# UL 60730-2-4

## STANDARD FOR SAFETY

Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors for Motor-Compressors of Hermetic and Semi-Hermetic Type

UL Standard for Safety for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors for Motor-Compressors of Hermetic and Semi-Hermetic Type, UL 60730-2-4

First Edition, Dated January 17, 2003

***Summary of Topics***

***These revisions are being issued to:***

***1) Add a national difference to the Heat, Fire and Tracking section, Section 21, to clarify that it is applicable only to non-metallic and insulating materials which are outside the motor-compressor housing.***

***2) Reflect the established effective date of UL 60730-2-4. AS OF OCTOBER 19, 2018, THE TWELFTH EDITION OF UL 873 WILL BE WITHDRAWN AND WILL BE REPLACED BY THIS STANDARD.***

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 revised requirements are substantially in accordance with Proposal(s) on this subject dated November 27, 2013 and February 25, 2014.

Although every page is being redated, the only changes being made are to the UL Title Page, Preface, Foreward, National Difference page and to Section 21.



The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the preface. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

The following table lists the future effective dates with the corresponding reference.

| Future Effective Date | Reference |
|---|---|
| October 19, 2018 | Entire 1st Edition |

**JANUARY 17, 2003**
(Title Page Reprinted: May 28, 2014)

**1**

# UL 60730-2-4

## Standard for Automatic Electrical Controls for Household and Similar Use;

## Part 2: Particular Requirements for Thermal Motor Protectors for Motor-

## Compressors of Hermetic and Semi-Hermetic Type

Prior to the first edition of UL 60730-2-4, the requirements for the products covered by this Standard were included in UL 8730-2-4.

**First Edition**

**January 17, 2003**

This UL Standard for Safety consists of the First Edition including revisions through May 28, 2014.

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 http://csds.ul.com.

No Text on This Page

## CONTENTS

**Annexes**

**Annex C Cotton Used for Mercury Switch Test**

**Annex D Resistance to Heat, Fire and Tracking**

**Annex E Circuit for Measuring LEAKAGE CURRENT**

**Annex H Requirements for ELECTRONIC CONTROLS**

**Annex AA (informative) Endurance test for THERMAL MOTOR PROTECTORS as components, i.e. not installed on a motor**

# Preface (UL)

This UL Standard 60730-2-4, Standard for Safety for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors for Motor-Compressors of Hermetic and Semi-Hermetic Type, is to be used in conjunction with the third edition of UL 60730-1A. Consideration may be given to future editions of UL 60730-1. The requirements for thermal motor protectors for motor-compressors of hermetic and semi-hermetic type 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 60730-2-4, the UL 60730-1 subclause applies.

The text, figures and tables of IEC Publication Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors for Motor-Compressors of Hermetic and Semi-Hermetic Type, IEC 60730-2-4, copyright 1990, as amended in 1994 and 2001, are used in this Standard with the consent of the IEC and the American National Standards Institute (ANSI). The IEC copyrighted material has been reproduced with permission from ANSI. ANSI should be contacted regarding the reproduction of any portion of the IEC material. The IEC Foreword and Introduction are not a part of the requirements of this Standard but are included for information purposes only. Copies of IEC Publication 60730-2-4 may be purchased from ANSI, 11 West 42nd Street, New York, New York, 10036, (212) 642-4900.

**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.**

**Effective Date**

The effective date for this edition is October 19, 2018.

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

## Foreword (UL)

*THE UL FOREWORD IS NO LONGER PART OF THIS DOCUMENT*

# NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60730-2-4, Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Thermal Motor Protectors for Motor-Compressors of Hermetic and Semi-Hermetic Type, copyright 1990, as amended in 1994 and 2001, 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**.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE – Part 2: Particular Requirements for Thermal Motor Protectors for Motor-Compressors of Hermetic and Semi-Hermetic Type**

# FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

# PREFACE

This publication has been prepared by IEC Technical Committee No. 72: Automatic controls for household use.

It forms the first edition of IEC Publication 60730-2-4.

The text of this publication is based upon the following documents:

| Six Months' Rule | Report on Voting |
|---|---|
| 72(CO)39 | 72(CO)50 |

Full information on the voting for the approval of this publication can be found in the Voting Report indicated in the above table.

Amendment 1 has been prepared by IEC technical committee 72: Automatic controls for household use.

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

| DIS | Report on Voting |
|---|---|
| 72(CO)131 | 72(CO)137 |

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

Amendment 2 has been prepared by IEC technical committee 72: Automatic controls for household use.

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

| FDIS | Report on Voting |
|---|---|
| 72/522/FDIS | 72/533/RVD |

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

The committee has decided that the contents of the base publication and its amendments will remain unchanged until 2003. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

This part 2-4 is intended to be used in conjunction with IEC 60730-1. It was established on the basis of the third edition of that standard (1999). Consideration may be given to future editions of, or amendments to, IEC 60730-1.

This Part 2 supplements or modifies the corresponding clauses in IEC Publication 60730-1 so as to convert that publication into the IEC standard: Safety requirements for electrical controls for electrical household appliances (first edition).

Where this first edition 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 the Part 2 indicates that the relevant clause or sub-clause 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 differences existing in some countries regarding differing national practices are contained in the following sub-clauses: 12.2, 17.1, 18.1.3.101.4, 20.3 and Annex D.

*In this publication, the following print types are used:*

– Requirements proper: in roman type.

– *Test specifications: in italic type.*

– Explanatory matter: in smaller roman type.

Sub-clauses or figures which are additional to those in Part 1 are numbered starting from 101.

**101DV DE *Modification of the sixth paragraph of the Preface of the part 2:***

**Change ″Safety requirements for electrical controls for electrical household appliances″ to ″Safety requirements for thermal motor protectors for motor-compressors of hermetic and semi-hermetic type.″**

**102DV DE *Modification of the print types used in the part 2:***

**– Words in SMALL ROMAN CAPITALS in the text are defined in clause 2.**

**103DV DE *Addition of the following to the part 2:***

**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.**

# AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE – Part 2: Particular requirements for thermal motor protectors for motor-compressors of hermetic and semi-hermetic type

## 1 Scope and normative references

This clause of Part 1 is replaced by the following:

1.1 This standard applies to the partial evaluation of THERMAL MOTOR PROTECTORS as defined in IEC Publication 60730-1 for sealed (hermetic and semi-hermetic type) motor-compressors.

A THERMAL MOTOR PROTECTOR is an INTEGRATED CONTROL which is dependent on its correct mounting and fixing in or on a motor and which can only be fully tested in combination with the relevant motor.

Requirements concerning the testing of the combination of motor and THERMAL MOTOR PROTECTOR are given in IEC Publication 60335-2-34.

This standard applies to THERMAL MOTOR PROTECTORS for motor compressors using NTC or PTC THERMISTORS, additional requirements for which are contained in Annex J.

**1.1DV DE *Addition of the following Note to 1.1 of the part 2:***

**NOTE – Requirements concerning the testing of the combination of hermetic motor-compressor and THERMAL MOTOR PROTECTOR are given in UL 60335-2-34.**

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 sealed (hermetic and semi-hermetic type) motor-compressors.

This standard applies to THERMAL MOTOR PROTECTORS for motor-compressors within the scope of IEC Publication 60335.

Throughout this standard the word ″equipment” means ″appliance and equipment”.

THERMAL MOTOR PROTECTORS for motor compressors 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 *Modification of 1.1.1 of the part 2:***

**This standard applies to THERMAL MOTOR PROTECTORS for motor-compressors within the scope of UL 60335-2-34.**

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.

1.2 This standard applies to THERMAL MOTOR PROTECTORS for use with electric motors with a RATED VOLTAGE equal to or less than 690 V and a rated output of 11 kW or less.

**1.2DV DR *Modification of 1.2 of the part 2:***

**This standard applies to THERMAL MOTOR PROTECTORS for use with hermetic motor-compressors with a RATED VOLTAGE equal to or less than 600 V. No specific output power limits apply.**

1.3 This standard does not take into account the RESPONSE VALUE of an AUTOMATIC ACTION of a control, if such a RESPONSE VALUE is dependent upon the method of mounting the control in the equipment. Where a RESPONSE VALUE is of significant purpose for the protection of the USER, or surroundings, the value defined in the appropriate household equipment standard or as determined by the manufacturer shall apply.

**1.5** *Normative references*

This subclause of part 1 applies except as follows:

*Add the following IEC standards:*

IEC 60269-1: 1998,
*Low-voltage fuses – Part 1: General requirements*

IEC 60269-3: 1987,
*Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications)*

IEC 60335-2-34: 1999,
*Safety of household and similar electrical appliances – Part 2: Particular requirements for motor-compressors*

**1.5DV DE *Addition to 1.5 of the part 2:***

**The following UL Standard is quoted in this Standard:**

**UL 60335-2-34,**
***Household and Similar Electrical Appliances, Part 2: Particular Requirements for Motor-Compressors***

**2 Definitions**

This clause of Part 1 is applicable, except as follows:

**2.2.16DV D2 *Addition to 2.2.16 of the UL part 1:***

**The thermal protector may consist of one or more SENSING ELEMENTS integral with the motor-compressor and an external control device.**

**2.2.101DV D2 *Addition to the UL part 2:***

**MOTOR-COMPRESSOR ENCLOSURE: A MOTOR-COMPRESSOR ENCLOSURE denotes a sealed housing that contains the compressor, motor, and in some cases, a THERMAL MOTOR PROTECTOR; all of which are subjected to refrigeration pressures.**

**2.6** *Definitions of type of AUTOMATIC ACTION of a control according to test procedures*

*Additional definition:*

2.6.101 TYPE 3 ACTION: TYPE 3 ACTION denotes an AUTOMATIC ACTION for which reliability of the operating characteristics can only be evaluated in terms of measurements made on the protected motor-compressor.

**2.13** *Miscellaneous definitions*

*Additional definition:*

2.13.101 SEALED MOTOR-COMPRESSOR: A SEALED MOTOR-COMPRESSOR (hermetic or semi-hermetic type) denotes a mechanical compressor 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. 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 requirement**

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 Not applicable.

4.3.1.2 Not applicable.

4.3.2 Not applicable.

**5 Rating**

This clause of Part 1 is not 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:

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

An action providing more than one feature may be classified by a combination of the appropriate letters, for example, Type 3CL.

A MANUAL ACTION is not classified according to this sub-clause.

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 sub-clause:*

6.101 According to limited short-circuit capability if declared in Table 7.2, Requirement 101, in terms of current, voltage, fuse size and special fuse requirements, if applicable.

For limited short-circuit test details, refer to Sub-clause 17.1.

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 Sub-clause 17.1 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 for hermetic motor-compressors, information shall be provided as indicated in Table 7.2.

*Replacement:*

**Table 7.2**

| | Information | Clause or Sub-clause | Method |
|---|---|---|---|
| 1 | Manufacturer's name or trade mark [2] | | C |
| 2 | UNIQUE TYPE REFERENCE [1) 2)] | | C |
| 6 | Purpose of control | 4.3.5 | X |
| | | 6.3 | |
| 7 | Type of load controlled by each circuit [7)] | 6.2, 17 | X |
| 30 | PTI of materials used for insulation | 6.13 | X |
| 31 | Method of mounting control | 8 | X |
| 31a | Method of providing earthing of control | 7.4.3 | D |
| | | 9 | |
| 43 | Reset characteristics for cut-out action [3)] | 6.4 | X |
| | | 11.4 | |
| 49 | Control POLLUTION situation | 6.5.3 | X |
| 51 | Heat and fire resistance category | 21 | X |
| 101 | Limited short-circuit capability, if declared | 6.101 | X |
| | | 17.1 | |
| 102 | Features of AUTOMATIC ACTIONS [101)] | 6.4 | X |

*Replacement:*

**Note 3 – Manufacturers may declare a lower ambient temperature than that specified in Sub-clause 11.4.102.**

*Additional note:*

**101 – THERMAL MOTOR PROTECTORS are classified as Type 3.B.H and 3.C.**

## 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:*

For the purpose of this Part 2, internal wiring conductors are considered as INTEGRATED CONDUCTORS.

## 11 Constructional requirements

This clause of Part 1 is applicable except as follows:

**11.1DV D2 *Modification to add 11.1DV.1 to 11.1 of the UL part 1:***

**11.1DV.1 Electrical insulating materials and systems used on the inside of MOTOR-COMPRESSOR ENCLOSURES shall be compatible with:**

**a) The refrigerants and oils intended to be used with the motor-compressor;**

**b) Each other; and**

**c) Other materials used within the enclosure.**

**NOTE – Requirements and compatibility tests for this determination are specified in UL 60335-2-34.**

**11.3.4** SETTING BY THE MANUFACTURER

*Addition:*

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

**11.4** *Actions*

*Additional sub-clauses:*

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. 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 resistance

This clause of Part 1 is applicable, except as follows:

**12.2** *Protection against humid conditions:*

*Addition:*

In Canada and the U.S.A., the tests of Annex D determine proof against humid conditions.

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:*

The suitability of the test in Clause 13 may 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.

**13.2.1DV.1.1 D2** ***Modification to add the following to 13.2.1DV.1.1 of the UL part 1:***

**The test potential shall be 1 000 V for motor-compressors rated not more than 250 V and having locked-rotor values not exceeding 6,76 kVA for single-phase motor-compressors and 4,76 kVA for three-phase motor-compressors.**

## 14 Heating

This clause of Part 1 is not applicable.

(For THERMAL MOTOR PROTECTORS, successful completion of the tests of IEC Publication 60335-2-34 or the appropriate IEC standard is deemed to be sufficient.)

**14DV DE** ***Modification of the part 2:***

**Requirements concerning the testing of THERMAL MOTOR PROTECTORS are given in UL 60335-2-34.**

## 15 MANUFACTURING DEVIATION and DRIFT

This clause of Part 1 is not applicable.

## 16 Environmental stress

This clause of Part 1 is applicable.

## 17 Endurance

This clause of Part 1 is replaced as follows:

Endurance requirements for THERMAL MOTOR PROTECTORS for motor-compressors are represented by the abnormal test of Sub-clause 19.101 to 19.105 inclusive of IEC Publication 60335-2-34.

Annex AA contains information on an endurance test on the THERMAL MOTOR PROTECTOR as a component, i.e. not installed in a motor.

### 17DV DE *Modification of the note in the part 2:*

**NOTE – Endurance requirements for THERMAL MOTOR PROTECTORS applied to hermetic motor-compressors are represented by the locked-rotor test requirements of UL 60335-2-34.**

**17.1** *Limited short-circuit capability for thermal protectors classified under Sub-clause 6.101*

A THERMAL MOTOR PROTECTOR classified under Sub-clause 6.101 shall not present a hazard when the protector is subjected to current corresponding to a short-circuit in the motor-compressor.

In Canada and the U.S.A., compliance is checked by the test of Sub-clause 17.1.

*Three samples are tested in accordance with the values specified in Table 17.1.*

*The protector is mounted and connected as declared. The mounting may be made on a compressor or the relevant parts thereof.*

*The protector is connected in series with an appropriate fuse. The fuse shall be a standard rating fuse for domestic application as defined in IEC Publications 60269-1 and 60269-3. The fuse shall be suitable for the RATED VOLTAGE of the compressor. It shall be of a sufficiently high current rating to permit start-up and OPERATION, under all conditions of use, of any compressor for which this test is considered applicable, without OPERATION of the fuse.*

**Table 17.1 – Limited short-circuit capacity**

| Motor-compressor Rated-load current V | | | | | | Prospective current* A |
|---|---|---|---|---|---|---|
| **100 – 120** | **200 – 208** | **220 – 250** | **277** | **440 – 480** | **550 – 600** | **A** |
| Single-phase motors | | | | | | |
| ≤ 9,8 | ≤ 5,4 | ≤ 4,9 | – | – | – | 200 |
| 9,9 – 16,0 | 5,5 – 8,8 | 5,0 – 8,0 | ≤ 6,65 | – | – | 1 000 |
| 16,1 – 34,0 | 8,9 – 18,6 | 8,1 – 17,1 | – | – | – | 2 000 |
| 34,1 – 80,0 | 18,7 – 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 |
| – | 2,13 – 3,7 | 2,1 – 3,5 | – | ≤ 1,8 | ≤ 1,4 | 1 000 |
| – | 3,8 – 9,5 | 3,6 – 9,0 | – | – | – | 2 000 |
| – | 9,6 – 23,3 | 9,1 – 22,0 | – | – | – | 3 500 |
| – | > 23,3 | > 22,0 | – | > 1,8 | > 1,4 | 5 000 |
| *The symmetrical r.m.s. current which will flow in the circuit without the THERMAL MOTOR PROTECTOR connected and at a power factor of 0,9 – 1,0. | | | | | | |

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.

Thermal protectors located within the sealed MOTOR-COMPRESSOR ENCLOSURE are not required to be tested for limited short-circuit because the compressor enclosure will provide a suitable barrier.

Conductors used in this test are to have an ampacity equal to 125% of the rated load current of the motor-compressor.

17.1.1 *Case of motor-compressor used in a circuit with a fuse having specific time/current characteristics declared in Table 7.2, requirement 101.*

*The protector is connected in series with a fuse having the declared characteristics rated at 225% of the rated load current for a motor-compressor rated 400 kVA or less. The nearest standard size fuse is used rated not higher than the current indicated by the 225% value. The protector may be tested with a fuse having a lower rating.*

The motor-compressor must be capable of starting and operating in the end-use equipment without blowing the fuse.

If the calculated fuse size is less than 15 A and the motor-compressor is rated between 151 V and 600 V or is polyphase, a 15 A fuse is to be employed. If the calculated fuse size is less than 20 A and the motor-compressor is rated 150 V or less, single-phase, a 20 A fuse is to be employed.

In the case of a self-resetting protector, it is acceptable for the protector to cycle during this test. The test is continued until the protector permanently opens the circuit or until the fuse blows. Contact welding or disintegration of the protector is permissible.

There shall be no ignition of surgical grade cotton surrounding the outer enclosure, assembled in accordance with the manufacturer's instructions, in which the thermal protector is installed and the enclosure shall not become dislodged or damaged to the extent that it will no longer contain the fault when subjected to the conditions of this test.

By agreement with the manufacturer, it is permissible for the tests to be carried out at a higher voltage, or with a larger fuse size than specified above. The results of such tests would also cover lower values of voltage and current.

17.1.2 *Case of motor used in a group installation*

Thermal protectors may be used in motors which are used in multi-motor and combination load equipment on circuits with fuses of larger size than specified in Sub-clause 17.1.

*17.1.2.1 When the manufacturer declares that the equipment is for incorporation into a group-fused installation, the following additional tests are carried out.*

*The thermal protectors are tested in series with a fuse having the declared characteristics and a rating greater than that used for the test in Sub-clause 17.1.1. The test is carried out as specified in Sub-clause 17.1 except that a layer of bleached cotton gauze material (cheesecloth), instead of surgical cotton, shall be placed surrounding the outer enclosure of the protector. The bleached cotton gauze material shall have an area per unit mass between 26 and 28 $m^2$/kg and a count of 13 by 11 threads per $cm^2$ (or a close commercially available alternative).*

The limited short-circuit test is carried out to ensure that the addition of a thermal protector which is self-heat-generating on motor current does not cause a safety hazard outside a motor which has failed.

For group fused installations, the test circuit conditions are abnormally severe. To compensate for this to some extent, cotton gauze material (cheesecloth) is used as the indicator of external flame instead of absorbent cotton which is used in the motor with a fuse having particular time/current characteristics declared in Table 7.2, requirement 101.

Group-fused installations usually involve multi-motor and combination load equipment which provides an enclosure which can withstand flame and molten materials, whereas during the specified test the motor is used as the sole enclosure. A prerequisite for recognition of a THERMAL MOTOR PROTECTOR for a group fused installation is that it shall first have qualified for normal fusing condition which uses absorbent cotton in the test. Group fused installations are usually involved with relatively small motors such as are used with fans and blowers. These motors are internally wired with small sizes of conductors which tend to reduce the value of the short-circuit compared to the extreme values of maximum power used for the test.

Thus, the group-fused installation test carried out at the higher power and with larger fuse ratings represents an extreme condition, which can be duplicated for test purposes. When this extreme condition is combined with cotton gauze material (cheesecloth) as an indicator of the flame, it becomes a suitable compromise compared to conducting a number of tests over a wide range of circuit powers.

## 18 Mechanical strength

This clause of Part 1 is applicable, except as follows:

*18.1.3 Additional sub-clause:*

18.1.3.101 THERMAL MOTOR PROTECTORS 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 equal to the pressure specified in Sub-clause 22.7 of IEC Publication 60335-2-34, for the MOTOR-COMPRESSOR ENCLOSURE tests without:*

*1) collapsing, bending, warping or distorting the protective device housing as determined by visual examination;*

*2) short-circuiting of the housing to internal current-carrying parts of the protective device; and*

*3) affecting electrical continuity between terminals of the protective device.*

**18.1.3.101.1DV DE *Modification of 18.1.3.101.1 of the part 2:***

**Requirements concerning the testing of THERMAL MOTOR PROTECTORS are given in UL 60335-2-34.**

*18.1.3.101.2 Alternatively, at the request of the manufacturer, the tests of Sub-clause 18.1.3.101.1 may be conducted at a pressure equal to 60% of the test pressure specified in Sub-clause 18.1.3.101.1 provided that the protector complies with the requirements of the calibration check test of Sub-clause 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 *and* CLEARANCE*.*

In Canada and the U.S.A., higher or lower test pressures than the values specified in Sub-clauses 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 check test is performed by measuring the cut-out and cut-in temperatures of the* THERMAL MOTOR PROTECTOR *before and after the pressure test of Sub-clause 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 cut-out and cut-in is to be obtained by a low-energy continuity-indicating circuit whose current does not influence* OPERATION *of the device. The cut-out and cut-in 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 cut-out temperature and 11 K above the cut-in 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.*

Alternate calibration check test equipment may be used subject to agreement between test house and manufacturer.

A higher test pressure may be used by agreement between test house and manufacturer.

## 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, except as follows:

*20.3 Replacement:*

In Canada and the U.S.A., which do not use the requirements of Sub-clauses 20.1 and 20.2, the CREEPAGE DISTANCES and CLEARANCES shall not be less than the appropriate value in Sub-clauses 20.3.1 and 20.3.2.