iii) An oil-resistant cord is required if the EQUIPMENT is likely to be subjected to grease or oil.

*See rationale for 57.2DV

57.4 *Connection of POWER SUPPLY CORDS*

a) Cord anchorages

– EQUIPMENT and MAINS CONNECTORS provided with POWER SUPPLY CORDS shall have cord anchorages such that the conductors are relieved from strain, including twisting, where they are connected within the EQUIPMENT and within the MAINS CONNECTOR and the insulation of the conductors is protected from abrasion.

Strain relief methods, such as tying the cord into a knot or tying the ends with string, shall not be used.

– Cord anchorages of POWER SUPPLY CORDS shall be made:

1) of insulating material, or

2) of metal, insulated from conductive ACCESSIBLE PARTS not PROTECTIVELY EARTHED by SUPPLEMENTARY INSULATION, or

3) of metal provided with an insulating lining, if otherwise a total insulation failure of the POWER SUPPLY CORD could render LIVE conductive ACCESSIBLE PARTS not PROTECTIVELY EARTHED. This lining shall be fixed to the cord anchorage, unless it is a flexible bushing which forms part of the cord guard specified in this sub-clause, and shall comply with the requirements for BASIC INSULATION.

– Cord anchorages of POWER SUPPLY CORDS shall be so designed that the cord is not clamped by a screw which bears directly on the cord insulation.

– Screws, if any, which have to be operated when replacing the POWER SUPPLY CORD shall not serve to fix any component other than parts of the cord anchorage.

– Conductors of the POWER SUPPLY CORD shall be so arranged that if the cord anchorage fails the PROTECTIVE EARTH CONDUCTOR is not subject to strain as long as the phase conductors are in contact with their terminals.

Compliance is checked by inspection and by the following tests:

EQUIPMENT, if designed for a POWER SUPPLY CORD, is tested with the cord supplied by the manufacturer.

The POWER SUPPLY CORD conductors should, if possible, be disconnected from the mains terminals or from the MAINS CONNECTOR of the EQUIPMENT.

The cord shall be subjected 25 times to a pull on the sheath of the value shown in Table XVIII. The pulls shall be applied in the most unfavourable direction without jerks, each time for 1 s.

Immediately afterwards, the cord shall be subjected for 1 min to a torque of the value shown in Table XVIII.

Note – Table XVII not used. Table XVI incorporates (see Sub-clause 57.10a)) Tables XVI and XVII of the first edition.

Table XVIII
Testing of cord anchorages

Mass of EQUIPMENT (kg)	Pull (N)	Torque (Nm)
Up to and including 1	30	0,1
over 1 up to and including 4	60	0,25
over 4	100	0,35

After the tests, the cord sheath shall not have been longitudinally displaced by more than 2 mm and the conductor ends shall not have moved over a distance of more than 1 mm from their normally connected position.

CREEPAGE DISTANCES and AIR CLEARANCES shall not be reduced below the values specified in Sub-clause 57.10.

For the measurement of the longitudinal displacement, while the cord is subjected to the pull, a mark is made on the cord at a distance of approximately 2 cm from the cord anchorage or other suitable point, before starting the tests.

After the tests, the displacement on the cord sheath in relation to the cord anchorage or the above other suitable point while the cord is subjected to the pull, is measured.

It shall not be possible to push the cord into EQUIPMENT to such an extent that the cord, or internal parts of the EQUIPMENT, could be damaged.

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b) Cord guards

POWER SUPPLY CORDS of other than STATIONARY EQUIPMENT shall be protected against excessive bending at the inlet opening of EQUIPMENT by means of a cord guard of insulating material.

Alternatively, an opening in EQUIPMENT shall be so shaped that the applied POWER SUPPLY CORD, even if not provided with a guard, passes the following flexing test.

Compliance is checked by inspection, by measurement and by the following test(s):

EQUIPMENT designed for a POWER SUPPLY CORD is fitted with a cord guard or opening and the POWER SUPPLY CORD shall have an exposed length of approximately 100 mm. The EQUIPMENT is so held that the axis of the cord guard, where the cord leaves it, projects upward at an angle of 45° to the horizontal when the cord is free from stress.

A mass equal to 10 D^2g is then attached to the free end of the cord, D being the overall diameter, in millimetres, or, for flat cords, the minor overall dimensions of the POWER SUPPLY CORD delivered with the EQUIPMENT.

If the cord guard is temperature sensitive, the test is made at 23°C ± 2°C.

Flat cords are bent in a direction perpendicular to the plane containing the axis of the cores.

Immediately after the mass has been attached, the curvature of the cord shall nowhere be less than 1,5 D, being checked by a cylindrical rod with a diameter of 1,5 D.

Guards which fail the above dimensional test shall have to pass the test described in IEC 60335-1, Amendment 6, 1988, subclause 25.10.

c) Accessibility of the connection

The space inside EQUIPMENT designed for fixed wiring or a rewirable POWER SUPPLY CORD shall be adequate to allow conductors to be easily introduced and connected, and covers, if any, to be fitted without risk of damage to the conductors or their insulation. It shall be possible to check that the conductors are correctly connected and positioned before the cover is fitted.

Compliance is checked by inspection and by an installation test.

57.5 *MAINS TERMINAL DEVICES and wiring of MAINS PART*

**a) General requirements for MAINS TERMINAL DEVICES*

EQUIPMENT intended to be permanently connected to fixed wiring and EQUIPMENT intended to be connected by means of rewirable non-DETACHABLE POWER SUPPLY CORDS shall be provided with MAINS TERMINAL DEVICES in which connection shall be made by means of screws, nuts, soldering, clamping, crimping of conductors or equally effective methods.

Reliance shall not be placed upon the terminals alone to maintain the conductors in position, unless barriers are provided such that CREEPAGE DISTANCES and AIR CLEARANCES between LIVE parts and other conductive parts cannot be reduced to less than the values specified in Sub-clause 57.10, should the conductor break away.

Terminals of components other than terminal blocks may be used as terminals intended for external conductors if they comply with the requirements of this sub-clause and are properly marked according to Sub-clauses 6.2*h)*, *j)* and *k)*.

Screws and nuts which clamp external conductors shall not serve to fix any other component, except that they may also clamp internal conductors if these are so arranged that they are unlikely to be displaced when fitting the supply conductors.

Compliance is checked by inspection.

b) Arrangement of MAINS TERMINAL DEVICES

– For EQUIPMENT with rewirable cords where terminals are provided for the connection of external cords or POWER SUPPLY CORDS, these terminals together with any PROTECTIVE EARTH TERMINAL shall be closely grouped, so as to provide a convenient means of connection.

– For details of PROTECTIVE EARTH CONDUCTOR connections see Clause 58.

– For marking of MAINS TERMINAL DEVICES see Sub-clause 6.2.

– MAINS TERMINAL DEVICES shall not be accessible without the use of a TOOL, even if their LIVE parts are not accessible.

Compliance is checked by inspection.

– MAINS TERMINAL DEVICES shall be so located or shielded that, should a wire of a stranded conductor escape when the conductors are fitted, there is no risk of accidental contact between LIVE parts and ACCESSIBLE PARTS and, for CLASS II EQUIPMENT, between LIVE parts and conductive parts separated from ACCESSIBLE PARTS by SUPPLEMENTARY INSULATION only.

Compliance is checked by inspection and, in case of doubt, by the following test:

The end of a flexible conductor having the NOMINAL cross-sectional area specified in Sub-clause 57.3c) (Table XV) is stripped of its insulation for a length of 8 mm.

A single wire of the stranded conductor is left free and the rest of the conductor is secured to the terminal.

The free wire is bent in every possible direction without pulling back the insulating sheath and without making sharp bends around partitions.

The free wire of a conductor connected to a LIVE *terminal shall not come into contact with any* ACCESSIBLE PARTS *or parts connected to* ACCESSIBLE PARTS*, or, for* CLASS II EQUIPMENT*, parts which are separated from* ACCESSIBLE PARTS *by* SUPPLEMENTARY INSULATION *only.*

The free wire of a conductor connected to a PROTECTIVE EARTH TERMINAL *shall not come into contact with any* LIVE *part (see Sub-clause 57.5a)).*

c) Fixing of mains terminals

Terminals of EQUIPMENT shall be so fixed that, when the means for clamping the conductors are tightened or loosened, the internal wiring is not subjected to stress and CREEPAGE DISTANCES and AIR CLEARANCES are not reduced below the values specified in Sub-clause 57.10.

Compliance is checked by inspection and by measurement after fastening and loosening a conductor of the largest cross-sectional area specified 10 times.

**d) Connections to mains terminals*

– For EQUIPMENT with rewirable flexible cords to be connected by clamping means the cord terminals shall not require special preparation of the conductor in order to effect correct connection, and they shall be so designed or placed that the conductor is not damaged and cannot slip out when the clamping screws or nuts are tightened.

– For further requirements limiting conductor preparation in POWER SUPPLY CORDS and DETACHABLE POWER SUPPLY CORDS see Sub-clause 57.3*d)*.

Compliance is checked by inspection of the terminals and of the conductors after the test of Sub-clause 57.5c).

e) Fixing of wiring

Not used. See Sub-clause 56.1*f)*.

*See rationale for 57.5

57.5DV D2 *Modification of 57.5 by adding the following to item b):*

– If leads are provided for connection to the branch circuit and one end of the lead terminates in a wire binding screw, a terminal block, or the like within the EQUIPMENT, the free end shall be in a compartment separate from that containing the wire binding screws, terminal block, or the like. This may be in a separate wiring compartment provided as part of the EQUIPMENT, a separate recessed mounted splice (junction) box described in the installation instructions, or the like. See Figure 52DV.

– The free length of a lead inside an outlet box or field-wiring compartment shall be 152 mm (6 inches) or more. A lead may be less than 152 mm (6 inch) in length if it is evident that the use of a longer lead might result in a risk of fire or electric shock.

*See rationale for 57.2DV

57.6 *Mains fuses and* OVER-CURRENT RELEASES

Fuses or OVER-CURRENT RELEASES shall be provided in each supply lead for CLASS I EQUIPMENT and CLASS II EQUIPMENT having a functional earth according to Sub-clause 18*l)* and in at least one supply lead for other single-phase CLASS II EQUIPMENT.

The current rating of mains fuses and OVER-CURRENT RELEASES shall be such that they reliably carry the normal operating current and shall not be greater than the current rating of any component in the mains circuit carrying the mains supply current.

– A PROTECTIVE EARTH CONDUCTOR shall not be fused.

– For PERMANENTLY INSTALLED EQUIPMENT the neutral conductor shall not be fused.

Compliance is checked by inspection.

57.7 ***Location of interference suppressors in the** MAINS PART

Not used.

*See rationale for 57.7

57.8 *Wiring of the* MAINS PART

a) Insulation

The insulation of an individual conductor in the MAINS PART shall be at least electrically equivalent to that of the individual conductors of POWER SUPPLY CORDS complying with IEC 227 or 245, or that conductor shall be considered to be a bare conductor.

Compliance is checked by the following test:

The insulation is regarded to be electrically equivalent, if it withstands a dielectric strength test of 2 000 V for 1 min. The test voltage is applied to a sample of the wire between the conductor and aluminum foil wrapped around the insulation for a length of 10 cm.

b) Cross-section

– Internal wiring in a MAINS PART between the MAINS TERMINAL DEVICE and the protective devices shall have a cross-sectional area not less than the minimum required for the POWER SUPPLY CORD as specified in Sub-clause 57.3*c)*.

Compliance is checked by inspection.

– The cross-sectional area of other wiring in the MAINS PART and the sizes of tracks on printed wiring circuits shall be sufficient to prevent any fire hazard in case of possible fault currents.

If any doubt exists concerning the adequacy of incorporated overcurrent protection, compliance is checked by connecting the EQUIPMENT to a specified SUPPLY MAINS from which the most unfavourable short-circuit current expected can be drawn in the event of a fault in the MAINS PART.

Subsequently, a fault in a single insulation in the MAINS PART is simulated so that the fault current is the least favourable. No SAFETY HAZARD shall arise.

57.9 ***Mains supply transformers***

*See rationale for 57.9

Mains supply transformers shall comply with the following requirements:

57.9.1 *Overheating*

– Mains supply transformers used in MEDICAL ELECTRICAL EQUIPMENT shall be protected against overheating of BASIC INSULATION, SUPPLEMENTARY INSULATION and REINFORCED INSULATION in the event of short-circuit or overload on any output winding.

Compliance is checked by the tests described in Sub-clauses 57.9.1a) and 57.9.1b).

– Where protective devices external to the transformer or transformer ENCLOSURE provide the protection against overheating, e.g. fuses, OVER-CURRENT RELEASES, THERMAL CUT-OUTS, these devices shall be connected in such a way that failure of any component other than wiring interposed between the protective devices and the transformer cannot render the protective devices inoperative.

Compliance is checked by inspection.

Table XIX
Maximum allowable temperatures at 25°C ambient temperature of mains supply transformer windings under overload and short-circuit conditions

Parts	Maximum temperature °C
Windings and core laminations in contact therewith, if the winding insulation is:	
– of Class A material	150
– of Class B material	175
– of Class E material	165
– of Class F material	190
– of Class H material	210

a) Short-circuit

Compliance is checked by application of the following tests under the conditions specified in Clause 42:

– Mains supply transformers, provided with a protective device for limitation of the winding temperatures, are connected to a supply voltage which is the least favourable within the limits of 90% of the lowest to 110% of the highest RATED supply voltage or the RATED supply voltage range. Each secondary winding is short-circuited in turn, all other windings, except the primary winding, being loaded as in NORMAL USE.

– Any protective device for a secondary winding shall be operative.

– The protective device shall operate before the maximum temperatures of Table XIX are exceeded.

– Where a primary protective device does not operate, the maximum temperatures of Table XIX shall not be exceeded in steady thermal condition.

b) Overload

Mains supply transformers including their protective devices, if any, are tested in conditions of normal operation:

– under the conditions specified in Clause 42 until steady thermal conditions are obtained;

– the supply voltage being maintained at 90% or 110% of RATED supply voltage or at 110% of the highest value of the RATED supply voltage range, whichever is the least favourable;

– the tests are made on each winding or section in turn, the other windings or sections being loaded as in the relevant EQUIPMENT in NORMAL USE;

– the section or winding of the transformer under overload is loaded as follows:

• Mains supply transformers having fuses in accordance with IEC Publications 127 and 241 as protective devices, are loaded for 30 min and 1 h respectively, so that the test current in the fused circuit is in accordance with Table XX with the fuses replaced by links of negligible impedance.

• Mains supply transformers having fuses deviating from IEC Publications 127 and 241 as protective devices, are loaded for 30 min so that the test current in the fused circuit is as high as possible according to the characteristics supplied by the fuse manufacturer, but does not cause the fuse to operate. The fuses shall be replaced by links of negligible impedance.

Table XX
Test current for mains supply transformers

Marked value of RATED current of protecting fuse-link (A)	*Ratio between test current and RATED current of the fuse-link*
Up to and including 4	*2,1*
over 4 up to and including 10	*1,9*
over 10 up to and including 25	*1,75*
over 25	*1,6*

• If the current under short-circuit condition is smaller than the test current specified above, the transformer section or winding is short-circuited until steady thermal condition is attained.

• Mains supply transformers having THERMAL CUT-OUTS as protective devices are loaded so that the current through the transformer section or winding is the maximum which does not cause the cut-out to operate, the test being continued until steady thermal condition is attained.

• Mains supply transformers having OVER-CURRENT RELEASES as protective devices are loaded so that the test current in the circuit is as high as possible according to the trip current stated by the manufacturer of the OVER-CURRENT RELEASES but