking
61–75°C (142–167°F) 76–99°C (168–194°F)	75°C (167°F) 90°C (194°F)

6.8 Double insulation marking

Equipment employing double insulation according to Clause 20 shall bear an identification of such a construction.

The symbol  (IEC Publication 417, symbol no. 5172; see Appendix) shall be used for this identification.

6.8.1 Double insulation servicing marking

Equipment or the servicing instructions for equipment employing double insulation shall bear a servicing marking. The marking shall:

- i) include a reference to the operating instructions, and
- ii) indicated the equipment employs double insulation, and
- iii) indicated only specified replacement parts are to be employed

Such marking shall be located where visible when servicing the equipment or prominently in the servicing instructions.

The symbols , along with the wording "When Servicing, Use Only Specified Replacement Parts" or the equivalent, shall be used for this purpose.

7 Equipment Emanations

The equipment shall be constructed to limit the levels of ionizing radiation.

Exception: This requirement does not apply to equipment containing radioactive substances. Such equipment is covered under separate standards.

Compliance is checked according to 7.1.

7.1 Ionizing radiation

7.1.1 X-radiation measurement

The exposure-rate limit averaged over an area of 10 square centimeters (1.55 inches²) shall not exceed 0.5 mR/h, 36 pA/kg or 129 nC per kg/h 5 cm (2 inches) from the surface of the equipment or surface of the part of the equipment being measured. The method of determining the amount of radiation shall be effective over the range of possible radiation energies.

The equipment shall be prepared and adjusted such that:

- a) The equipment under test shall be complete.

Covers or doors that are intended to be removed or opened by the operator shall be removed or opened.

- b) The supply-circuit voltage to the equipment under test shall be
 - i) adjusted to be within the rated range(s) according to 5.2.1(b), or
 - ii) 130 V if the supply-circuit voltage rating is within the range of 105 – 130 V, and 260 V if the supply-circuit voltage rating is within the range of 210 – 260 V.

whichever produces the maximum X-radiation.

c) Measurements on multifunction equipment shall be made with the equipment in any and all modes of normal operation, and with applicable signals applied to all input terminals in whatever manner produces the maximum X-radiation.

d) Cathode-ray-tube equipment shall display a pattern from each beam not exceeding 30 by 30 mm (1-3/16 by 1-3/16 inches) or the smallest possible display, whichever is larger. The display(s) shall be positioned to maximize X-radiation.

For example: Not necessarily centered or multiple beams overlapping.

e) To simulate conditions that may occur during repair of the equipment, the equipment under test shall be adjusted to produce maximum X-radiation, and all parts whose opening or removal is normal during service or repair shall be opened or removed during the test.

For example: Covers, cathode-ray tube bezels, panels, windows, shields, barriers, or chassis.

Compliance is checked by measuring the X-radiation under the conditions of this Sub-clause in a direction normal to the surface of the equipment or surface of the part of the equipment being measured.

7.1.2 Enclosure or shield construction requirements

Parts of equipment that produce X-radiation exceeding the limits in 7.1.1 shall be additionally enclosed or shielded. The enclosures or shields:

- a) shall not be removable by hand, and
- b) shall be captive, and
- c) shall provide shielding during normal use, operator servicing according to 10.1 (a) and (b), and repair by service personnel (except servicing of the enclosed or shielded parts), and
- d) shall be marked according to 6.4.5 (X-radiation warning marking).

Compliance is checked by inspection.