

INTERNATIONAL STANDARD

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Automatic electrical controls – Part 2-22: Particular requirements for thermal motor protectors

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Dispositifs de commande électrique automatiques –
Partie 2-22: Exigences particulières pour les protecteurs thermiques

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Partie 2-22: Exigences particulières pour les protecteurs thermiques

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AUTOMATIC ELECTRICAL CONTROLS–

Part 2-22: Particular requirements for thermal motor protectors

FOREWORD

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International Standard IEC 60730-22 has been prepared by IEC technical committee 72: Automatic electrical controls.

The text of this standard is based on the following documents:

FDIS	Report on voting
72/941/FDIS	72/950/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This Part 2-22 is intended to be used in conjunction with IEC 60730-1. It was established on the basis of the fourth edition (2010) of that standard¹. Consideration may be given to future editions of, or amendments to, IEC 60730-1.

This Part 2-22 supplements or modifies the corresponding clauses in IEC 60730-1 so as to convert that publication into the IEC standard: Safety requirements for automatic electrical thermal motor protectors.

Where this Part 2-22 states "addition", "modification", or "replacement", the relevant requirement, test specification or explanatory matter in Part 1 should be adapted accordingly. Where no change is necessary, this Part 2-22 indicates that the relevant clause or subclause applies.

In the development of a fully international standard, it has been necessary to take into consideration the differing requirements resulting from practical experience in various parts of the world and to recognize the variation in national electrical systems and wiring rules.

The "in some countries" notes regarding differing national practice are contained in the following subclauses:

- 7.2.6 (Canada, USA)
- 12.2 (Canada, Japan, USA)
- 17.101.2.1.2 (Canada, USA)
- 18.1.3.101.2 (Canada, USA)
- BB17.205.1.2 (Canada, USA)

In this publication:

- [IEC 60730-2-22:2014](http://standards.iteh.ai/catalog/standards/sist/77077566-7bbc-4608-86c6-129e4eaba56f/iec-60730-2-22-2014)
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- 1) The following print types are used:
 - Requirements proper: in roman type,
 - *Test specifications: in italic type;*
 - Explanatory matter; in small roman type;
 - Words defined in Clause 2: **bold**.
 - 2) Subclauses, notes, tables and figures which are additional to those in part 1 are numbered starting from 101, additional annexes are lettered AA, BB, etc.

A list of all parts of the IEC 60730 series, under the general title *Automatic electrical controls for household and similar use*, can be found on the IEC website.

¹ A fifth edition of IEC 60730-1 was published in 2013.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
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AUTOMATIC ELECTRICAL CONTROLS–

Part 2-22: Particular requirements for thermal motor protectors

1 Scope and normative references

This clause of Part 1² is applicable except as follows:

1.1 Replacement:

This part of IEC 60730 applies to the partial evaluation of **thermal motor protectors** as defined in IEC 60730-1 for household and similar use, including heating, air conditioning and similar applications as well as for sealed (hermetic and semi-hermetic type) motor-compressors.

NOTE A **thermal motor protector** is considered an **integrated control** since its protective functionality is dependent on the correct mounting and fixing in or on a motor and which can only be fully tested in combination with the relevant motor. This dependency is illustrated by:

- the ability of the **thermal motor protector** to accurately and reliably sense the heat of the motor windings; thus, addressing the over-temperature protection due to motor overload conditions;
- the ability of the **thermal motor protector** to accurately and reliably sense the current due to motor locked-rotor conditions; thus, reducing the response time and not being adversely affected by heat-sink at the assembly spot in the application;
- the influence of the motor's electromagnetic field on the switch behaviour of the **thermal motor protector**; particularly, affecting the arc direction between the contacts resulting in uneven wear of the contact material and eventually leading to failure of operation.

Requirements concerning the testing of the combination of sealed (hermetic and semi-hermetic type) motor-compressors and **thermal motor protectors** are given in IEC 60335-2-34.

This standard applies to **thermal motor protectors** using NTC or PTC thermistors, additional requirements for which are contained in Annex J.

1.1.1 This standard applies to the inherent safety, to the **operating values, operating times, and operating sequences**, where such are associated with equipment safety, and to the testing of **thermal motor protectors** used in or on household or similar equipment as well as sealed (hermetic and semi-hermetic type) motor-compressors.

This standard applies to **thermal motor protectors** for appliances within, but not limited to, the scope of IEC 60335-1 and its Part 2's.

NOTE Throughout this standard, the word "equipment" means "appliance and equipment".

Thermal motor protectors not intended for normal household use, but which nevertheless may be used by the public, such as equipment intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

This standard does not apply to **thermal motor protectors** designed exclusively for industrial applications.

1.1.2 This standard does not apply to other means of motor protection.

² References to "Part 1" in this document pertain to the fourth edition of IEC 60730-1 published in 2010.

1.1.3 This standard does not apply to a manual device for opening the circuit.

1.5 Normative references

Addition:

IEC 60269-3, *Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Examples of standardized systems of fuses A to F*

IEC 60335-2-34:2012, *Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors*

2 Definitions

This clause of Part 1 is applicable except as follows:

2.6 Definitions of type of automatic action of a control according to test procedure

Additional definition:

2.6.101

type 3 action

automatic action for which reliability of the operating characteristics can only be evaluated in terms of measurements made on the protected motor or motor compressor

2.13 Miscellaneous definitions

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Additional definition: <https://standards.iteh.ai/catalog/standards/sist/77077566-7bbc-4608-86c6-129e4eaba56f/iec-60730-2-22-2014>

2.13.101

sealed motor-compressor

mechanical compressor (of a hermetic or semi-hermetic type) consisting of a compressor and a motor, both of which are enclosed in the same sealed housing with no external shaft seals, the motor operating in a refrigerant atmosphere

Note 1 to entry: The enclosure may be permanently sealed by welding or brazing (hermetic compressor) or may be sealed by one or more gasketed joints (semi-hermetic compressor).

3 General requirements

This clause of Part 1 is applicable.

4 General notes on tests

This clause of Part 1 is applicable except as follows:

4.3.1.1 and **4.3.1.2** Not applicable.

4.3.2 Not applicable.

5 Rating

This clause of Part 1 is applicable.

6 Classification

This clause of Part 1 is applicable except as follows:

6.4 According to features of automatic action

6.4.1 Not applicable.

6.4.2 *Replacement:*

– **Type 3 action.**

6.4.3 *Replacement:*

Type 3 actions are further classified according to one or more of the following constructional or operational features:

NOTE 1 These further classifications are only applicable if the relevant declarations have been made and any appropriate tests completed.

NOTE 2 An action providing more than one feature is classified by a combination of the appropriate letters, for example, Type 3.C.L.

NOTE 3 A **manual action** is not classified according to 6.4.3.

6.4.3.1 Void

6.4.3.2 – **micro-disconnection on operation** (Type 3.B);

6.4.3.3 – **micro-interruption on operation** (Type 3.C);

6.4.3.4 Void

6.4.3.5 Void

6.4.3.6 Void

6.4.3.7 Void

6.4.3.8 – a trip-free mechanism in which the contacts cannot be prevented from opening and which may automatically be reset to the “closed” position after normal **operation** conditions have been restored if the reset means is held in the “reset” position (Type 3.H);

6.4.3.101 Thermal motor protectors are further classified according to the following constructional or operational features:

- non-self-resetting (Type 3.B.H);
- self-resetting (Type 3.C).

Additional subclause:

6.101 According to limited short-circuit capability

NOTE For limited short-circuit test details, refer to 17.101.

Not all designs of devices are capable of sustaining or interrupting the short-circuit current without introducing a fire **hazard**. There is definite evidence that a short circuit in an unprotected motor by itself may not necessarily introduce a fire **hazard** because the circuit is safely de-energized by the opening of the mains overcurrent device. But if there is a thermal protector in the path of the fault current, a fire may result from an arcing disturbance when

this protector attempts to clear the **fault**. Such disturbances can and do occur before the mains overcurrent device has an opportunity to open. The tests of 17.101 are designed to assess the **operation** of a **thermal motor protector** under these conditions.

7 Information

This clause of Part 1 is applicable except as follows:

7.2.6 Replacement:

For **thermal motor protectors**, information shall be provided as indicated in Table 1.

7.2.9 Replacement of the existing Table 1 by the following new table:

Table 1

Information	Clause or subclause	Method
1 Manufacturer's name or trade mark	7.2.6	C
2 Unique type reference ^a	2.11.1, 2.13.1, 7.2.6	C
3 Rated voltage or rated voltage range in volts (V)	2.1.2	D
6 Purpose of control	4.3.5, 6.3	X
30 PTI of materials used for insulation	6.13	X
31 Method of mounting control	11.6	X
31a Method of providing earthing of control	7.4.3, 9	D
43 Reset characteristics for cut-out action ^b	6.4, 11.4	X
49 Control pollution degree	6.5.3	X
51 Heat and fire resistance category	21	X
77 Temperature for the ball pressure test	21.2.1, 21.2.2, 21.2.3 and 21.2.4	D
101 Limited short-circuit capability in terms of prospective current, voltage and rated current and characteristic of fuse, if declared ^c	6.101, 17.101	X
102 Features of automatic actions ^d	6.4	D
103 Maximum pressure for controls located within the sealed compressor enclosure ^e	18.1.3.101.1	D
<p>^a The unique type reference shall be such that, when it is quoted in full, the manufacturer of the control can supply a replacement which will be fully interchangeable with the original electrically, mechanically, dimensionally and functionally.</p> <p>It may comprise a series type reference with other marking, such as voltage rating or an ambient temperature marking, which together provide a unique type reference.</p> <p>^b Manufacturers may declare a lower ambient temperature than that specified in 11.4.102.</p> <p>^c Applicable in Canada and the USA.</p> <p>^d Thermal motor protectors are classified as Type 3.B.H and Type 3.C.</p> <p>^e The test pressure depends on the intended refrigerant and the location of the protector inside the compressor (high side or low side). Values can be taken from 22.7 of IEC 60335-2-34:2012.</p>		

8 Protection against electric shock

This clause of Part 1 is applicable.

9 Provision for protective earthing

This clause of Part 1 is applicable.

10 Terminals and terminations

This clause of Part 1 is applicable except as follows:

10.1 Not applicable.

10.2 Terminals and terminations for internal conductors

Addition:

NOTE For the purpose of this standard, **internal conductors** are considered as **integrated conductors**.

11 Constructional requirements

This clause of Part 1 is applicable except as follows:

11.3.4 Setting by the manufacturer

Addition:

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NOTE Sealing compounds, lock nuts and the like are deemed adequate for this purpose.

11.4 Actions

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11.4.101 A Type 3.B.H action shall operate to provide the electric strength requirements specified for **micro-disconnection**.

Compliance is checked by the tests of Clause 13 and the relevant requirements of Clause 20.

11.4.102 A Type 3.B.H action shall be so designed that the contacts cannot be prevented from opening and may automatically reset to the closed position if the reset means is held in the reset position. With the reset means in its normally free position, the control shall not reset automatically at any test ambient temperature above $-5\text{ }^{\circ}\text{C}$.

*Compliance is checked by **inspection** and, where necessary, by test, with no force applied to the **actuating member**.*

11.4.103 A Type 3.C action shall operate to provide circuit interruption by **micro-interruption**.

Compliance is checked by the relevant requirements of Clause 20.

12 Moisture and dust resistance

This clause of Part 1 is applicable except as follows:

12.2 Protection against humid conditions

Addition:

NOTE 1 In Canada and the USA, the tests of Annex D determine proof against humid conditions.

NOTE 2 In Japan, this evaluation is done in the motor-compressor.

13 Electric strength and insulation resistance

This clause of Part 1 is applicable except as follows:

Addition:

NOTE The suitability of the test in Clause 13 can depend upon the method of mounting the **thermal motor protector** in the equipment.

If the results of the tests in Clause 13 are not likely to be representative of the results obtained when the **thermal motor protector** is mounted in the equipment, then these tests would normally be carried out in the equipment.

14 Heating

This clause of Part 1 is not applicable.

NOTE For **thermal motor protectors** for motor compressor only, successful completion of the tests of IEC 60335-2-34 or the appropriate IEC standard is deemed to be sufficient.

15 Manufacturing deviation and drift

This clause of Part 1 is not applicable.

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16 Environmental stress

This clause of Part 1 is applicable.

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17 Endurance

This clause of Part 1 is replaced as follows:

17.1 General

NOTE Endurance requirements for **thermal motor protectors** for motor-compressors are represented by the abnormal test of 19.101 to 19.105 inclusive of IEC 60335-2-34:2012.

Annex AA contains information on an endurance test on the **thermal motor protector** as a component, i.e. not installed in a motor.

17.101 Limited short-circuit capability for thermal protectors classified under 6.101

17.101.1 A **thermal motor protector** classified under 6.101 shall not present a **hazard** when the protector is subjected to current corresponding to a short circuit in the motor.

17.101.1.1 When declared by the manufacturer in Table 1, item 101, the limited short-circuit test shall be performed either on the protector alone or on the protector installed as intended.

17.101.1.2 Compliance is checked by the test of 17.101.2. The protector shall be deemed to comply with the requirements of 17.101.2 provided there is no ignition of the cotton and accessible metal parts shall not be live as determined by the test of 13.2.

17.101.1.3 In a three-phase motor, a **thermal motor protector** connected to the common point of a star-connected motor is not required to be tested for limited short circuit because the current in the protector is limited by the inherent impedance of the motor.

17.101.1.4 Each manual reset protector shall be subjected to one test in which the short circuit is closed on the protector.

17.101.1.5 A **thermal motor protector** that is tested within a motor shall not be connected to the motor windings.

17.101.2 Limited short-circuit test

17.101.2.1 Three samples are tested in accordance with the values specified in Table 101.

17.101.2.1.1 A protector shall be tested either within the motor it is intended to protect or positioned between two copper bars to simulate the motor enclosure within which it is intended to be used.

NOTE The dimensions of the copper bus bars are equal to the dimensions of the protector in width and length.

17.101.2.1.2 The test circuit, as shown in Figure 101, shall contain a series fuse complying with IEC 60269-3. The fuse shall be as declared in Table 1, item 101, but not less than 16 A. The circuit shall be adjusted such that the prospective current selected from Table 101 is obtained at the maximum voltage declared in Table 1, item 101 and without the protector connected in the circuit. The power factor of the circuit shall not be less than 0,9.

NOTE In the US and Canada, the fuse shall be as declared in Table 1, but not less than 20 A for a device rated 150 V or less, or 15 A for a device rated greater than 150 V; but not less than four times the motor full-load nameplate amperes.

Table 101 – Limited short-circuit capacity (applicable in Canada and the USA)

Motor rated-load current A ^a						Prospective current ^b A
≤ 120 V	200 V to 208 V	220 V to 250 V	277 V	440 V to 480 V	550 V to 600 V	
Single-phase motors						
≤9,8	≤5,4	≤4,9	–	–	–	200
>9,8 – ≤16,0	>5,4 – ≤8,8	>4,9 – ≤8,0	≤6,65	–	–	1 000
>16,0 – ≤34,0	>8,8 – ≤18,6	>8,0 – ≤17,1	–	–	–	2 000
>34,0 – 80,0	>18,6 – 44,0	>17,1 – 40,0	–	–	–	3 500
>80,0	>44,0	>40,0	>6,65	–	–	5 000
Three-phase motors						
–	≤2,12	≤2,0	–	–	–	200
–	>2,12 – ≤3,7	>2,0 – ≤3,5	–	≤1,8	≤1,4	1 000
–	>3,7 – ≤9,5	>3,5 – ≤9,0	–	–	–	2 000
–	>9,5 – ≤23,3	>9,0 – ≤22,0	–	–	–	3 500
–	>23,3	>22,0	–	>1,8	>1,4	5 000

^a The ampere values indicated do not include the service factor (SF).

^b The symmetrical r.m.s. or d.c. current which will flow in the circuit without the thermal motor protector connected and at a power factor of 0,9 to 1,0.