4.2.10 Wall or ceiling mounted equipment

The mounting means of equipment intended for wall or ceiling mounting shall be adequate.

Compliance is checked by inspection of the construction and of available data, or where necessary, by the following test.

The equipment is mounted in accordance with the installation instructions. A force, in addition to the weight of the equipment, is applied downwards through the centre of gravity of the equipment, for 1 min. The additional force shall be equal to three times the weight of the equipment but not less than 50 N. The equipment and its associated mounting means shall remain secure during the test. After the test, the equipment, including any associated mounting plate, shall not be damaged.

4.3 Design and construction

4.3.1 Edges and corners

Where edges or corners could be hazardous to OPERATORS because of location or application in the equipment, they shall be rounded or smoothed.

This requirement does not apply to edges or corners that are required for proper functioning of the equipment.

Compliance is checked by inspection.

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4.3.2 Handles and manual controls

Handles, knobs, grips, levers and the like shall be reliably fixed so that they will not work loose in normal use, if this might create a hazard. Sealing compounds and the like, other than self-hardening resins, shall not be used to prevent loosening.

If handles, knobs and the like are used to indicate the position of switches or similar components, it shall not be possible to fix them in a wrong position if this might create a hazard.

Compliance is checked by inspection, by manual test and by trying to remove the handle, knob, grip or lever by applying for 1 min an axial force as follows.

If the shape of these parts is such that an axial pull is unlikely to be applied in normal use, the force is:

- *15 N for the operating means of electrical components; and*
- *20 N in other cases.*

If the shape is such that an axial pull is likely to be applied, the force is:

- *30 N for the operating means of electrical components; and*
- *50 N in other cases.*

A handle or handles intended to support more than 9.0 kg shall be capable of supporting four times the weight of the product without breakage of the handle, its securing means, or that part of the product to which the handle is attached. D2 D2 D2

Compliance is determined by applying a force in the intended carrying direction uniformly over a 75 mm length at the centre of the handle. Starting at zero, the applied force shall be gradually increased so that the required test value is attained in 5 – 10 s and then maintained at the test value for 1 min. If more than one handle is provided, the test force shall be determined by the percentage of the product weight sustained by each handle with the product in the intended carrying position. If a product weighing less than 25,0 kg is provided with more than one handle but can be carried by only one handle, each handle shall be capable of withstanding a force based on the total weight of the product. D2 D2 D2 D2 D2 D2 D2 D2 D2

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4.3.3 Adjustable controls

Equipment shall be so constructed that manual adjustment of a control device, such as a device for selection of different AC MAINS SUPPLY voltages, requires the use of a TOOL if incorrect setting or inadvertent adjustment might create a hazard.

NOTE Marking requirements for supply voltage adjustment are in 1.7.4.

Compliance is checked by manual test.

4.3.4 Securing of parts *P.2*

Screws, nuts, washers, springs or similar parts shall be secured so as to withstand mechanical stresses occurring in normal use if loosening would create a hazard, or if CLEARANCES or CREEPAGE DISTANCES for SUPPLEMENTARY INSULATION or REINFORCED INSULATION would be reduced to less than the values specified in 2.10 (or Annex G).

NOTE 1 Requirements regarding fixing of conductors are in 3.1.9.

Compliance is checked by inspection, by measurement and by manual test.

For the purpose of assessing compliance:

– it is assumed that two independent fixings will not become loose at the same time; and

– it is assumed that parts fixed by means of screws or nuts provided with self-locking washers or other means of locking are not liable to become loose.

NOTE 2 Spring washers and the like can provide satisfactory locking.

4.3.5 Connection by plugs and sockets *P.1*

Within a manufacturer's unit or system, plugs and sockets likely to be used by the OPERATOR or by a SERVICE PERSON shall not be employed in a manner likely to create a hazard due to misconnection. In particular, connectors complying with IEC 60083 or IEC 60320 shall not be used for SELV CIRCUITS or TNV CIRCUITS. Keying, location or, in the case of connectors accessible only to a SERVICE PERSON, clear markings are permitted to meet the requirement.

Compliance is checked by inspection.

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4.3.6 Direct plug-in equipment *P.1*

DIRECT PLUG-IN EQUIPMENT shall not impose undue stress on the socket-outlet. The mains plug part shall comply with the standard for the relevant mains plug.

Compliance is checked by inspection and, if necessary, by the following test.

The equipment is inserted, as in normal use, into a fixed socket-outlet of a configuration as intended by the manufacturer, which can be pivoted about a horizontal axis intersecting the centre lines of the contacts at a distance of 8 mm behind the engagement face of the socket-outlet. The additional torque that has to be applied to the socket-outlet to maintain the engagement face in the vertical plane shall not exceed 0,25 N · m.

NOTE 1 In Australia and New Zealand, compliance is checked in accordance with AS/NZS 3112.

NOTE 2 In the United Kingdom, the torque test is performed using a socket-outlet complying with BS 1363, and the plug part of DIRECT PLUG-IN EQUIPMENT shall be assessed to the relevant clauses of BS 1363.

4.3.7 Heating elements in earthed equipment

Heating elements in equipment that is earthed for safety purposes shall be protected so that, under earth fault conditions, a fire hazard due to overheating is prevented. In such equipment, temperature sensing devices, if provided, shall be located in all line conductors supplying the heating elements.

The temperature sensing devices shall also disconnect the neutral conductor for each of the following cases:

a) in equipment supplied from an IT power distribution system;

b) in PLUGGABLE EQUIPMENT supplied through a reversible appliance coupler or a reversible plug;

c) in equipment supplied from a socket-outlet with indeterminate polarity.

In cases b) and c), it is permitted to meet this requirement by connecting a THERMOSTAT in one conductor and a THERMAL CUT-OUT in the other conductor.

It is not required to disconnect the conductors simultaneously.

Compliance is checked by inspection.

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4.3.8 Batteries *P.1*

NOTE 1 Requirements for markings or instructions are given in 1.7.13.

NOTE 2 Requirements for overcurrent protection are given in 3.1.1 and 5.3.1.

NOTE 3 Requirements for stationary batteries (such as large secondary batteries installed in a fixed installation and external to the equipment) are given in IEC 60896-21, IEC 60896-22 and EN 50272-2.

Portable secondary sealed cells and batteries (other than button) containing alkaline or other non-acid electrolyte shall comply with either (a) IEC 62133 and applicable parts of Annex M of IEC 62368-1, Edition No. 2, or (b) UL 2054 and 4.3.8. DC DC

Battery packs with secondary sealed cells and batteries (other than button) containing alkaline or other non-acid electrolyte and used in STATIONARY EQUIPMENT shall comply with either IEC 62133, UL 2054 or UL 1973. DC DC DC

Such battery packs used in STATIONARY EQUIPMENT that rely on solid-state circuits and software controls as safeguards shall comply with either a) the requirements in UL 1973 for System Safety Analysis (5.7) and Protective Circuit and Controls (5.8) or b) similar requirements in an appropriate standard for electronic safety-related controls that are suitable for investigation of such protection of secondary cells and batteries. DC DC DC DC DC

Where a battery standard does not contain requirements for electrical insulation used as a safeguard, appropriate insulation requirements from sub-clause 2.10 are applicable based on the WORKING VOLTAGE. DC DC DC

Equipment containing batteries shall be designed to reduce the risk of fire, explosion and chemical leaks under normal conditions and after a single fault in the equipment (see 1.4.14). For USER-replaceable batteries, the design shall reduce the likelihood of reverse polarity installation if this would create a hazard.

Battery circuits shall be designed so that:

– the output characteristics of a battery charging circuit are compatible with its rechargeable battery; and

– for non-rechargeable batteries, discharging at a rate exceeding the battery manufacturer's recommendations, and unintentional charging, are prevented; and

– for rechargeable batteries, charging and discharging at a rate exceeding the battery manufacturer's recommendations, and reversed charging, are prevented; and

– OPERATOR-replaceable batteries shall either:

- have contacts that cannot be shorted with the test finger Figure 2A; or
- be inherently protected to avoid creating a hazard within the meaning of the standard.

NOTE 4 Reversed charging of a rechargeable battery occurs when the polarity of the charging circuit is reversed, aiding the discharge of the battery.

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If a battery contains liquid or gel electrolyte, a battery tray shall be provided that is capable of retaining any liquid that could leak as a result of internal pressure build-up in the battery. The requirement to provide a battery tray does not apply if the construction of the battery is such that leakage of the electrolyte from the battery is unlikely (see also 1.3.6).

NOTE 5 An example of a battery construction where leakage of the electrolyte is considered to be unlikely is the sealed cell valve-regulated type.

If battery tray is required, its capacity shall be at least equal to the volume of electrolyte of all the cells of the battery, or the volume of a single cell if the design of the battery is such that simultaneous leakage from multiple cells is unlikely.

NOTE 6 If several cells (for example, the six cells in a 12 V lead-acid battery) are in a single casing, its fracture could lead to a greater volume of leakage than from a single cell.

Compliance is checked by inspection and by evaluation of the data provided by the equipment manufacturer and battery manufacturer.

When appropriate data is not available, compliance is checked by test. However, batteries that are inherently safe for the conditions given are not tested under those conditions. Consumer grade, non-rechargeable carbon-zinc or alkaline batteries are considered safe under short-circuiting conditions and therefore are not tested for discharge; nor are such batteries tested for leakage under storage conditions.

The battery used for the following tests is either a new non-rechargeable battery or a fully charged rechargeable battery as provided with, or recommended by the manufacturer for use with, the equipment.

– ***Overcharging of a rechargeable battery****. The battery is charged while briefly subjected to the simulation of any* SINGLE FAULT CONDITION *that is likely to occur in the charging circuit and that results in overcharging of the battery. To minimize testing time, the failure is chosen that causes the worst-case overcharging condition. The battery is then charged for a single period of 7 h with the simulated failure in place.*

– ***Unintentional charging of a non-rechargeable battery****. The battery is charged while briefly subjected to the simulation of any single component failure that is likely to occur in the charging circuit and that would result in unintentional charging of the battery. To minimize testing time, the failure is chosen that causes the highest charging current. The battery is then charged for a single period of 7 h with that simulated failure in place.*

– ***Reverse charging of a rechargeable battery****. The battery is reverse charged while briefly subjected to the simulation of any single component failure that is likely to occur in the charging circuit and that would result in reverse charging of the battery. To minimize testing time, the failure is chosen that causes the highest reverse charging current. The battery is then reverse charged for a single period of 7 h with that simulated failure in place.*

– ***Excessive discharging rate for any battery****. The battery is subjected to rapid discharge by open-circuiting or short-circuiting any current-limiting or voltage-limiting components in the load circuit of the battery under test.*

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NOTE 7 Some of the tests specified can be hazardous to the persons carrying them out; all appropriate measures to protect personnel against possible chemical or explosion hazards should be taken.

These tests shall not result in any of the following:

– chemical leaks caused by cracking, rupturing or bursting of the battery jacket, if such leakage could adversely affect required insulation; or

– spillage of liquid from any pressure relief device in the battery, unless such spillage is contained by the equipment without risk of damage to the insulation or harm to the USER*; or*

– explosion of the battery, if such explosion could result in injury to a USER*; or*

– emission of flame or expulsion of molten metal to the outside of the equipment ENCLOSURE*.*

After completion of the tests, the equipment is subjected to the electric strength tests of 5.3.9.2.

4.3.9 Oil and grease

Where internal wiring, windings, commutators, slip-rings and the like, and insulation in general, are exposed to oil, grease or similar substances, the insulation shall have adequate properties to resist deterioration under these conditions.

Compliance is checked by inspection, and by evaluation of the data for the insulating material.

4.3.10 Dust, powders, liquids and gases

Equipment producing dust (for example, paper dust) or using powders, liquids or gases shall be so constructed that it is unlikely that either a dangerous concentration of these materials or a hazard in the meaning of this standard will be created by condensation, vaporization, leakage, spillage or corrosion during normal operation, storage, filling or emptying. CLEARANCES and CREEPAGE DISTANCES shall not be reduced below the values specified in 2.10 (or Annex G).

Compliance is checked by inspection, measurement and, where spillage of liquid could affect electrical insulation during replenishment, by the following test and, for flammable liquids, by the tests of 4.3.12.

The equipment shall be ready to use according to its installation instructions, but not energized.

The liquid container of the equipment is completely filled with the liquid specified by the manufacturer and a further quantity, equal to 15 % of the capacity of the container is poured in steadily over a period of 1 min. For liquid containers having a capacity not exceeding 250 ml, and for containers without drainage and for which the filling cannot be observed from outside, a further quantity of liquid, equal to the capacity of the container, is poured in steadily over a period of 1 min.

Immediately after this treatment, the equipment shall withstand an electric strength test as specified in 5.2.2 on any insulation on which spillage could have occurred and inspection shall show that the liquid has not created a hazard in the meaning of this standard.

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The equipment is permitted to stand in normal test-room atmosphere for 24 h before being subjected to any further electrical test.

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4.3.11 Containers for liquids or gases

Equipment that, in normal use, contains liquids or gases shall incorporate adequate safeguards against build-up of excessive pressure.

Compliance is checked by inspection and, if necessary, by an appropriate test.

4.3.12 Flammable liquids

P.2
NAA
NAE

If a flammable liquid is used in equipment, the liquid shall be kept in a closed reservoir, except for the amount needed for the functioning of the equipment. The maximum quantity of flammable liquid stored in an equipment shall in general be not more than 5 l. If, however, the usage of liquid is such that more than 5 l is consumed in 8 h, it is permitted to increase the quantity stored to that required for an 8 h operation.

Oil or equivalent liquids used for lubrication or in a hydraulic system shall have a flash point of 149 °C or higher, and the reservoir shall be of sealed construction. The system shall have provision for expansion of the liquid and shall incorporate means for pressure relief. This requirement is not applicable to lubricating oils that are applied to points of friction in quantities that would contribute negligible fuel to a fire.

Except under conditions given below, replenishable liquids such as printing inks shall have a flash point of 60 °C or higher, and shall not be under sufficient pressure to cause atomization.

Replenishable flammable liquids that have a flash point of less than 60 °C or that are under sufficient pressure to cause atomization are permitted provided inspection shows that there is no likelihood of liquid sprays or build-up of flammable vapour-air mixtures that could cause explosion or create a fire hazard. Under normal operating conditions, equipment using a flammable liquid shall not generate a mixture with a concentration exceeding one quarter of the EXPLOSION LIMIT if the mixture is in proximity to an ignition source, or exceeding half the EXPLOSION LIMIT if the mixture is not in proximity to an ignition source. The investigation shall also take into account the integrity of the liquid handling system. The liquid handling system shall be suitably housed or constructed so that risk of fire or explosion is reduced, even under the test conditions specified in 4.2.5.

Compliance is checked by inspection and, where necessary, by the following test.

The equipment is operated in accordance with 4.5.2 until its temperature stabilizes. In this condition, the equipment is operated in a normal manner, as directed in the operating instructions, and samples of the atmosphere in the vicinity of the electrical components and around the equipment are taken to determine the concentration of flammable vapours present.

Samples of the atmosphere are taken at 4 min intervals; four samples to be taken during normal operation, then seven samples after the equipment has stopped.

If, after the equipment has stopped, the concentration of flammable vapours appears to be increasing, samples shall continue to be taken at 4 min intervals until the concentration is shown to be decreasing.

If an abnormal operation of the equipment is possible with any of its fans not running, this condition is simulated during this compliance test.

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4.3.13 Radiation

4.3.13.1 General

Equipment shall be so designed that the risk of harmful effects of radiation to persons, and damage to materials affecting safety, is reduced.

Compliance is checked by inspection and as detailed in 4.3.13.2, 4.3.13.3, 4.3.13.4, 4.3.13.5 and 4.3.13.6 as appropriate.

4.3.13.2 Ionizing radiation *NAA*

For equipment that generates ionizing radiation, compliance is checked by the test in Annex H.

4.3.13.3 Effect of ultraviolet (UV) radiation on materials *P.2*

The following requirements apply only to equipment containing lamps that produce significant UV radiation, that is, having emission predominantly in the spectrum 180 nm to 400 nm, as specified by the lamp manufacturer.

NOTE General-purpose incandescent and fluorescent lamps, with ordinary glass envelopes, are not considered to emit significant UV radiation. A lamp that has UV in the spectrum from 180 nm to 400 nm as its predominant radiation emission (as specified by the lamp manufacturer), and emits higher than 0,001 W/m^2 irradiance, is considered to produce ″significant″ radiation.

Non-metallic parts (for example, non-metallic ENCLOSURES and internal materials including wire and cable insulation) that are exposed to UV radiation from a lamp in the equipment, shall be sufficiently resistant to degradation to the extent that safety is not affected.

Table 4A – Minimum property retention limits after UV exposure

Parts to be tested	Property	Standard for the test method	Minimum retention after test
Parts providing mechanical support	Tensile strength [a] or Flexural strength [a b]	ISO 527	70 %
		ISO 178	70%
Parts providing impact resistance	Charpy impact [c] or Izod impact [c] or Tensile impact[c]	ISO 179	70 %
		ISO 180	70 %
		ISO 8256	70 %
All parts	Flammability classification	See 1.2.12 and Annex A	See [d]

[a] Tensile strength and flexural strength tests are to be conducted on specimens no thicker than the actual thicknesses.

[b] The side of the sample exposed to UV radiation is to be in contact with the two loading points when using the three point loading method

[c] Tests conducted on 3,0 mm thick specimens for Izod impact and Tensile impact tests and 4,0 mm thick specimens for Charpy impact tests are considered representative of other thicknesses, down to 0,8 mm.

[d] The flammability classification may change as long as it does not fall below that specified in Clause 4.

Compliance is checked by examination of the construction and of available data regarding the UV resistance characteristics of the parts exposed to UV radiation in the equipment. If such data is not available, the tests in Table 4A are conducted on the parts.

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