

General requirements for rotating electrical machines —

**Part 111: Specification for built-in
thermal protection for electric motors
rated at 660 volts a.c. and below**

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Foreword

This Part of BS 4999 has been prepared under the direction of the Power Electrical Engineering Standards Committee and supersedes BS 4999-72:1972, which is withdrawn.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 72, has been abandoned. No technical changes have been made to the text of BS 4999-72:1972.

Whilst this standard sets out the requirements to be met by motors employing built-in thermal protective devices, such protection will not usually be a normal feature of a standard machine and it will therefore be necessary for it to be specially ordered when required.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their 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 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Introduction to Part 111

The requirements of the specification are based on the need to provide a simple yet effective means of protecting the motor against damage by overheating but at the same time permitting maximum utilization of the motor's capabilities.

With current operated protective schemes the level of protection can be related to the rated load of the motor and generally can be adjusted, but with the thermal protection scheme covered by this standard the degree of protection is governed by the thermal endurance of the winding insulation and the level is not adjustable.

The requirements of this standard are intended as far as possible to protect the motor from damage due to the excessive overheating (short term) resulting from stalling and single phasing as well as the overheating (long term) caused by persistent overloading, impaired ventilation, etc. This involves a compromise, since the level of protection must not be set so low as to cause nuisance tripping, for instance when there is a temporary reduction in the supply voltage and the rated motor current is exceeded. The requirements in themselves are not intended to guarantee "normal" motor life but rather to avoid premature thermal ageing. Normal motor life can only be assured by correct selection, application and maintenance of the motor in conjunction with the proper application of thermal protection.

It should not be assumed that the thermal protection specified is effective for all motors against all faults or abnormal conditions, as the degree of protection depends on a number of factors including the rate of rise of temperature of the motor windings. The greatest rate of rise of temperature will usually occur under stalled conditions and it may not be possible to protect all machines against these, particularly when the machine is initially cold, while retaining a proper level of protection against other conditions. It is for this reason that the concepts of Class I and Class II have been introduced in 2.2.

In addition to the rate of rise of temperature of the motor windings, there are other factors which affect the performance of thermal protection and these are as follows.

The temperature characteristic and thermal time constant of the device.

The location of and the method of installation of the device within the motor and the number of devices used.

The tolerances on the temperatures at which the operating conditions are attained.

The tolerances on the control system to which the devices are connected.

With thermal protection the margin between the protection level and the rated load conditions depends on the difference between the actual and permitted temperature rise of the protected winding and the difference between the actual and specified cooling air temperature. As the temperature settings of these built-in thermal devices are not adjustable, the level has to be chosen to accommodate the highest cooling air temperature condition and the maximum permissible temperature rise. It is thus possible that motors with this form of protection will operate for long periods at elevated temperatures close to the protection level if the driven equipment is able to demand substantial overloads for long periods.

While such conditions, within reason, should not give rise to any undue concern for the motor, there are two points which should be appreciated.

- 1) The effective life of the winding insulation is approximately halved for every 8 °C to 10 °C increase in continuous operating temperature.
- 2) If the motor is working in a low ambient temperature the possible overload on the motor is such that special attention may be required in ensuring that the driven apparatus and or the supply and control gear are capable of handling the overload.

In general any overloading should be monitored by the line current of the motors but this may be done automatically by built-in thermal devices and control units designed to give a warning signal when a temperature below the tripping level is reached. If in the latter case the warning device is used to monitor the condition of the load, and if frequent operation of the warning system is anticipated, this fact should be drawn to the attention of the supplier of the control unit, since special arrangements may be required.

1 General

1.1 Scope

This Part of this British Standard specifies requirements appertaining to a system of thermal protection applied to the stator windings of cage type induction motors (other than small electric motors complying with BS 5000-11) having a rated voltage not exceeding 660 V.