BRITISH STANDARD

BS 4999-145:1987
Incorporating Amendment No. 1

General requirements for rotating electrical machines —

Part 145: Specification for winding terminations

ICS 29.160.01

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Power Electrical Engineering Standards Committee (PEL/-) to Technical Committee PEL/1, upon which the following bodies were represented:

Association of Consulting Engineers

Association of Electrical Machinery Trades

Association of Manufacturers Allied to the Electrical and Electronic Industry (BEAMA Ltd.)

Association of Supervisory and Executive Engineers

British Coal

Bureau of Engineer Surveyors

ERA Technology Ltd.

Electricity Supply Industry in England and Wales

Engineer Surveyors Section of the ASTMS

Engineering Equipment and Materials Users' Association

Health and Safety Executive

Ministry of Defence

Power Generation Association (BEAMA Ltd.)

Rotating Electrical Machines Association (BEAMA Ltd.)

South of Scotland Electricity Board

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14980	22 April 2004	Deletion of references to BS 5000-10 from Table 2 and Table 3

The following BSI references relate to the work on this British Standard:
Committee reference PEL/1
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Contents

Foreword

This part of BS 4999 has been prepared under the direction of the Power Electrical Engineering Standards Committee and supersedes BS 4999-71:1984, which is withdrawn.

This part has been issued to implement the decision to renumber all the parts of BS 4999 to bring the part numbers more into line with those of IEC Publication 34.

In addition to the renumbering of the part, the inclusion of the part number in the point numbering system, adopted in Part 71, has been abandoned. No technical changes have been made to the text of BS 4999-71:1984.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 5 and a back cover.

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1 Scope

This part of this British Standard specifies types of and performance requirements for winding terminations for rotating electrical machines rated for a.c. voltages up to 15 kV r.m.s. Minimum creepage and clearance distances appropriate to the rated voltages are also specified.

This standard does not specify requirements for the ability of the terminations of the following machines to withstand a high energy fault:

a) machines rated for voltages up to and including 660 V, which it is assumed, would be protected by fuses or other energy limiting devices.

b) machines rated for voltages of 1 100 V and above either protected by fuses or other energy limiting devices or intended for operation on a system where the nominal short-circuit capacity is lower than the relevant value given in Table 1.

The standard applies to terminals, terminal boxes and terminal enclosures, but it does not specify requirements for flameproof terminal enclosures.

The choice of a particular termination will be largely governed by the service and environmental conditions, but the standard is also relevant to the various types of cables normally used, including aluminium and, where applicable, cable sealing and dividing boxes. It is outside the scope of this British Standard to cover external supply cables in detail, but insofar as the design of the terminals is concerned, essential data are listed.

Winding terminations for small power machines having rated outputs up to and including 0.75 kW or kV·A per 1 000 r/min, such as those specified in BS 5000-11, are not covered by this standard.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this part of this British Standard, the following definitions apply.

2.1
termination
the arrangement provided for making the connections between the machine winding leads and the external conductors

2.2
terminal
a conducting element of a winding intended for connection to an external electrical conductor

2.3
stud terminals
a form of termination in which the terminals are studs mounted integral with the machine frame or in a separate terminal enclosure

2.4
strip terminals
a form of termination in which the terminals are strips mounted integral with the machine frame or assembly

2.5
loose leads
a form of termination in which the ends of the machine winding are brought out as unsupported insulated flexible conductors

2.6
air insulated termination
a termination so designed that the protection of phase conductors against electrical failure is by adequately spaced bare conductors with appropriate insulated supports

2.7
cable coupler
a form of termination in which the terminals are connected to the supply leads by means of a plug and socket device

2.8
separable insulated connectors
a form of termination comprising a moulded bushing and insulated elbow connector coupling

2.9
separate terminal enclosure
a form of termination in which the terminals are connected to the incoming supply leads inside a chamber which need not be fully enclosed and may be formed by the foundations beneath the machine

2.10
terminal box
a form of terminal enclosure in which the terminals are connected to the incoming supply leads inside a box which encloses the connections and is of a minimum size consistent with adequate access and with clearance and creepage distance requirements

2.11
pressure relief terminal box
a terminal box so designed that the products of an electrical breakdown within the box are relieved through a pressure relief diaphragm

2.12
pressure containing terminal box
a terminal box so designed that the products of an electrical breakdown within the box are safely contained

2.13
flameproof terminal box
a terminal box designed to comply with flameproof requirements

2.14
air insulated terminal box
a terminal box so designed that the protection of phase conductors against electrical failure within the terminal box is by adequately spaced bare conductors with appropriate insulated supports

2.15
phase insulated terminal box
a terminal box so designed that the protection of phase conductors against electrical failure within the terminal box is mainly by solid insulation

2.16
phase separated terminal box
a terminal box so designed that phase separation is provided by earthed metal barriers within the single compartment so as to restrict any electrical breakdown to an earth fault

2.17
phase segregated terminal box
a terminal box so designed that phase segregation is provided by earthed metallic barriers forming completely distinct individual phase compartments so as to restrict any electrical break-down to an earth fault

3 Ratings

Winding terminations shall be suitable for the machine rated voltage, rated current and rated frequency.

4 Ability of terminations for machines rated at 1 100 V and above to withstand system faults

Machine primary winding terminations, including internal flexible cables and connection cables between the power supply cables and the motor windings, of machines for use on electrical systems having nominal short circuit MV·A capacities equal to or greater than those in Table 1 shall be so rated that they will safely carry the fault current for the specified duration.

NOTE The fault clearance time is usually assumed to be not longer than 0.25 s for machines protected by circuit breakers.

The maximum density of the fault current in the internal flexible and connecting cables and winding terminations shall not exceed 400 A/mm^2 for copper and 250 A/mm^2 for aluminium for the 0.25 s clearance time.

Terminal boxes for machines protected by circuit breakers and having nominal short circuit capacities equal to or higher than those in Table 1 shall be of either the pressure relief or pressure containing type.

5 Electrical clearances

With the components of the terminations in the correct position, the clearances and creepage distances shall be not less than the values given in Table 2 and Table 3 respectively.

Table 1 — Nominal short-circuit capacity

Rated voltage V	Nominal short-circuit capacity MV·A
1 100	7.5
2 300	17.5
3 300	25.0
4 160	31.5
6 600	50.0
11 000	70.0
13 800	80.0
15 000	90.0

Table 2 — Minimum clearance distances in air to earth or between phases

Nominal voltage	Machines with frame sizes			
	Up to 160	180, 200 and 225	250 and 280	315
	Ratings of other machines at nominal voltage			
	Up to 22 kW	Above 22 kW up to 75 kW	Above 75 kW up to 185 kW	Above 185 kW
V	mm	mm	mm	mm
660	6.4	8.0	10.0	12.5
1 100	—	—	12.5	19.0
2 300	—	—	—	30.0
3 300	—	—	—	37.5
4 160	—	—	—	45.0
6 600	—	—	—	63.0
11 000	—	—	—	75.0
13 800	—	—	—	85.0
15 000	—	—	—	95.0

Table 3 — Minimum creepage distances in air to earth or between phases

Nominal voltage	Machines with frame sizes			
	Up to 160	180, 200 and 225	250 and 280	315
	Ratings of other machines at nominal voltage			
	Up to 22 kW	Above 22 kW up to 75 kW	Above 75 kW up to 185 kW	Above 185 kW
V	mm	mm	mm	mm
660	11.2	12.5	12.5	19
1 100	—	—	19	25
2 300	—	—	—	40
3 300	—	—	—	50
4 160	—	—	—	60
6 600	—	—	—	90
11 000	—	—	—	125
13 800	—	—	—	140
15 000	—	—	—	150

NOTE Some designs of pressure containing type terminal boxes may require the use of clearance and creepage distances smaller than the values given in Table 2 and Table 3.

6 Arrangements and enclosures

When a terminal box is provided it shall be designed so that it remains clean and dry internally in service.

The arrangements shall embody the relevant features selected from Table 4.

NOTE BS 5372 specifies the dimensions which should be observed in the design of cable terminations for external cables on electrical equipment to enable the cables to be connected satisfactorily. It relates to 3-core and 4-core 600/1 000 V and 3-core 1 900/3 300 V cables with solid and stranded aluminium conductors of size 16 mm^2 to 300 mm^2 and having polymeric insulation.

Table 4 — Combinations for termination assembly

Termination arrangement	Conducting part	Type of terminal box for high fault levels V ⩾ 1 100 MV·A ⩾ values in Table 1
Air insulated Phase insulated Phase separated Phase segregated Separate terminal enclosure	Stud Strip Cable coupler Separable insulated connectors Loose leads	Pressure containing terminal box Pressure relief terminal box

NOTE The combination is to consist of any one of the termination arrangements given in column 1, combined with any one of the conducting parts given in column 2, combined with, for high fault levels, either of the terminal boxes given in column 3.

Publications referred to

BS 5000, *Rotating electrical machines of particular types or for particular applications*

BS 5000-11, *Small-power electric motors and generators*

BS 5372, *Specification for cable terminations for electrical equipment*

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London
W4 4AL