



UL 60730-2-22

STANDARD FOR SAFETY

Automatic Electrical Controls – Part 2-22: Particular Requirements for Thermal Motor Protectors

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UL Standard for Safety for Automatic Electrical Controls – Part 2-22: Particular Requirements for Thermal Motor Protectors, UL 60730-2-22

First Edition, Dated April 7, 2017

Summary of Topics

This revision of ANSI/UL 60730-2-22 dated January 7, 2020 covers incorporated and integrated thermal motor protectors; [6.4.2DV.1](#), [6.4.2.101DV](#), [6.4.3.3DV.1](#)

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new requirements are substantially in accordance with Proposal(s) on this subject dated June 21, 2019.

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ANSI/UL 60730-2-22-2020

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UL 60730-2-22

**Standard for Automatic Electrical Controls – Part 2-22: Particular
Requirements for Thermal Motor Protectors**

First Edition

April 7, 2017

This ANSI/UL Standard for Safety consists of the First Edition including revisions through January 7, 2020.

The most recent designation of ANSI/UL 60730-2-22 as an American National Standard (ANSI) occurred on January 7, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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Preface (UL)

This UL Standard is based on IEC Publication 60730-2-22: first edition Automatic Electrical Controls – Part 2-22: Particular Requirements for Thermal Motor Protectors. IEC publication 60730-2-22 is copyrighted by the IEC.

This edition has been issued to satisfy UL Standards policy.

This UL Standard 60730-2-22, Standard for Automatic Electrical Controls – Part 2-22: Particular Requirements for Thermal Motor Protectors, is to be used in conjunction with the fifth edition of UL 60730-1. The requirements for thermal motor protectors are contained in this Part 2 Standard and UL 60730-1.

Requirements of this Part 2 Standard, where stated, amend the requirements of UL 60730-1.

Where a particular subclause of UL 60730-1 is not mentioned in UL 60730-2-22, the UL 60730-1 subclause applies.

These materials are subject to copyright claims of IEC and UL. No part of this publication may be reproduced in any form, including an electronic retrieval system, without the prior written permission of UL. All requests pertaining to the Automatic Electrical Controls – Part 2-22: Particular Requirements for Thermal Motor Protectors, UL 60730-2-22, Standard should be submitted to UL.

Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60730-2-22, Automatic electrical controls – Part 2-22: Particular requirements for thermal motor protectors copyright 2014 are indicated by notations (differences) and are presented in bold text.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUTOMATIC ELECTRICAL CONTROLS– Part 2-22: Particular requirements for thermal motor protectors

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and nongovernmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

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5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

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

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)
- [BB.17.205.1.2](#) (Canada, USA)

In this publication:

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.

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,
- replaced by a revised edition, or
- amended.

101.DV DE *Modification of the explanatory note (1) in the part 2 by adding the following:*

– Words in SMALL ROMAN CAPITALS in the text are defined in clause [2](#).

102.DV DE *Modification of the explanatory note (2) in the part 2 by adding the following:*

The numbering system in the standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

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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:

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

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.

1.1DV DE Modification of 1.1 to by adding the following note after the third paragraph:

NOTE Thermal motor protectors that are off-winding (not integrated with the motor winding) to the motor are covered under the scope of this part 2 and may be considered incorporated controls with respect to the requirements of this standard. Thermal protectors with integral heating elements (resistors, thermistors and the like) are considered voltage maintained thermal cutouts and are covered under UL 60730-2-9.

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.

1.1.1DV D2 Addition:

1.1.1DV.1 This part 2 is to be used in conjunction with the latest edition of UL 60730-1 and its amendments.

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

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

1.1.101DV D2 Addition:

1.1.101DV.1 This standard applies to thermal motor protectors designed for household, commercial, or industrial use.

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

2.6.101DV D2 Modification by adding the following notes:

NOTE 1 Type 3 action applies to in-winding, integrated thermal motor protectors.

NOTE 2 Type 2 action applies to off-winding, incorporated thermal motor protectors.

2.13 Miscellaneous definitions

Additional definition:

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.

4.3.2DV D2 Modification of 4.3.2:

4.3.2DV.1 The requirements in 4.3.2 are 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.

6.4.2DV D2 Modification of 6.4.2 by replacing with the following:

6.4.2DV.1 This clause of the Part 1 is applicable to thermal motor protectors declared to be incorporated (off-winding) with deviation, drift and endurance values in [Table 1DV](#).

6.4.2.101DV D2 Addition:**– 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);****6.4.3.3DV D2 Modification to 6.4.3.3 as follows:****6.4.3.3DV.1 Delete.****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).

6.11DV D2 Modification of 6.11 by replacing it with the following:

6.11DV.1 This clause of the Part 1 is applicable for controls declared as incorporated controls with endurance values in [Table 1DV](#).

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
^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.			

Table 1 Continued on Next Page

Table 1 Continued

	Information	Clause or subclause	Method
	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.		
b	Manufacturers may declare a lower ambient temperature than that specified in 11.4.102 .		
c	Applicable in Canada and the USA.		
d	THERMAL MOTOR PROTECTORS are classified as Type 3.B.H and Type 3.C.		
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.		

Table 1DV D2 Replace [Table 1](#) of the Part 2 with the following table:

Table 1DV

	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
27DV	Number of automatic cycles (A) for each AUTOMATIC ACTION)	6.11DV.1 , 17.8	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
37DV	Minimum and/or maximum rates of change of ACTIVATING QUANTITY, or minimum and/or maximum cycling rates for a SENSING CONTROL ⁴⁾	15 , 17	X
39DV	Type of Action	6.4	D
41DV	MANUFACTURING DEVIATION and condition of test appropriate to deviation	15 , 17.14	X
42DV	DRIFT	15 , 16.2.4DV.1	X
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
DV	Note 4 of the part 1 applies.		
^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.		
	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.		

Table 1DV Continued on Next Page

Table 1DV Continued

	Information	Clause or subclause	Method
^b	Manufacturers may declare a lower ambient temperature than that specified in 11.4.102 .		
^c	Applicable in Canada and the USA.		
^{dDV}	Thermal motor protectors are classified as Type 3.B.H or 3.B controls.		
^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.		

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:

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

11.4 Actions

Additional subclauses:

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°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.

15DV D2 Modification of Clause 15:

15DV.1 The requirements in Clause [15](#) are applicable to thermal motor protectors that are declared to be incorporated with deviation and drift values in [Table 1DV](#).

16 Environmental stress

This clause of Part 1 is applicable.

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.

17DV D2 Modification of Clause 17:

17DV.1 This clause of Part 1 is applicable to thermal motor protectors only when declared in [Table 1DV](#). All sub-clauses of the Part 1 are applicable except as follows:

17.1.3.1DV D2 Addition of the following dashed sentence:

– a test of AUTOMATIC ACTION at accelerated rate specified in [17.8.4DV.1](#) only applies.

17.1.3.3DV D2 Modification:

17.1.3.3DV.1 Not applicable.

17.1.4DV D2 Modification:

17.1.4DV.1 Not applicable.

17.2.2DV D2 Modification:

17.2.2DV.1 Not applicable.

17.2.5DV D2 Modification:

17.2.5DV.1 Not applicable.

17.4DV D2 Modification:

17.4DV.1 Not applicable.

17.6DV D2 Modification:

17.6DV.1 Not applicable.

17.7DV D2 Modification:

17.7DV.1 Not applicable.

17.8.4DV D2 Add the following:

17.8.4DV.1 The number of automatic cycles shall be a minimum of 2000 cycles or as declared in [Table 1DV](#). The cycling rate (on-off time), locked rotor or overload current and power factor shall be declared. A synthetic or artificial load may be used to simulate the test parameters for this test.

17.9DV D2 Modification:

17.9DV.1 Not applicable.

17.10DV D2 Modification:

17.10DV.1 Not applicable.

17.11DV D2 Modification:

17.11DV.1 Not applicable.

17.12DV D2 Modification:

17.12DV.1 Not applicable.

17.13DV D2 Modification:

17.13DV.1 Not applicable.

17.14DV D2 Add the following:

17.14DV.1 The requirement in the second dash of 17.14 applies to off-winding protectors. The fourth dash applies to protectors that have deviation, drift and endurance values declared in [Table 1DV](#). The fifth dash of 17.14 is not applicable.

17.16DV D2 Modification:

17.16DV.1 Not applicable.

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.

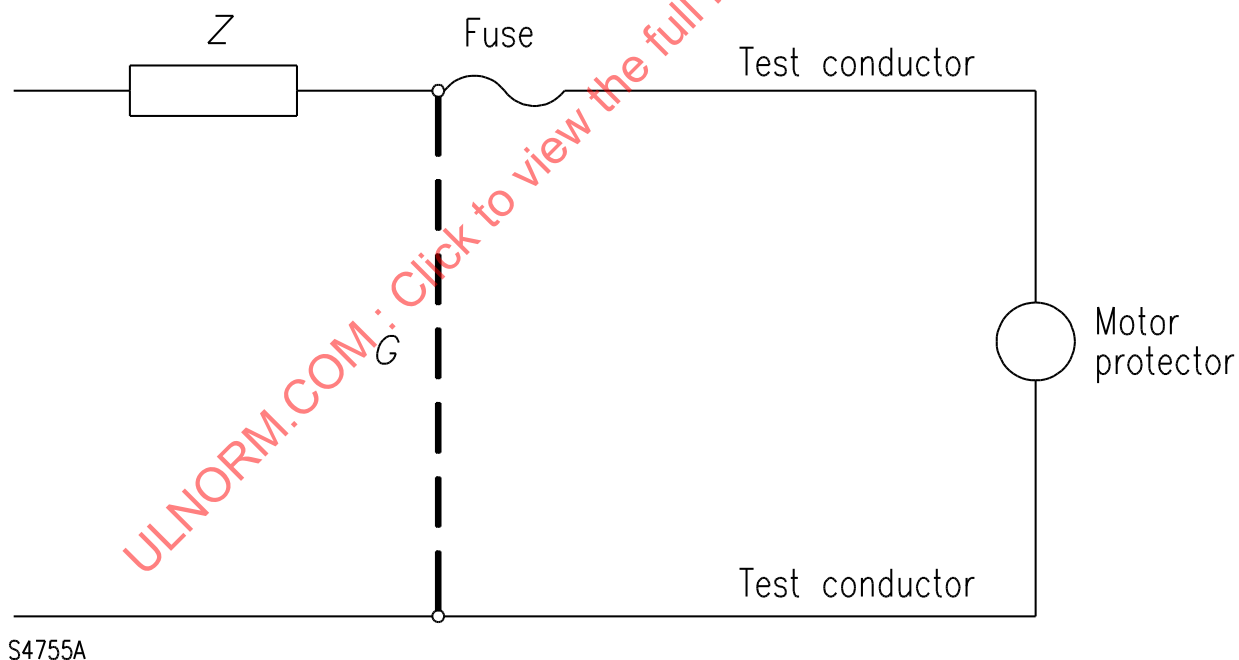
17.101.2.1.2DV D2 Modification of 17.101.2.1.2:

17.101.2.1.2DV.1 The first sentence of [17.101.2.1.2](#) should read, "The test circuit shall contain a series fuse complying with IEC 60269 or the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1."

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.



Components

Z impedance for adjusting the current to the prospective current of [Table 101](#)

G temporary connection for adjusting the current to the prospective current

Figure 101
Limited short circuit test scheme

17.101.2.1.3 The protector is connected in the circuit, without further circuit adjustment, by two 1 m lengths of copper wire having a cross-sectional area as indicated in Table 6 for the current rating of the fuse. If the protector is tested inside the equipment, the cotton is to be wrapped around the equipment enclosure.

17.101.2.1.3DV DE Modification of 17.101.2.1.3:

17.101.2.1.3DV.1 The reference to "Table 6" should refer to "Table 6 in UL 60730-1".

17.101.2.1.4 Cotton is to surround the openings of the motor enclosure or the THERMAL MOTOR PROTECTOR, if tested alone. Cotton used shall be as specified in Annex C.

17.101.2.1.4DV DE Modification of the sentence starting with "Cotton used shall ...":

17.101.2.1.4DV.1 The last sentence should read, "Cotton used shall be as specified in Annex C of UL 60730-1."

17.101.2.1.5 If the protector cycles during the test and if the cotton is not ignited, the test shall be continued until the protector permanently opens the circuit or the series fuse opens. If the control continues to cycle for 300 cycles without damage the test is discontinued.

NOTE 300 cycles of operation are specified in IEC 60335-1:2010, Annex D.

18 Mechanical strength

This clause of Part 1 is applicable except as follows:

18.1.3 Additional subclause:

18.1.3.101 *THERMAL MOTOR PROTECTORS for motor compressor only located within the sealed motor compressor enclosure shall be so designed and constructed to withstand the pressures developed under operating conditions.*

18.1.3.101.1 *Compliance is checked by exposing two samples of the thermal protector to an external pressure value declared in [Table 1](#), item 103 without:*

- collapsing, bending, warping or distorting the protective device housing as determined by visual examination;*
- short-circuiting the housing to internal current-carrying parts of the protective device; and*
- affecting electrical continuity between terminals of the protective device.*

18.1.3.101.2 *Alternatively, at the request of the manufacturer, the tests of [18.1.3.101.1](#) may be conducted at a pressure equal to 60 % of the test pressure specified in [18.1.3.101.1](#) provided that the protector complies with the requirements of the calibration check test of [18.1.3.101.4](#) and with the following.*

In addition, the test as determined by visual examination shall not cause structural damage which would decrease the required electrical CREEPAGE DISTANCE and CLEARANCE.

NOTE In Canada and the USA, higher or lower test pressures than the values specified in [18.1.3.101.1](#) and [18.1.3.101.2](#) are required.

18.1.3.101.3 *The pressure test medium is to be any non-hazardous liquid, such as water. The test samples are to be placed in a container filled with the test medium to exclude air. The container is to be connected to a hydraulic system whose pressure is to be increased gradually to the required test pressure, which is then maintained for 1 min.*

18.1.3.101.4 *A calibration test is performed by measuring the operating and reset temperatures of the THERMAL MOTOR PROTECTOR before and after the pressure test of [18.1.3.101.2](#). The difference in measured temperature shall be within 5 K or 5 %, whichever is greater, of the temperature measured prior to the pressure test.*

The test is performed by mounting the test samples in an air oven, having forced air circulation at a velocity of at least 0,5 m/s and designed to nullify the effects of radiation. Temperatures are to be measured by thermocouples attached to an adjacent protector device or located in air adjacent to the protector device under test. Indication of operating and reset is to be obtained by a low-energy continuity-indicating circuit whose current does not influence OPERATION of the device. The operating and reset temperatures are to be the average of two trials.

Prior to cut-out or cut-in temperature calibration, uniform temperatures of all parts of the thermal protector are to be maintained at approximately 11 K below the operating temperature and 11 K above the reset temperature until conditions of equilibrium have been established. The temperature is then to be increased or decreased as required at a rate not greater than 0,5 K/min until the protector opens or closes.

NOTE 1 Alternate calibration test equipment is subject to agreement between test house and manufacturer.

NOTE 2 A higher test pressure is subject to agreement between test house and manufacturer.

18.1.4 to 18.9 Not applicable.

19 Threaded parts and connections

This clause of Part 1 is applicable.

20 Creepage distances, clearances and distances through solid insulation

This clause of Part 1 is applicable.

NOTE 101 Annex CC provides additional information on the application of MOTOR PROTECTORS in POLLUTION DEGREE 1, 2 and 3 situations.

Table 20.102DV DE *Deletion:*

20.102DV.1 Delete Table 20.102 as these requirements do not apply to thermal motor protector components.

21 Resistance to heat, fire and tracking

This clause of Part 1 is applicable.

22 Resistance to corrosion

This clause of Part 1 is applicable.

Addition:

No test is required for component parts within a hermetically sealed enclosure.

22DV D2 Modification to Clause 22:

22DV.1 Clause 22 is not applicable.

23 Electromagnetic compatibility (EMC) requirements – emission

This clause of Part 1 is applicable.

23DV D2 Modification to Clause 23:

This clause of Part 1 is not applicable.

24 Components

This clause of Part 1 is applicable.

25 Normal operation

This clause of Part 1 is applicable.

26 Electromagnetic compatibility (EMC) requirements – immunity

This clause of Part 1 is applicable.

27 Abnormal operation

This clause of Part 1 is applicable.

28 Guidance on the use of electronic disconnection

This clause of Part 1 is applicable.

Annexes

The annexes of Part 1 are applicable except as follows:

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Annex E
(normative)

Circuit for measuring leakage current

This annex of Part 1 is not applicable.

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Annex AA (informative)

Endurance test for thermal motor protectors as components, i.e. not installed on a motor

AA.1 Purpose

The purpose of Annex AA is to provide the USER of THERMAL MOTOR PROTECTORS a means for pre-selecting THERMAL MOTOR PROTECTORS. The results of this test do not provide assurance that devices passing the test will also pass the final motor test. Also, devices failing this test may still pass the final motor test.

The test of Annex AA cannot, therefore, be used as a basis for certification of a MOTOR PROTECTOR or motor/MOTOR PROTECTOR combination. It does not replace the locked rotor test in IEC 60335-2-34.

AA.2 Endurance test of automatic action at accelerated rate

AA.2.1 Electrical conditions for tests

Each circuit of the control is loaded with the ratings intended by the manufacturer.

AA.2.2 Thermal conditions for the tests

For parts of the control other than the temperature SENSING ELEMENT, the following applies:

- those parts which are accessible when the control is mounted in the intended manner are exposed to normal room temperature;*
- the mounting surface of the control is maintained between either $T_{s\ max}$ and $T_{s\ max} + 5\ ^\circ\text{C}$ or 1,05 times $T_{s\ max}$, whichever is greater;*
- the remainder of the SWITCH HEAD is maintained between either T_{MAX} and $T_{MAX} + 5\ ^\circ\text{C}$ or 1,05 times T_{MAX} , whichever is greater. If T_{min} is less than $0\ ^\circ\text{C}$, additional tests are carried out with the SWITCH HEAD maintained between T_{min} and $T_{min} - 5\ ^\circ\text{C}$.*

AA.2.3 Manual and mechanical conditions for the test

AA.2.3.1 *The speed of movement of the ACTUATING MEMBER is:*

- $(45 \pm 5)\ ^\circ\text{mm/s}$ for rotary actions;*
- $(25 \pm 2,5)\ \text{mm/s}$ for linear actions.*

AA.2.3.2 *During the test of [AA.2.4](#), the following conditions apply.*

- Care is taken to ensure that the test apparatus allows the ACTUATING MEMBER to operate freely, so that it does not interfere with the normal action of the mechanism.*
- For controls where the movement of the ACTUATING MEMBER is limited, a torque (for rotary controls) or a force (for non-rotary controls) is applied at the extreme of each movement to verify the strength of the limiting end stops. The torque is either five times the normal actuating torque or 1,0 Nm, whichever is the smaller, but with a minimum of 0,2 Nm. The force is either five times the normal actuating force or 45 N, whichever is the smaller, but with a minimum of 9 N. If the normal actuating torque exceeds 1,0 Nm, or the normal actuating force exceeds 45 N, then the torque or force applied is the same as the normal actuating torque or force.*

– For controls which are designed for *ACTUATION* in one direction only, the test is performed in the designed direction, provided that it is not possible to rotate the *ACTUATING MEMBER* in the reverse direction using the torques mentioned above.

AA.2.4 Test of automatic action at accelerated rate

AA.2.4.1 The method and rate of *OPERATION* should cause no significant alterations to safety, life or purpose of the action.

The normal rate of *OPERATION* can be accelerated by the application of an external heat source, self-operation due to rated current or a combination of both, depending on the relevant sensitivities of a particular device. Forced cooling may be applied during the test.

AA.2.4.2 The number of automatic cycles used for the test is as intended by the manufacturer. Attention is drawn however to 19.101 of IEC 60335-2-34:2012, in which, for self-resetting *THERMAL MOTOR PROTECTORS*, a minimum *OPERATION* of 360 h, with a minimum of 2 000 cycles, is required. For non-self-resetting *THERMAL MOTOR PROTECTORS*, 50 cycles are required.

AA.2.5 Evaluation of test results

After the test of [AA.2.4](#), the control is considered passed if:

- all actions function automatically and manually in the intended manner within the meaning of this standard;
- the requirements of [Clauses 8](#) and [20](#) of this part of IEC 60730 are still met;
- the requirements of 17.5 of IEC 60730-1:2010 are still met. For the tests of [AA.2.4](#), the controls are tested at an appropriate condition to ensure that the contacts are open;
- there is no evidence that any transient *FAULT* between *LIVE PARTS* and accessible metal parts of *ACTUATING MEMBERS* has occurred.

Annex BB (informative)

Testing of the combination of motor and thermal motor protectors (not applicable to sealed motor-compressors)

Annex BB is given for information and includes requirements from IEC 60034-11 for the testing of THERMAL MOTOR PROTECTORS in combination with the motor with which the THERMAL MOTOR PROTECTOR is to be used.

Annex BB is written in the form of additions and replacements, applied by this annex to IEC 60730-1. Subclauses, tables and figures that are numbered starting from 201 are additional to those introduced in the main body of the text of this Part 2-22.

BB.1 Purpose

Annex BB applies to tests for the THERMAL MOTOR PROTECTORS which can only be carried out in combination with the motor with which the protector is intended to be used.

NOTE It is not applicable to the motor itself.

BB.4 General notes on tests

BB.4.2 Samples required

Additional subclauses:

BB.4.2.201 *For THERMAL MOTOR PROTECTORS with a declared MANUFACTURING DEVIATION equal to or less than ± 5 K for the opening temperature and ± 15 K for the closing temperature for self-resetting types, the tests of Annex BB are carried out on one representative sample of the combination of thermal protector and motor. Thermal protectors with opening and closing temperatures at any value within the specified tolerance limits are considered representative samples.*

BB.4.2.202 *For THERMAL MOTOR PROTECTORS with a declared MANUFACTURING DEVIATION greater than ± 5 K for the opening temperature, or greater than ± 15 K for the closing temperature for self-resetting types, the tests of Annex BB shall be carried out to determine that thermal protectors with the wider tolerance shall have an acceptable locked rotor life.*

To establish this, tests are carried out with one sample thermal protector calibrated to the maximum declared opening temperature and, for self-resetting THERMAL MOTOR PROTECTORS, with an additional sample calibrated to the minimum declared opening temperature.

For these tests, reset temperatures for the test samples may have any value within the declared tolerance.

BB.4.3.2.6 Replacement:

If the motor with thermal protector has provision for field alteration or adjustment of operating conditions such as reconnection for OPERATION on different voltages or different speeds, a test with the motor connected for each of such conditions may be necessary to determine that the protector will perform its intended function regardless of the connection employed.

BB.6 Classification

Additional subclauses:

BB.6.201 According to opening temperature tolerance of the thermal motor protector

BB.6.202 According to limited short-circuit capability in terms of current, voltage, fuse size and special fuse requirements, if applicable

NOTE Not all designs of equipment 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, fire can 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.

BB.7 Information

BB.7.2.1

When THERMAL MOTOR PROTECTORS are tested in combination with the protected motor, information is obtained by inspection and measurement of the combination, except as indicated in Table BB.1.

Table BB.101
Additional required information and methods of providing information

	Information	Clause or subclause	Method
7	The type of load controlled by each circuit	14 , 17 , 6.2	D
41	Manufacturing deviation and condition of test appropriate to deviation	2.11.1, 11.4.3, 15 , 17.14	X
42	Drift	2.11.2, 11.4.3, 15 , 16.2.4	X
104	Opening temperature (reset temperature for self-resetting protectors) and tolerance	BB.4.2.201 , BB.6.201	D
105	Limited short-circuit capability	BB.6.202	D

BB.15 Manufacturing deviation and drift

Addition:

MANUFACTURING DEVIATION and DRIFT of the THERMAL MOTOR PROTECTOR are checked in combination with the motor, as indicated in Clause [BB.17](#).

BB.17 Endurance

Additional subclauses:

BB.17.201 Endurance test on combination of motor and thermal motor protector

THERMAL MOTOR PROTECTORS with Type 3 action in thermally protected motors shall operate such that any DRIFT will not impair compliance with the motor winding temperature limits specified in [BB.17.205.1](#) and [BB.17.205.1](#).

BB.17.202 Electrical conditions for the tests

For THERMAL MOTOR PROTECTORS, the tests of [BB.17.205](#) are carried out at 105 % of the rated voltage of the motor.

BB.17.203 Thermal conditions for the tests

Unless otherwise indicated, the tests specified may be carried out at any ambient temperature between 10 °C and 40 °C.