UL 60335-2-34

STANDARD FOR SAFETY

Household and Similar Electrical Appliances – Safety – Part 2-34: Particular Requirements for Motor-Compressors

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

Sixth Edition, Dated November 3, 2017

Summary of Topics

The following is the Sixth Edition of ANSI/UL 60335-2-34, the common CSA Group and UL (binational) standard that is an adoption of IEC 60335-2-34, Safety Standard for of Household and Similar Electrical Appliances – Safety – Part 2-34: Particular Requirements for Motor-Compressors (IEC 60335-2-34, Edition 5.2:2016.)

The new requirements are substantially in accordance with Proposal(s) on this subject dated March 24, 2017 and July 7, 2017.

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Second Edition
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Underwriters Laboratories Inc.
UL 60335-2-34
Sixth Edition

Household and Similar Electrical Appliances – Safety – Part 2-34: Particular Requirements for Motor-Compressors

November 3, 2017

This national standard is based on publication IEC 60335-2-34, Edition 5.2:2016 (Edition 5:2012 consolidated with amendment 1:2015 and its corrigendum 1:2015, and amendment 2:2016).

ANSI/UL 60335-2-34-2017

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquires@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Sixth Edition. The most recent designation of ANSI/UL 60335-2-34 as an American National Standard (ANSI) occurred on November 3, 2017. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the 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.

To purchase UL Standards, visit UL's Standards Sales Site at http://www.shopulstandards.com/HowToOrder.aspx or call toll-free 1-888-853-3503.

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PREFACE

This is the harmonized CSA Group and UL standard for particular requirements for motor-compressors. It is the second edition of CAN/CSA-C22.2 No. 60335-2-34, and the sixth edition of UL 60335-2-34. This edition of CAN/CSA-C22.2 No. 60335-2-34 supersedes the previous edition published on March 22, 2013. This edition of UL 60335-2-34 supersedes the previous edition published on March 22, 2013.

This harmonized standard is based on IEC Publication 60335-2-34: Edition 5.2, Household and Similar Electrical Appliances – Safety – Part 2-34: Particular Requirements for Motor-Compressors, issued November 2016. IEC 60335-2-34 is copyrighted by the IEC.

This harmonized Standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the motor-compressor manufacturing industry are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This Standard was reviewed by the CSA Subcommittee on Household Appliances for Refrigeration, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This Standard was also reviewed and approved by UL's Standards Technical Panel for Heating and Cooling Equipment – Particular Requirements for Motor-Compressors, STP 60335-2-34.

This Standard has been approved as a National Standard of Canada by the Standards Council of Canada (SCC) and approved by the American National Standards Institute (ANSI) for publication as an American National Standard.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

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.

CAN/CSA-C22.2 No. 60335-2-34 is to be used in conjunction with the second edition of CAN/CSA-C22.2 No. 60335-1:16. The requirements for motor-compressors are contained in this Part 2 Standard and CAN/CSA-C22.2 No. 60335-1:16. Requirements of this Part 2 Standard, where stated, amend the requirements of CAN/CSA-C22.2 No. 60335-1:16. Where a particular subclause of CAN/CSA-C22.2 No. 60335-1:16 is not mentioned in CAN/CSA-C22.2 No. 60335-2-34, the CAN/CSA-C22.2 No. 60335-1:16 subclause applies.

UL 60335-2-34 is to be used in conjunction with the sixth edition of UL 60335-1. The requirements for motor-compressors are contained in this Part 2 Standard and UL 60335-1. Requirements of this Part 2 Standard, where stated, amend the requirements of UL 60335-1. Where a particular subclause of UL 60335-1 is not mentioned in UL 60335-2-34, the UL 60335-1 subclause applies.

Level of Harmonization

This standard adopts the IEC text with national differences. This standard is published as an equivalent standard for CSA and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows:

a) Technical national differences are allowed for national differences resulting from conflicts in codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate.

b) Presentation is word for word except for editorial changes that do not alter the technical content of the standard. Examples of editorial changes include:

1) different font sizes, figure sizes, and table sizes;

2) minor variations in format, such as indentation and pagination;

3) font appearance (including the use of italic or bold text or uppercase or lowercase letters);

4) the use of a symbol (e.g., A or %) rather than the word (Ampere or percent), or the word rather than the symbol;

5) inclusion of inch-pound units for informational purposes;

6) corrections of misprints or typographical errors;

7) bilingual column headings or figure captions on a common table or figure in a bilingual edition;

8) change from first-angle to third-angle drawing;

9) addition of a statement: “This is a first-angle drawing”; and

10) substitution of a point (.) for a comma (,) as the decimal marker.

All national differences from the IEC text are included in the CSA Group and UL versions of the standard. While the technical content is the same in each organization’s version, the format and presentation may differ.

Reasons for Differences From IEC

Differences from the IEC are being added in order to address safety and regulatory situations present in the US and Canada.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

IEC Copyright

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 60335-2-34, Household and Similar Electrical Appliances – Safety – Part 2-34: Particular Requirements for Motor-Compressors, copyright 2016, are used in this standard with the consent of the International Electrotechnical Commission. The IEC Foreword and Introduction are not a part of the requirements of this standard but are included for information purposes only.

NATIONAL DIFFERENCES

GENERAL

In the CSA Group and UL publications of this standard, National Differences from the text of International Electrotechnical Commission (IEC) Publication 60335-2-34, Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors, copyright 2016, are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

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.

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.

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY – Part 2-34: Particular requirements for motor-compressors

FOREWORD

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

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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.

This Consolidated version of IEC 60335-2-34 bears the edition number 5.2. It consists of the fifth edition (2012-05) [documents 61C/508/FDIS and 61C/517/RVD], its amendment 1 (2015-05) [documents 61C/597/FDIS and 61C/603/RVD] and its corrigendum (2015-06), and its amendment 2 (2016-11) [documents 61C/686/FDIS and 61C/691/RVD]. The technical content is identical to the base edition and its amendment.

This part of International Standard IEC 60335 has been prepared by subcommittee 61C: Safety of refrigeration appliances for household and commercial use, of IEC technical committee 61: Safety of household and similar electrical appliances.

The principal changes in this edition as compared with the fourth edition of IEC 60335-2-34 are as follows (minor changes are not listed):

– some notes have been deleted or converted to normative text (1, 6.103, 19.14, 22.7, Figure 101);

– manufacturer must declare the type of motor protection used (5.102, 6.104);

– tests to fault-test MOTOR-COMPRESSORS incorporating ELECTRONIC CIRCUITS introduced (19.11.2, AA.5);

– application of the EMP tests clarified (19.11.4);

– testing of contactors and relays associated with MOTOR-COMPRESSORS introduced (19.14);

– tables 101 and 102 updated and corrected;

– running overload test conditions extended (AA.1, AA.2, AA.3, AA.4, AA.5).

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

This part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of the fifth edition (2010) of that standard.

NOTE 1 When “Part 1” is mentioned in this standard, it refers to IEC 60335-1.

This part 2 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Safety requirements for electrical motor-compressors.

When a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. When this standard states “addition”, ″modification″ or ″replacement″, the relevant text in Part 1 is to be adapted accordingly.

NOTE 2 The following numbering system is used:

– subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;

– unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;

– additional annexes are lettered AA, BB, etc.

NOTE 3 The following print types are used:

– requirements: in roman type;

– *test specifications: in italic type;*

– notes: in smaller roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in bold.

A list of all parts of the IEC 60335 series, under the general title *Household and similar electrical appliances – Safety*, can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendment 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.

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

It is the recommendation of the committee that the content of this publication be adopted for implementation nationally not earlier than 12 months or later than 36 months from the date of publication.

The following differences exist in the countries indicated below.

– 7.1: The locked-rotor current marking is required for some motor-compressors (USA).

– 22.7: Different test pressures are used (Japan, USA).

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

101DV D2 ***Modification by replacing the 5th paragraph after Item (9) of the IEC Foreword and Note 1 with the following:***

This Part 2-34 is intended to be used in conjunction with the CSA/UL harmonized standard of the second edition of CAN/CSA-C22.2 No. 60335-1:16 and the sixth edition of UL 60335-1 dated October 31, 2016. This harmonized standard is an adoption of IEC 60335-1, Safety Standard for Household and Similar Electrical Appliances, Part 1: General Requirements, (Edition 5.1, Issued by the IEC April 2014.) All references in this standard to IEC 60335-1 shall be replaced by reference to this CSA/UL harmonized standard.

102DV DE ***Modify the paragraph following Note 3 in the IEC Foreword by replacing it with the following:***

Words in SMALL ROMAN CAPS in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in SMALL ROMAN CAPS.

103DV DE ***Modification by adding the following text at the end of the IEC Foreword:***

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.

INTRODUCTION

It has been assumed in the drafting of this International Standard that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice and takes into account the way in which electromagnetic phenomena can affect the safe operation of appliances.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the appliance is connected to the supply mains. However, national wiring rules may differ.

If an appliance within the scope of this standard also incorporates functions that are covered by another part 2 of IEC 60335, the relevant part 2 is applied to each function separately, as far as is reasonable. If applicable, the influence of one function on the other is taken into account.

When a part 2 standard does not include additional requirements to cover hazards dealt with in Part 1, Part 1 applies.

NOTE 1 This means that the technical committees responsible for the part 2 standards have determined that it is not necessary to specify particular requirements for the appliance in question over and above the general requirements.

This standard is a product family standard dealing with the safety of appliances and takes precedence over horizontal and generic standards covering the same subject.

NOTE 2 Horizontal and generic standards covering a hazard are not applicable since they have been taken into consideration when developing the general and particular requirements for the IEC 60335 series of standards. For example, in the case of temperature requirements for surfaces on many appliances, generic standards, such as ISO 13732-1 for hot surfaces, are not applicable in addition to Part 1 or part 2 standards.

An appliance that complies with the text of this standard will not necessarily be considered to comply with the safety principles of the standard if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

An appliance employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

If testing of the MOTOR-COMPRESSOR includes testing in accordance with Annex AA, temperatures of the MOTOR-COMPRESSOR windings, HOUSING and other parts related to the MOTOR-COMPRESSOR, such as terminals, internal wiring and insulating materials, are not measured when the complete appliance in which the MOTOR-COMPRESSOR is used is tested.

These requirements apply to sealed (hermetic and semi-hermetic type) MOTOR-COMPRESSORS with their associated starting, cooling capacity control and protection systems, tested separately under the most severe conditions of the refrigerating system operation which, within reasonable limits, could occur in the applications for which they are used.

In particular, the construction detail inspection and locked-rotor testing may be done separately on the MOTOR-COMPRESSOR, thereby eliminating the need for inspection and testing when the MOTOR-COMPRESSOR is applied to many different appliances and factory-built assemblies.

Operational tests may also be conducted on the MOTOR-COMPRESSOR separately in certain circumstances. The specification for this type testing is provided in Annex AA. However, the tests of the existing standards relevant to the given kind of application, such as IEC 60335-2-24 and IEC 60335-2-40, may need to be conducted on the final application and used as the final determination of acceptability.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY – Part 2-34: Particular requirements for motor-compressors

1 Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of sealed (hermetic and semi-hermetic type) MOTOR-COMPRESSORS, their protection and control systems, if any, which are intended for use in equipment for household and similar purposes and which conform with the standards applicable to such equipment. It applies to MOTOR-COMPRESSORS tested separately, under the most severe conditions that may be expected to occur in normal use, their rated voltage being not more than 250 V for single-phase MOTOR-COMPRESSORS and 600 V for other MOTOR-COMPRESSORS.

1DV.1 D2 ***Modification to replace the second sentence of the second paragraph in Clause 1 with the following:***

It applies to motor-compressors tested separately, under the most severe conditions that can be expected to occur in normal use, their rated voltage being not more than 300 V for single-phase motor-compressors and 600 V for other motor-compressors intended for use in accordance with:

– CSA C22.1, Canadian Electrical Code (CE Code) Part I, in Canada;

– NFPA 70, National Electrical Code (NEC), in the United States.

1DV.2 D2 ***Modification by adding the following to Clause 1 of the Part 2:***

For MOTOR-COMPRESSORS rated greater than 600 V, see the requirements of Annex 101.DVI.

This standard also covers

– multi-speed MOTOR-COMPRESSORS, that are MOTOR-COMPRESSORS, the speed of which can be set to different values;

– variable capacity MOTOR-COMPRESSORS, that are MOTOR-COMPRESSORS where the capacity of the compressor is controlled at fixed speeds.

NOTE 101 Examples of equipment which contain MOTOR-COMPRESSORS are

– refrigerators, food freezers and ice makers (IEC 60335-2-24);

– air-conditioners, electric heat pumps and dehumidifiers (IEC 60335-2-40);

– commercial dispensing appliances and vending machines (IEC 60335-2-75);

– factory-built assemblies for transferring heat in applications for refrigerating, air-conditioning or heating purposes or a combination of such purposes.

This standard does not supersede the requirements of standards relevant to the particular appliance in which the MOTOR-COMPRESSORS is used. However, if the MOTOR-COMPRESSORS type used complies with this standard, the tests for the MOTOR-COMPRESSORS specified in the particular appliance standard may not need to be made in the particular appliance or assembly. If the MOTOR-COMPRESSORS CONTROL SYSTEM is associated with the particular appliance control system, additional tests may be necessary on the final appliance.

So far as is practical, this standard deals with the common hazards presented by MOTOR-COMPRESSORS used in appliances which are encountered by all persons in and around the home. However, it does not in general take into account

– the use of appliances by young children or infirm persons without supervision;

– playing with the appliances by young children.

NOTE 102 Attention is drawn to the fact that

– for MOTOR-COMPRESSORS intended to be used in appliances in vehicles or on board ships, additional requirements may be necessary;

– in many countries, additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour and similar authorities.

NOTE 103 This standard does not apply to

– MOTOR-COMPRESSORS designed exclusively for industrial purposes;

– motor-compressors used in appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

NOTE 104 If MOTOR-COMPRESSORS for refrigerant R-744 used in appliances with a TRANSCRITICAL REFRIGERATION SYSTEM are equipped with PRESSURE RELIEF DEVICES, compliance with the requirements for these devices is checked during the tests on the final appliance.

2 Normative references

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

Addition:

IEC 60079-15:2010, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 60851-4, *Methods of test for winding wires – Part 4: Chemical properties*

IEC 60851-5:2008, *Winding wires – Test methods – Part 5: Electrical properties*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

2DV DC *Modification by adding the following to Clause 2:*

Any reference within this standard to International Standards that are adopted in Canada and in the United States shall be replaced by a reference to the equivalent adopted standard. The requirements of these adopted Standards shall take precedence over International Standards on which they are based.

CSA C22.1-15,
Canadian Electrical Code (CE Code) Part I

CAN/CSA-C22.2 No. 0-10,
General requirements – Canadian Electrical Code, Part II

C22.2 No. 253,
Standard for Medium-Voltage AC Contactors, Controllers and Control Centers

CAN/CSA-C22.2 No. 60335-1,
Safety Standard for Household and Similar Electrical Appliances, Part 1: General Requirements

IEC 60068-2-52,
Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution)

IEC 60112,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60216,
Electrical insulating materials – Thermal endurance properties – Part 4-1: Ageing ovens – Single-chamber ovens

IEC 60243-1,
Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies

IEC 60243-2,
Electrical strength of insulating materials – Test methods – Part 2: Additional requirements for tests using direct voltage

IEC 60695-11-20,
Fire hazard testing – Part 11-20: Test flames – 500 W flame test methods

IEEE 1776,
IEEE Recommended Practice for Thermal Evaluation of Unsealed or Sealed Insulation Systems for AC Electric Machinery Employing Form-Wound Pre-Insulated Stator Coils for Machines Rated 15 000 V and Below

ISO 817,
Refrigerants – Designation system

ISO 4892-2,
Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps

ASHRAE 34,
Designation and Safety Classification of Refrigerants

ASME, Boiler and Pressure Vessel Code, Section VIII

ASTM A90/A90M,
Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

NFPA 70,
National Electrical Code (NEC)

UL 347
Safety Standard for Medium-Voltage AC Contactors, Controllers and Control Centers

UL 60335-1
Safety Standard for Household and Similar Electrical Appliances, Part 1: General Requirements

3 Terms and definitions

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

3.101
MOTOR-COMPRESSOR
appliance consisting of the mechanical mechanism of the compressor and the motor, both of which are enclosed in the same sealed HOUSING, with no external shaft seals, and with the motor operating in a refrigerant atmosphere with or without oil

Note 1 to entry: The HOUSING may be permanently sealed, such as by welding or brazing (HERMETIC MOTOR-COMPRESSOR), or may be sealed by gasketted joints (SEMI-HERMETIC MOTOR-COMPRESSOR). A terminal box, a terminal box cover, and other electrical components or an electronic control system may be included.

Note 2 to entry: Hereafter, the term MOTOR-COMPRESSOR will be used to designate either a HERMETIC MOTOR-COMPRESSOR or SEMI-HERMETIC MOTOR-COMPRESSOR.

3.102
HOUSING
sealed enclosure for the MOTOR-COMPRESSOR, which contains the compressor mechanism and the motor, and which is subjected to refrigerant pressures

3.103
THERMAL MOTOR-PROTECTOR
automatic control, built-in or fitted on a MOTOR-COMPRESSOR, that is specifically intended to protect the MOTOR-COMPRESSOR against over-heating due to running overload and failure to start

Note 1 to entry: This control carries MOTOR-COMPRESSOR current and is sensitive to one or both of the following:

– MOTOR-COMPRESSOR temperature;

– MOTOR-COMPRESSOR current.

Note 2 to entry: The control is capable of being reset (either manually or automatically) when its temperature falls to the reset value.

3.104

MOTOR-COMPRESSOR PROTECTION SYSTEM

THERMAL MOTOR PROTECTOR and associated components, if any, or PROTECTIVE ELECTRONIC CIRCUIT fully or partly separate or integrated into the MOTOR-COMPRESSOR CONTROL SYSTEM and which is specifically intended to protect the MOTOR-COMPRESSOR against over-heating due to running overload or failure to start

Note 1 to entry: The control carries MOTOR-COMPRESSOR current and is sensitive to one or both of the following:

– MOTOR-COMPRESSOR temperature;

– MOTOR-COMPRESSOR current.

3.105

MOTOR-COMPRESSOR CONTROL SYSTEM

system comprising one or more electrical or ELECTRONIC COMPONENTS, or ELECTRONIC CIRCUITS that provides at least one of the following:

– MOTOR-COMPRESSOR starting control functions;

– MOTOR-COMPRESSOR cooling capacity control functions

3.106

STARTING RELAY

electrically operated control device intended for integration or incorporation into a MOTOR-COMPRESSOR and used within the MOTOR-COMPRESSOR circuit to control the starting of single-phase MOTOR-COMPRESSORS

3.107

APPLICATION CATEGORY

back pressure relative to the evaporation temperature range over which the MOTOR-COMPRESSOR operates

Note 1 to entry: For the purpose of this standard, the following classifications of application categories are made relative to the evaporation temperature range:

– low back pressure (LBP): denotes an evaporation temperature range from –35 °C to –15 °C;

– medium back pressure (MBP): denotes an evaporation temperature range from –20 °C to 0 °C;

– high back pressure (HBP): denotes an evaporation temperature range from –5 °C to +15 °C.

3.108

TRANSCRITICAL REFRIGERATION SYSTEM

refrigeration system where the pressure in the high pressure side is above the pressure where the vapour and liquid states of the refrigerant can coexist in thermodynamic equilibrium

3.109

DESIGN PRESSURE

gauge pressure that has been assigned to a TRANSCRITICAL REFRIGERATION SYSTEM

Note 1 to entry: It is specified for the high pressure side of a refrigeration system.

3.110
PRESSURE RELIEF DEVICE
pressure sensing device, intended to reduce pressure automatically when pressures within the refrigeration system exceed the preset pressure of the device

Note 1 to entry: This device has no provisions for setting by the end user.

3.111
TWO-STAGE MOTOR-COMPRESSOR
MOTOR-COMPRESSOR comprising two compressors and one motor in a single HOUSING

3.112DV DE *Addition of the following definitions to Clause 3 as follows:*

3.112DV.1
PRIMARY SINGLE PHASING
Primary single-phasing occurs when one of the three incoming lines to the primary of the transformer supplying the MOTOR-COMPRESSOR supplies no voltage to the transformer.

3.112DV.2
MAXIMUM CONTINUOUS CURRENT
The maximum amount of current that is allowed to flow to the MOTOR-COMPRESSOR MOTOR by the MOTOR-COMPRESSOR PROTECTION SYSTEM.

3.112DV.3
BYPASS VALVE
A device that relieves high-side pressure into the low-side at a predetermined pressure differential.

3.112DV.4
FORM WOUND MOTOR
A motor using insulated rectangular shaped conductors that are wrapped with additional electrical insulation over the entire coil prior to insertion and are precisely positioned and formed into coils.

3.112DV.5
RANDOM WOUND MOTOR
A motor using insulated round conductors in which the winding turns occupy random positions in a slot.

3.112DV.6
MAXIMUM RATED CURRENT (MRC)
The current resulting when a hermetic refrigerant motor-compressor and ELECTRONIC CIRCUIT are operated under any conditions such as maximum speed/maximum load, maximum speed/minimum load, minimum speed/minimum load, minimum speed/maximum load, including locked-rotor such that current to the motor-compressor and ELECTRONIC CIRCUIT is at a maximum. The MRC is the current at the input of the ELECTRONIC CIRCUIT controlling device.

3.112DV.7

FORMETTE

A special test model used for the evaluation of the electrical insulation systems for form-wound windings.

3.112DV.8

BARG

The pressure, in units of bars, above or below atmospheric pressure. The "g" at the end of the word indicates that the measurement is not absolute pressure, sometimes indicated by bara.

3.112DV.9

MAXIMUM ALLOWABLE PRESSURE

A limit to the refrigerating system operating pressure, generally the maximum pressure for which the equipment is designed, as specified by the manufacturer. Maximum allowable pressure constitutes a limit to the operating pressure whether the equipment is working or not.

4 General requirement

This clause of Part 1 is applicable.

4DV.101 DR *Addition (Canada only):*

This clause of Part 1 is applicable except as follows.

CAN/CSA-C22.2 No. 0 shall form a part of, and be read in conjunction with, this Standard as far as the requirements apply, except that, where this Standard contains requirements that are at variance with those of CAN/CSA-C22.2 No. 0, the requirements of this Standard shall take precedence.

5 General conditions for the tests

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

5.2 *Addition:*

At least one additional sample is required for the tests of clause 19, however further samples may also be provided or are needed.

For the test of 22.7, two samples of the HOUSING *are required.*

5.7 *Replacement:*

Tests are carried out in an ambient temperature of 20 °C ± 5 °C.

5.8.2 *Addition:*

MOTOR-COMPRESSORS with SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEMS, and designed for more than one RATED VOLTAGE, are subjected to the tests of 19.101 and 19.103 at the highest voltage.

5.10 *Addition:*

For the tests of Clause 19, the additional sample or samples shall be identical in all respects to the test sample, charged with oil, if necessary, and vapour refrigerant. The sample has to be provided with the MOTOR-COMPRESSOR PROTECTION SYSTEM, STARTING RELAY, start capacitor, run capacitor and control system, if any, as specified by the manufacturer, except that the rotor shall have been locked by the manufacturer.

The manufacturer or responsible agent shall provide the following information for each type of MOTOR-COMPRESSOR submitted for the tests:

– type (synthetic or cellulosic) of winding insulation;

– refrigerant identification:

a) for a single component refrigerant, by at least one of the following:

- *chemical name;*
- *chemical formula;*
- *refrigerant number;*

b) for a blended refrigerant, at least one of the following:

- *chemical name and nominal proportion of each of the components;*
- *chemical formula and nominal proportion of each of the components;*
- *refrigerant number and nominal proportion of each of the components;*
- *refrigerant number of the refrigerant blend;*

– types and quantity of oil to be used if the test samples which use oil are not already charged;

– APPLICATION CATEGORY or APPLICATION CATEGORIES for MOTOR-COMPRESSORS classified as being tested with Annex AA;

– whether a SUPPLY CORD can be connected directly to terminals on the MOTOR-COMPRESSOR;

– for MOTOR-COMPRESSORS intended for appliances with a TRANSCRITICAL REFRIGERATION SYSTEM, the test pressure for the high pressure side if higher than the minimum test pressure.

5.11 *Replacement:*

For MOTOR-COMPRESSORS *which can be used in appliances where the* SUPPLY CORD *is connected directly to terminals on the* MOTOR-COMPRESSOR*, the test sample shall be provided with a* SUPPLY CORD*.*

NOTE 101 Any additional samples required for testing need not be provided with a SUPPLY CORD.

5.101 *MOTOR-COMPRESSORS, including those with crank-case heaters, are tested as MOTOR-OPERATED APPLIANCES.*

5.102 *With regard to 6.104,* PROTECTIVE DEVICES *other than the declared device under test shall be disabled during the tests of Annex AA and Clause 19. If multiple* PROTECTIVE DEVICES *are declared, each shall be tested independently.*

5.103 *For cascade systems comprising two or more motor-compressor circuits, each* MOTOR-COMPRESSOR *circuit is tested separately in the end product. IEC 60335-2-34 is not applicable for the system but each* MOTOR-COMPRESSOR *can be tested according to this standard.*

5.104DV DR *Add the following clause to Clause 5 of the Part 1:*

Cheesecloth specified in this Standard shall be untreated cotton cloth 0,8 – 1,0 m (31 – 39 inches) wide and 28 – 30 m/kg (42 – 45 ft/lb). Tests involving cheesecloth shall be conducted in a room free of drafts.

6 Classification

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

6.101 MOTOR-COMPRESSORS without an incorporated or associated ELECTRONIC CIRCUIT are classified as being tested with Annex AA or without Annex AA.

MOTOR-COMPRESSORS with an incorporated or associated ELECTRONIC CIRCUIT are classified as being tested with Annex AA.

MOTOR-COMPRESSORS can be classified as being tested with Annex AA only if the MOTOR-COMPRESSOR in combination with the MOTOR-COMPRESSOR PROTECTION SYSTEM or MOTOR-COMPRESSOR CONTROL SYSTEM, if any, can be configured to operate so as to deliver maximum cooling capacity, independently of any input sensors that are only provided as part of the final application.

NOTE MOTOR-COMPRESSORS classified as being tested without Annex AA and their protection system or control system, if any, are normally subjected to a heating test as a complete system in the final application in accordance with the appropriate appliance standard.

Compliance is checked by

– the tests of this standard including the tests in Annex AA, for MOTOR-COMPRESSORS *tested with Annex AA;*

– the tests of this standard but not including the tests in Annex AA, for MOTOR-COMPRESSORS *tested without Annex AA.*

6.102 MOTOR COMPRESSORS are classified as being

– intended for direct connection of the appliance SUPPLY CORD to the MOTOR-COMPRESSOR terminals, or

– not intended for direct connection of the appliance SUPPLY CORD to the MOTOR-COMPRESSOR terminals.

NOTE 1 MOTOR-COMPRESSORS can in both cases be delivered with or without the external components necessary for connection of the SUPPLY CORD.

NOTE 2 MOTOR-COMPRESSORS intended for direct connection of the appliance SUPPLY CORD to their terminals can also be used without the SUPPLY CORD being connected directly to their terminals.

NOTE 3 If the MOTOR-COMPRESSOR is used without the relevant components or with components different from those specified by the manufacturer, additional testing in accordance with the appropriate appliance standard can be necessary.

Compliance is checked by inspection and by the relevant tests.

6.103 MOTOR-COMPRESSORS are classified as being protected by PROTECTIVE ELECTRONIC CIRCUITS or not being protected by PROTECTIVE ELECTRONIC CIRCUITS.

This does not preclude the PROTECTIVE ELECTRONIC CIRCUITS being provided in the end product, in which case many of the tests of this standard shall be conducted on the end product.

Compliance is checked by inspection and by the relevant tests.

6.104 *The MOTOR-COMPRESSOR manufacturer shall declare the means of motor protection, THERMAL MOTOR PROTECTOR, impedance protection, PROTECTIVE ELECTRONIC CIRCUIT, or a combination of the above.*

Compliance is checked by inspection and by the relevant tests.

6.105 Motor-compressors using refrigerant R744 shall be classified as used in a TRANSCRITICAL REFRIGERATION SYSTEM or in a non-TRANSCRITICAL REFRIGERATION SYSTEM.

Compliance is checked by inspection and by the relevant tests.

7 Marking and instructions

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

7.1 *Modification:*

The RATED POWER INPUT or RATED CURRENT need not be marked.

Addition:

MOTOR-COMPRESSORS suitable for use with a flammable refrigerant shall be marked with symbol ISO 7010 W021.

7.1DV.1 DR *Modification of Clause 7.1 of the Part 1 to replace the second dashed item with the following:*

– symbol for nature of supply including number of phases, unless for single phase operation;

7.1DV.2 DR *Modification of Clause 7.1 of the Part 1 to add the following after the eighth dashed item:*

– motor compressor locked rotor amperage (LRA) rating(s). If motor winding switching or alternate motor wiring options cause or allow different LRA, the highest resulting LRA shall be marked;

– manufacturing date or date code and location if the product is produced in more than one location.

If the motor compressor is thermally protected it shall be marked with:

– ″Thermally Protected″ if a THERMAL PROTECTOR is provided or is specified by the MOTOR-COMPRESSOR manufacturer; or

– ″Thermally Protected System″ if a protective system with all sensing elements and motor-current-interrupting means is provided or specified by the MOTOR-COMPRESSOR manufacturer.

A motor-compressor subjected to the Optional Pressure Test in Annex 101.DVG shall be legibly and permanently marked with the maximum allowable or design pressure, psig (kPa) or Barg.

7.5 Not applicable.

7.6 *Addition:*

Symbol ISO 7010 W021 Warning: Flammable materials

7.7 Not applicable.

7.12 Not applicable, except 7.12.1 which is applicable.

7.13 Not applicable.

7.101 Refrigerants that can be used with the MOTOR-COMPRESSOR shall be listed in the instructions.

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of Part 1 is applicable.

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is not applicable.

11 Heating

This clause of Part 1 is not applicable.

NOTE 101 For MOTOR-COMPRESSORS, this clause of Part 1 can be covered by Annex AA.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is not applicable, except 13.3 as required by 19.104.

13.3 *Addition:*

In Table 4, add the following to table footnote a:

The test voltage for 600 V multi-phase appliances is that specified for a WORKING VOLTAGE > 250 V where U is taken as the RATED VOLTAGE.

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

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

15.3 *Addition:*

NOTE 101 MOTOR-COMPRESSORS with glass-insulated terminals and without any external control devices, protectors or other components need not be tested.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.3 *Addition:*

In Table 7, add the following to table footnote a:

The test voltage for 600 V multi-phase appliances is that specified for a WORKING VOLTAGE > 250 V where U is taken as the RATED VOLTAGE.

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is not applicable.

19 Abnormal operation

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

19.1 *Modification:*

Replace the test specification by the following:

MOTOR-COMPRESSORS are submitted to the tests of 19.14, 19.15, 19.101, 19.102, 19.103 and, additionally, if so required by the classification of 6.101, to the tests specified in Annex AA.

MOTOR-COMPRESSORS incorporating ELECTRONIC CIRCUITS are also subjected to the tests of 19.11 and 19.12.

Only one abnormal condition is simulated each time.

Compliance with the tests of 19.11 and 19.12 is checked as described in 19.13. Compliance with the tests of 19.101, 19.102 and 19.103 is checked as described in 19.104. Compliance with the tests of Annex AA is checked as described in Annex AA.

19.2 to 19.10 Not applicable.

19.11.2 *Addition:*

For simulation of the fault conditions, a MOTOR-COMPRESSOR with its incorporated or associated ELECTRONIC CIRCUIT is connected to the substitute refrigeration circuit of Figure AA.1 and operated under the conditions given in Clause AA.5. The conditions applied are the step prior to that which caused the PROTECTIVE DEVICE to operate or the MOTOR-COMPRESSOR to stall during the tests of Clause AA.5.

19.11.3 *Replacement:*

If the MOTOR-COMPRESSOR is classified as being protected by a PROTECTIVE ELECTRONIC CIRCUIT and if this PROTECTIVE ELECTRONIC CIRCUIT operates to ensure compliance with Clause 19 and Annex AA, the tests of 19.101, 19.102, 19.103 and Annex AA are repeated with a single fault simulated, as indicated in a) to g) of 19.11.2.

However, the test of Annex AA is not repeated if during the test of Annex AA, for MOTOR-COMPRESSORS classified as being tested with Annex AA, the MOTOR-COMPRESSOR PROTECTION SYSTEM did not operate. The test of Annex AA is also not repeated on MOTOR-COMPRESSORS that are classified as being tested without Annex AA.

19.11.4 *Addition:*

If the tests have to be carried out, they shall be carried out in the end product application.

NOTE 101 The application of these tests in this part 2 is not mandatory since they are conducted in the end product application.

19.13 *Addition:*

If the MOTOR-COMPRESSOR *is intended to use flammable refrigerants, and if during the tests of 19.11.2 and 19.11.3 any electrical component produced sparks or arcs, this shall be reported unless the component was an* INTENTIONALLY WEAK PART *or a* NON-SELF-RESETTING PROTECTIVE DEVICE*.*

19.14 *Replacement:*

MOTOR-COMPRESSORS *are operated under the conditions of Clause AA.1. Any contactor or relay contact that operates under the conditions of Clause AA.1 is short-circuited.*

If a relay or contactor with more than one contact is used, all contacts are short-circuited at the same time.

Any relay or contactor which operates only in order to ensure that the MOTOR-COMPRESSOR *is energized for normal use and that does not otherwise operate in normal use is not short-circuited.*

If more than one relay or contactor operates in Clause AA.1, each such relay or contactor is short-circuited in turn.

For MOTOR-COMPRESSORS *that use alternate start capacitors, the test shall be carried out using each alternate start capacitor in turn.*

The test is only performed on MOTOR-COMPRESSORS *classified as being tested with Annex AA.*

NOTE 1 For MOTOR-COMPRESSORS not classified as being tested with Annex AA, this test will be performed on the final product.

NOTE 2 If the MOTOR-COMPRESSOR has several modes of operation, the tests are carried out with the MOTOR-COMPRESSOR operating in each mode, if necessary.

19.101 *The* MOTOR-COMPRESSOR *and* MOTOR-COMPRESSOR PROTECTION SYSTEM*, together with all their associated components which operate under locked-rotor conditions, are connected in the circuit shown in Figure 101 and supplied with* RATED VOLTAGE *as specified in 5.8.2.*

NOTE 1 The associated components which comply with the requirements in Clause 24 are not evaluated by this test.

For MOTOR-COMPRESSORS *with a* NON-SELF-RESETTING THERMAL MOTOR-COMPRESSOR PROTECTION SYSTEM*, the* MOTOR-COMPRESSOR *is operated until a sufficient number of operations have been made to ensure that continuous automatic recycling does not occur. The number of operations should, however, not be less than three and should be performed as rapidly as possible with a minimum delay of 6 s.*

A longer off time is permitted if a delay feature longer than 6 s is part of the PROTECTION SYSTEM *or* CONTROL SYSTEM*.*

All electromechnical components of the PROTECTION SYSTEM *shall be tested individually for 50 operations in total with the* MOTOR-COMPRESSOR *or with a load corresponding to the actual* MOTOR-COMPRESSOR *or a higher load.*

For MOTOR-COMPRESSORS *with a* SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM*, the* MOTOR-COMPRESSOR PROTECTION SYSTEM *is allowed to cycle continuously for a period of 15 days or for at least 2 000 cycles, whichever is the longer.*

MOTOR-COMPRESSORS *without a* MOTOR-COMPRESSOR PROTECTION SYSTEM *and only protected by the impedance of the windings, are connected in the circuit shown in Figure 101 and supplied with rated voltage. If a* MOTOR-COMPRESSOR *is designed for more than one rated voltage it is tested at the highest voltage.*

At the conclusion of the first 72 h of the locked-rotor test, the MOTOR-COMPRESSOR *is subjected to the electric strength test as specified in 16.3.*

For MOTOR-COMPRESSORS *with a* SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM*, if 2 000 cycles of the protection system have not been performed by the end of the 15-day period, the test may be terminated provided the following conditions are met:*

– the HOUSING *temperature is recorded on the 12th and 15th days. If, during this three day period, the temperature has not increased by more than 5 K, the test can be terminated. If the temperature has increased by more than 5 K, the test is to be continued until the temperature has not increased by more than 5 K over a period of three consecutive days or for at least 2 000 cycles of the* MOTOR-COMPRESSOR PROTECTION SYSTEM*, whichever occurs first;*

– the components in the circuit comply with the requirements of clause 24 using at least the current and a power factor not exceeding that measured during the test.

NOTE 2 If a given MOTOR-COMPRESSOR, SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM COMBINATION is intended for use with more than one refrigerant, only one 15 day test is required, the choice of the refrigerant being made by the MOTOR-COMPRESSOR manufacturer.

NOTE 3 These test procedures can be modified, if necessary, to evaluate MOTOR-COMPRESSOR PROTECTION SYSTEMS which incorporate special or unique features.

MOTOR-COMPRESSORS *with a* SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM *and designed for more than one* RATED VOLTAGE *are also tested at the lowest voltage for 3 h.*

NOTE 4 A separate sample can be used for the test at the lowest voltage.

For MOTOR-COMPRESSORS where the design of the PROTECTION SYSTEM or CONTROL SYSTEM is such that the windings are de-energized permanently, the MOTOR-COMPRESSOR and MOTOR-COMPRESSOR PROTECTION SYSTEM (if any), together with all their associated components which operate under locked-rotor conditions, are re-energized. This procedure is repeated as rapidly as possible until 10 operations have been performed, with a minimum off time of 6 s. A longer off time is permitted if a delay feature longer than 6 s is part of the PROTECTION SYSTEM or CONTROL SYSTEM.

If the MOTOR-COMPRESSOR is designed for more than one rated voltage, the test is performed at all rated voltages.

If the MOTOR-COMPRESSOR is designed for a voltage range, the test is performed at the upper and lower voltage limit.

MOTOR-COMPRESSORS without a MOTOR-COMPRESSOR PROTECTION SYSTEM are left energized as described above for 15 days. The HOUSING temperature is recorded on the 12th and 15th days. If during these three days, the temperature has not increased by more than 5 K, the test can be terminated.

19.101DV DR *Add Clauses 19.101ADV.1 to 19.101ADV.5 to Clause 19.101 of the Part 2:*

19.101ADV.1 For MOTOR-COMPRESSORS with primary thermal protection, Clauses 19.101ADV.2 – 19.101ADV.4 shall be used. For MOTOR-COMPRESSORS with electronic protection, Clause 19.101ADV.5 shall be used.

19.101ADV.2 The value of locked-rotor current of a MOTOR-COMPRESSOR assembly as determined by test shall not exceed 110 % of the marked locked-rotor current rating.

19.101ADV.3 The locked-rotor current and voltage shall be measured 4 s after the MOTOR-COMPRESSOR assembly is energized in accordance with Clause 19.101. Values measured in less than 4 s are acceptable if the motor protective device operates within that time. If the MOTOR-COMPRESSOR is designed for more than one rated voltage or a voltage range, the test shall be performed using the higher RATED VOLTAGE.

19.101ADV.4 A calculation shall then be made by multiplying the locked-rotor current measured at 4 s by the MOTOR-COMPRESSOR rated voltage. This value shall then be divided by the voltage measured at 4 s and used for comparison to the marked locked-rotor current rating. For three-phase motors, the locked-rotor current and voltage at 4 s shall be the average of these values measured in each of the three supply lines.

19.101ADV.5 Motor-compressors intended to be controlled or protected by an electronic circuit shall be marked with MAXIMUM RATED CURRENT (MRC). This current shall be:

– The maximum current value as measured during Clause AA.4 testing; or

– The current rating of the motor-compressor controlling device if a PROTECTIVE ELECTRONIC CIRCUIT OR ELECTRONIC CIRCUIT is part of the controlling device.

19.102 *The test of 19.101 is repeated for one operation of a* NON-SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM *or 3 h minimum for* SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM *under the following conditions:*

– with start and run capacitors open-circuited one at a time;

– with start and run capacitors short-circuited one at a time, unless they have been tested and shown to comply with the requirements for protection class P2 capacitors of IEC 60252-1.

NOTE 1 The test with the capacitors open-circuited need not be conducted for MOTOR-COMPRESSORS where the open-circuited capacitors remove the start winding from the circuits.

NOTE 2 For MOTOR-COMPRESSORS with a SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM and which are designed for more than one RATED VOLTAGE, it is not necessary to repeat the test at the lowest voltage.

NOTE 3 This test can be performed on separate samples.

19.103 *Three-phase* MOTOR-COMPRESSORS *and the* MOTOR-COMPRESSOR PROTECTION SYSTEMS, *together with all their associated components which operate under locked-rotor conditions, are connected in a circuit similar to that shown in Figure 101, the circuit being appropriately modified for three-phase* MOTOR-COMPRESSORS. *They are supplied with* RATED VOLTAGE *but with one phase to the* MOTOR-COMPRESSOR *disconnected during the following periods:*

– for MOTOR-COMPRESSORS *with a* SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM, *for 3 h;*

– for MOTOR-COMPRESSORS *with a* NON-SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM, *until the first operation of the* MOTOR-COMPRESSOR PROTECTION SYSTEM.

– for MOTOR-COMPRESSORS *without a* MOTOR-COMPRESSOR PROTECTION SYSTEM *for 3 h.*

NOTE This test can be carried out on a separate sample.

19.104 *During the tests of 19.101, 19.102 and 19.103,*

– the MOTOR-COMPRESSOR PROTECTION SYSTEM *shall be able to operate;*

– the temperature of the HOUSING *and the temperature of the accessible surfaces of associated components shall not exceed 150 °C;*

– the residual current device shown in Figure 101 shall not operate;

– the MOTOR-COMPRESSOR, *its associated* STARTING RELAY *and* MOTOR-COMPRESSOR PROTECTION SYSTEM *shall not emit flames, sparks or molten metal.*

At the conclusion of the tests of 19.101, 19.103 and the test of 19.102 that is carried out with start and run capacitors open-circuited,

– enclosures shall not have deformed to such an extent as to impair compliance with clause 29;

– the MOTOR-COMPRESSOR PROTECTION SYSTEM *shall be able to operate;*

– the MOTOR-COMPRESSOR *shall withstand*

• the leakage current test as specified in 16.2, the test voltage being applied between the windings and the HOUSING;

• the electric strength test of 13.3 of Part 1.

If the test of 19.102 is carried out with start and run capacitors short-circuited one at a time, then at the conclusion of this test,

– enclosures shall not have deformed to such an extent as to impair compliance with Clause 29;

– the MOTOR-COMPRESSOR shall withstand

• the leakage current test as specified in 16.2, the test voltage being applied between the windings and the HOUSING;

• the electric strength test of 13.3 of Part 1;

– the MOTOR-COMPRESSOR PROTECTION SYSTEM shall be able to operate or it shall remain permanently open-circuited.

If the MOTOR-COMPRESSOR PROTECTION SYSTEM remains permanently open-circuited, the test of 19.102 with start and run capacitors short-circuited shall be repeated on three additional samples and all three additional samples shall remain permanently open-circuited at the conclusion of the test.

NOTE The test can be repeated on three new MOTOR-COMPRESSORS or by replacing, in the MOTOR-COMPRESSOR originally tested, the MOTOR-COMPRESSOR PROTECTION SYSTEM with one of the same type.

19.105 Three-phase MOTOR-COMPRESSORS shall be adequately protected against primary single-phase failure.

NOTE 1 Primary single-phase failure means that one of the three incoming lines to the primary of the transformer supplying the MOTOR-COMPRESSOR is disconnected.

Compliance is checked by the following test.

The MOTOR-COMPRESSOR is supplied from a star-delta or delta-star connected transformer with a line voltage ratio such that the output voltage is equal to the RATED VOLTAGE of the MOTOR-COMPRESSOR. The transformer is supplied with an input voltage such that the output voltage is equal to the RATED VOLTAGE of the MOTOR-COMPRESSOR. One phase of the supply to the input windings of the transformer is then disconnected so that maximum current flows in an unprotected winding of the MOTOR-COMPRESSOR.

The test is continued for the following periods:

– 24 h, for MOTOR-COMPRESSORS with a SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM;

– until the first operation of the protective system, for MOTOR-COMPRESSORS with a NON-SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM.

MOTOR-COMPRESSORS designed for more than one RATED VOLTAGE are tested at each voltage.

However, MOTOR-COMPRESSORS with a SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM and designed for more than one RATED VOLTAGE are tested at the highest voltage for 24 h and at the lowest voltage for 3 h.

NOTE 2 Separate samples can be used in testing MOTOR-COMPRESSORS designed for more than one RATED VOLTAGE, at each of their RATED VOLTAGES.

During the test,

– the temperature of the HOUSING and the temperature of the accessible surfaces of associated components shall not exceed 150 °C;

– the MOTOR-COMPRESSOR windings shall not be damaged;

– the MOTOR-COMPRESSOR and MOTOR-COMPRESSOR PROTECTION SYSTEM shall not emit flames, sparks or molten metal.

NOTE 3 MOTOR-COMPRESSOR windings are considered damaged if the windings open circuit or if the MOTOR-COMPRESSOR does not comply with the electric strength tests specifications. MOTOR-COMPRESSORS with a SELF-RESETTING MOTOR-COMPRESSOR PROTECTION SYSTEM are also considered damaged if there is a change in the relative distribution of currents during the test, or if currents measured at the conclusion of the test vary by more than 5 % from currents measured 3 h after the start of the test or on the first closure of the protective system following these 3 h.

Immediately following this test, the MOTOR-COMPRESSOR shall withstand the electric strength test of 16.3.

A three-phase MOTOR-COMPRESSOR is considered to meet the requirement for primary single-phase failure protection without tests other than those specified in 19.101, 19.102 and 19.103, if it is protected by one of the following devices:

– an overcurrent device, protecting each phase of its supply and which is provided with the MOTOR-COMPRESSOR or the rating of which is specified by the MOTOR-COMPRESSOR manufacturer;

– a MOTOR-COMPRESSOR PROTECTION SYSTEM, responsive to motor current, installed symmetrically at the centre point of a star-connected MOTOR-COMPRESSOR and which simultaneously opens at least two windings;

– a MOTOR-COMPRESSOR PROTECTION SYSTEM, located in each winding of the MOTOR-COMPRESSOR, which activates pilot duty contacts controlling the supply to the coil of the MOTOR-COMPRESSOR supply contactor and which is responsive to at least one of the following:

- *MOTOR-COMPRESSOR current,*
- *MOTOR-COMPRESSOR temperature.*

19.105DV D1 *Modification by adding the following after the third paragraph:*

As an alternate test method, two of the MOTOR-COMPRESSOR windings shall be connected together to form a single line. A single-phase supply source rated at 0,866 of the RATED VOLTAGE of the MOTOR-COMPRESSOR shall be applied to the single line (formed from the two windings) and the remaining line (from the remaining winding) so that maximum current flows in an unprotected winding of the MOTOR-COMPRESSOR.

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable.

21.1DV D2 *Modification by adding the following Note to Clause 21.1DV of the Part 1:*

NOTE For the alternative test of Clause 21.1DV.1 in Part 1, a force of 6,8 J might be required by some existing North American final application product standards. The 6,8 J value would be employed to evaluate a non-metallic enclosure cover if additional protection was not afforded by final application equipment design.

21.101DV D1 *Add the following clause to Clause 21 of the Part 1:*

If electrical enclosure seal gaskets are required to comply with the tests of Clause 15, then they shall comply with Annex 101.DVA.

22 Construction

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

22.2 Not applicable.

22.5 Not applicable.

22.7 *Replacement:*

HOUSINGS shall withstand the pressure expected in normal use.

Compliance is checked by the following tests.

A HOUSING which is exposed to high side pressure, including those in a MOTOR-COMPRESSOR incorporating a bypass valve, shall be subjected to a pressure equal to:

– for subcritical refrigeration systems other than those using R-744, 3,5 times the saturated vapour pressure of the refrigerant at 70 °C, the test pressure being rounded up to the next 0,5 MPa (5 bar);

– for R-744 subcritical refrigeration systems, 3,5 times the saturated vapour pressure of the refrigerant at 27 °C, rounded up to the next 0,5 MPa (5 bar).

NOTE 101 Example of test pressure calculation for R-22 (subcritical):

Saturated vapour pressure at 70 °C (gauge with respect to atmospheric pressure at STP) = 2,89 MPa (28,9 bar)

Test pressure = 3,5 × 2,89 MPa (28,9 bar)

= 10,1 MPa (101 bar)

= 10,5 MPa (105 bar) when rounded up to the next 0,5 MPa (5 bar).

– for transcritical refrigeration systems, the highest of:

- *3 times the DESIGN PRESSURE; or*
- *the test pressure declared by the manufacturer; or*
- *the test pressure specified in Table 101.*

The test values for some refrigerants are given in Table 101. For refrigerants not mentioned, the saturated vapour pressure at the temperatures detailed is obtained from refrigerant vapour pressure curves supplied by the refrigerant manufacture.

Table 101 – Minimum high side test pressures

Refrigerant formulae	Refrigerant number	Test pressure	
		MPa	(bar)
Subcritical			
CCl_2F_2	R-12	6,5	(65)
CF_3CH_2F	R-134a	7,5	(75)
$CHClF_2$	R-22	10,5	(105)
CH_2F_2	R-32	17,0	(170)
$CH_3CH_2CH_3$	R-290	9,0	(90)
$CF_3CF=CH_2$	R-1234yf	7,0	(70)
$CF_3CH=CHF$	R-1234ze	5,5	(55)
$CH(CH_3)_3$	R-600a	3,5	(35)
CO_2	R-744	23,5	(235)
by weight 73,8 % R-12 + 26,2 % R-152a	R-500	7,5	(75)
by weight 48,8 % R-22 + 51,2 % R-115	R-502	11,0	(110)
by weight 44 % R-125 + 52 % R-143a + 4 % R-134a	R-404A	12,5	(125)
by weight 50 % R-125 + 50 % R-143a	R-507A	12,5	(125)
by weight 25 % R-125 + 52 % R-134a + 23 % R-32	R-407C	11,0	(110)
by weight 50 % R-125 + 50 % R-32	R-410A	16,5	(165)
Transcritical			
CO_2	R-744	42	(420)

NOTE The refrigerant test pressure data is based on NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1.

In subcritical applications, a HOUSING *which is exposed to low side pressure, including those in a* MOTOR-COMPRESSOR *incorporating a bypass valve, shall be subjected to a test pressure equal to*

– for subcritical applications, other than those using R-744, the higher of

- *5 times the saturated vapour pressure of the refrigerant at 20 °C rounded up to the next 0,2 MPa (2 bar); or*
- *2,5 MPa (25 bar);*

– for subcritical applications, using R-744, 5 times the saturated vapour pressure of the refrigerant at -6,5 °C rounded up to the next 0,2 MPa (2 bar).

In TRANSCRITICAL REFRIGERATION SYSTEMS, *a* HOUSING *which is exposed only to low side pressure shall be subjected to a test pressure that is equal to the highest of*

- *5 times the* DESIGN PRESSURE*; or*
- *5 times the saturated vapour pressure of the refrigerant at 20 °C rounded up to the next 0,2 MPa (2 bar); or*
- *2,5 MPa (25 bar); or*

• the test pressure specified in Table 102.

The test values for some refrigerants are given in Table 102. For refrigerants not mentioned, the saturated vapour pressure at the temperatures detailed is obtained from refrigerant vapour pressure curves supplied by the refrigerant manufacture.

NOTE 102 Example of test pressure calculation for R-22 (subcritical):

Saturated vapour pressure at 20 °C (gauge with respect to atmospheric pressure at STP) = 0,81 MPa (8,1 bar)

Test pressure = 5 × 0,81 MPa (8,1 bar)

= 4,05 MPa (40,5 bar)

= 4,2 MPa (42 bar) when rounded up to the next 0,2 MPa (2 bar).

Table 102 – Minimum low side test pressures

Refrigerant formulae	Refrigerant number	Test pressure	
		MPa	(bar)
Subcritical			
CCl_2F_2	R-12	2,4	(24)
CF_3CH_2F	R-134a	2,4	(24)
$CHClF_2$	R-22	4,2	(42)
CH_2F_2	R-32	7,0	(70)
$CH_3CH_2CH_3$	R-290	3,8	(38)
$CF_3CF=CH_2$	R-1234yf	2,6	(26)
$CF_3CH=CHF$	R-1234ze	1,8	(18)
$CH(CH_3)_3$	R-600a	1,0	(10)
CO_2	R-744	14,2	(142)
by weight 73,8 % R-12 + 26,2 % R-152a	R-500	3,0	(30)
by weight 48,8 % R-22 + 51,2 % R-115	R-502	4,6	(46)
by weight 44 % R-125 + 52 % R-143a + 4 % R-134a	R-404A	5,0	(50)
by weight 50 % R-125 + 50 % R-143a	R-507A	5,2	(52)
by weight 25 % R-125 + 52 % R-134a + 23 % R-32	R-407C	4,0	(40)
by weight 50 % R-125 + 50 % R-32	R-410A	6,8	(68)
Transcritical			
CO_2	R-744	28,2	(282)

NOTE The refrigerant test pressure data is based on NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1.

NOTE 103 Further information relating to refrigerant number designations can be obtained from ISO 817.

For refrigerant blends, the saturated vapour pressure is taken as the pressure at the dew point temperature of 20 °C and 70 °C for low and high side respectively.

For two stage MOTOR-COMPRESSORS *with direct discharge from the second stage, the* HOUSING *is considered to be exposed to low side pressure.*

For two stage MOTOR-COMPRESSORS *without direct discharge from the second stage, the* HOUSING *is considered to be exposed to high side pressure.*

The test shall be carried out on two samples. The test samples are filled with a liquid, such as water, to exclude air and are connected in a hydraulic pump system. The pressure is raised gradually until the required test pressure is reached. This pressure is maintained for 1 min during which time the sample shall not leak except as indicated below.

Where gaskets are employed for sealing the HOUSING *of a* SEMI-HERMETIC MOTOR-COMPRESSOR*, leakage at gaskets is not considered as a failure, provided the leakage occurs at a pressure greater than 40 % of the required test pressure.*

If a leakage occurs, the test has to be repeated on a sample specially prepared by the manufacturer to avoid leakage at the gasket.

For a SEMI-HERMETIC MOTOR-COMPRESSOR *employing a bypass valve which relieves high side pressure into the low side at a predetermined pressure differential, the* HOUSING *shall be capable of withstanding the required test pressure even though leakage occurs at gaskets.*

NOTE 104 All pressures are gauge pressures.

22.9 *Addition:*

Insulating materials used within the HOUSING shall be compatible with the refrigerant and oil used.

For the types of refrigerant and types of oil for which the MOTOR-COMPRESSOR *is intended to be used, compliance of winding wire insulation shall be checked by the tests detailed in Annex BB or* MOTOR-COMPRESSORS *that do not use oil by test 16 in IEC 60851-4 for resistance to refrigerants.*

For test 16 in IEC 60851-4, the percentage of extractable matter shall not exceed 0,5 %. The breakdown voltage shall be at least 75 % of the minimum specified value.

For the types of refrigerant and types of oil for which the MOTOR-COMPRESSOR *is intended to be used, compliance of tie cords and insulation materials other than winding wire insulation shall be checked by the tests detailed in Annex CC.*

22.14 Not applicable.

22.21 *Addition:*

NOTE 101 The requirement is applicable only to external parts of the MOTOR-COMPRESSOR.

22.101 Where a MOTOR-COMPRESSOR used in a TRANSCRITICAL REFRIGERATION SYSTEM includes a PRESSURE RELIEF DEVICE in the high side or discharge piping of the MOTOR-COMPRESSOR, there shall be no other shut off devices or system components except piping located between the MOTOR-COMPRESSOR and PRESSURE RELIEF DEVICE which could introduce a pressure drop.

NOTE The required PRESSURE RELIEF DEVICE could be installed by either the MOTOR-COMPRESSOR manufacturer or the appliance manufacturer.

Compliance is checked by inspection.

22.102DV D1 *Add the following clause to Clause 22 of the Part 1:*

Motor-compressors intended to be used with A2 or A3 classified refrigerants shall be of a hermetically sealed design construction with a leakage rate of 3 grams per year or less.

The leakage rate shall be measured by filling the MOTOR-COMPRESSOR HOUSING with helium to a pressure of not less than one-third of the pressure applied during the testing conducted under Clause 22.7 or Annex 101.DVG. A mass spectrometer shall be used to determine the leakage rate.

22.103DV DR *Add the following clause to Clause 22 of the Part 1:*

A positive displacement compressor operating at pressures exceeding 103 kPa and having a displacement exceeding 0,02 m^3/s shall be equipped with a PRESSURE RELIEF DEVICE having the capacity and the pressure setting necessary to prevent rupture of the compressor. The pressure relief device shall be located between the compressor and stop valve on the discharge side. Discharge from the device may be vented to the atmosphere or into the low pressure side of the system.

22.104DV DR *Add the following clause to Clause 22 of the Part 1:*

A pressure relief device shall comply with the applicable national pressure code. The device shall have a nameplate providing any applicable code symbol, together with the set pressure and capacity.

23 Internal wiring

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

23.8 *Addition:*

NOTE 101 This does not apply to wiring inside the HOUSING.

24 Components

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

24DV DC *Modification to replace Clause 24 of the Part 2 with the following:*

Except for 24.1.4, 24.1.4DV, 24.101, and 24.102DV, component requirements are replaced by the relevant component standards in Annex DVA. A component not complying with a Standard in Annex DVA shall be evaluated using the applicable component standard. If a standard does not exist for a component, then the component shall comply with requirements in this standard as far as they reasonably apply.

24.1.4 *Addition:*

– *STARTING RELAY*	*100 000*
– *SELF-RESETTING THERMAL MOTOR-PROTECTORS for MOTOR-COMPRESSORS**	*2 000**
– *NON-SELF RESETTING THERMAL MOTOR-PROTECTORS for MOTOR-COMPRESSORS*	*50*

* 2 000 or the number of operations during the 15 day locked-rotor test of 19.101, whichever is the greater.

24.1.4DV D1 *Modification to Clause 24.1.4 in the Part 2 to add the following:*

– Compressor pressure bypass valves 30 000**

**** Tested per the requirements of Annex 101.DVD.**

24.101 In MOTOR-COMPRESSORS that employ flammable refrigerants, components that may arc or spark during NORMAL OPERATION of the end product shall comply with the requirements of IEC 60079-15, as modified by Annex DD, for group IIA gases or the refrigerant used. This requirement is not applicable to components within the HOUSING.

Compliance is checked by inspection and the appropriate tests of IEC 60079-15.

24.102DV D1 *Add Clauses 24.102DV.1 to 24.102DV.3 to the Part 1:*

24.102DV.1 A controller that is included as an integral assembly of the MOTOR-COMPRESSOR, and which is required to break a motor load under locked-rotor conditions, shall have a current-interrupting capacity not less than the locked-rotor load of the motor controlled.

24.102DV.2 An external thermal protective device employed on a motor-compressor shall withstand short circuit conditions in accordance with the Limited short-circuit test described in Clause 27.7DV.1.5 to 27.7DV.1.7 of Part 1. The short circuit tests on the protective device may be waived if:

– the thermally protected motor or separately enclosed motor overload protective device is within an outer cabinet of a product or section of a product;

– the motor or device is intended to be protected by the overcurrent protective device as specified on the unit nameplate, or provided as part of the product, and which is acceptable for the branch circuit protection;

– the assembly is constructed so that flame and molten metal will be confined within the compressor terminal enclosure; or

– combustible material, except electrical insulation or an air filter, is not located below the motor.

24.102DV.3 Three samples of each component shall be subjected to each test condition, and a new protective device shall be used for each test. The components shall withstand short-circuit conditions described in Table 27DV.3 of the Part 1 when protected by an overcurrent protective device that is suitable for branch-circuit protection. The devices shall be of the type and rating as specified in Clause 27.7DV.1.8 of the Part 1. There shall be no damage to conductors or their terminations, no ignition of cheesecloth or cotton surrounding the enclosure housing the components under test, and no arc over between hazardous voltage and extra-low-voltage circuits.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable, except as follows, only if so required by the classification of 6.102.

25.1 *Addition:*

– a set of terminals allowing the connection of a SUPPLY CORD.

25.7 Not applicable.

26 Terminals for external conductors

This clause of Part 1 is applicable only if so required by the classification of 6.102.

27 Provision for earthing

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

27.1 *Addition:*

An earthing terminal is required only if the MOTOR-COMPRESSOR is classified in accordance with 6.102 as being intended for direct connection of the appliance SUPPLY CORD to the MOTOR-COMPRESSOR terminals.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

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

29.1 *Addition:*

Except as specified in 29.1.1 and 29.1.4, CLEARANCES less than those specified in Table 16 are not allowed for BASIC INSULATION and FUNCTIONAL INSULATION inside the HOUSING.

For a RATED VOLTAGE > 300 V and ≤ 346 V the rated impulse voltage is for

– overvoltage category I: 2 500 V;

– overvoltage category II: 4 000 V;

– overvoltage category III: 6 000 V.

29.1.1 *Addition:*

CLEARANCES inside the HOUSING shall not be less than 1,0 mm for a rated impulse voltage of 1 500 V.

29.1.4 *Addition:*

CLEARANCES inside the HOUSING are reduced by 0,5 mm for rated impulse voltages of 2 500 V or more. Between winding wires and winding leads for motors or THERMAL MOTOR PROTECTORS, no minimum CLEARANCE is specified.

29.2 *Addition:*

Pollution degree 1 applies inside the HOUSING.

29.2.1 *Modification:*

Add the following to Note 2 in Table 17:

This does not apply to glass insulated terminals where corrosion protection extends over the glass.

29.2.4 *Modification:*

Add the following to Note 2 in Table 18:

This does not apply to glass insulated terminals where corrosion protection extends over the glass.

29.3.4 *Addition:*

For a RATED VOLTAGE > 300 V and ≤ 346 V the minimum thickness for accessible parts of REINFORCED INSULATION consisting of a single layer is for

– *overvoltage category I: 0,6 mm;*

– *overvoltage category II: 1,2 mm;*

– *overvoltage category III: 1,5 mm.*

NOTE 101 For multi-phase appliances, the line to neutral or line to earth voltage is used for RATED VOLTAGE.

30 Resistance to heat and fire

This clause of Part 1 is applicable only to non-metallic and insulating materials which are outside the HOUSING except as follows.

30.2.2 Not applicable.

30.101DV D2 *Add the following clause to Clause 30 of the Part 1:*

Polymeric enclosures that contain exposed uninsulated live parts shall:

a) Have a 5VA flammability rating when tested in accordance with IEC 60695-11-20; or

b) Comply with the 5VA Classification in Table 2 of IEC 60695-11-20 except that the V-0 or V-1 classification is not applicable. Five samples shall be subjected to the test procedure in 8.1 and 8.2 of IEC 60695-11-20 except that actual polymeric enclosure samples shall be used. Each test sample shall be mounted as intended for service, the flame being applied to any interior portion of the sample judged likely to be ignited. Each sample shall be tested with the flame applied to a different location. The apparatus in Clause 6 of IEC 60695-11-20 shall be used

30.102DV D1 *Add Clauses 30.102DV.1 to 30.102DV.5 to the Part 1:*

30.102DV.1 A starting relay of positive coefficient resistor (PTCR) type shall comply with testing as described in Clauses 30.102DV.2 – 30.102DV.5. As a result of the test, there shall be no charred or burned fibers of the cheesecloth. Smoke discoloration is acceptable. Thirty samples shall be tested.

30.102DV.2 The PTCR starting relay assembly shall be assembled to the motor-compressor, and the entire outer surface of the PTCR starting relay enclosure shall be covered by a single layer of cheesecloth. The cheesecloth panels shall be held in close contact with the external surfaces of the enclosure and adjacent surfaces of the compressor shell.

30.102DV.3 With the PTCR starting relay assembly at rated voltage, the voltage shall be increased in 50 V increments every 2 minutes until the starting relay changes from a low resistance state to the high resistance state. If the voltage at which this occurs:

– Is less than three times the PTCR starting relay rated voltage, then the voltage shall be increased at the same rate until three times the starting relay rated voltage is reached. This voltage shall be held for not less than 6 minutes.

– Equals or exceeds three times the PTCR starting relay rated voltage, then this voltage shall be held for not less than 6 minutes.

The voltage to the PTCR starting relay shall then be increased at the same rate until the PTCR opens or short circuits, or the PTCR enters a negative temperature coefficient (NTC) zone with a thermal runaway. When one of these conditions occurs, the voltage shall be maintained for an additional 2 minutes. No ignition of the cheesecloth shall occur during any part of this test.

NOTE The PTCR change of state will occur when the voltage level exceeds the withstand voltage of the starting relay.

30.102DV.4 The test shall be considered completed if the PTCR fractures and results in an open circuit without igniting the cheesecloth during this phase of the test. If a fractured PTCR does not result in an open circuit, it must comply with Clause 30.102DV.5.

30.102DV.5 If the testing of Clause 30.102DV.3 and 30.102DV.4 does not result in an open circuit of the starting relay, then the starting relay shall be connected in series with a resistive load that allows the maximum continuous current to be applied through the starting relay when applying rated voltage. Rated voltage shall be applied until the circuit opens, untill the cheesecloth burns, or for a minimum of 8 hours. If ignition of the cheesecloth occurs, the fire shall be extinguished as soon as possible. A self-resetting thermal motor-protector may operate during the test.

NOTE The compressor windings are removed from the circuit and instead a resistive load is used to ensure the maximum continuous current value.

31 Resistance to rusting

This clause of Part 1 is applicable only to parts which are outside the HOUSING.

31.101DV D2 *Add Clauses 31.101DV.1 to 31.101DV.3 to the Part 1:*

31.101DV.1 Motor-compressor electrical enclosures intended for outdoor exposure shall comply with the following:

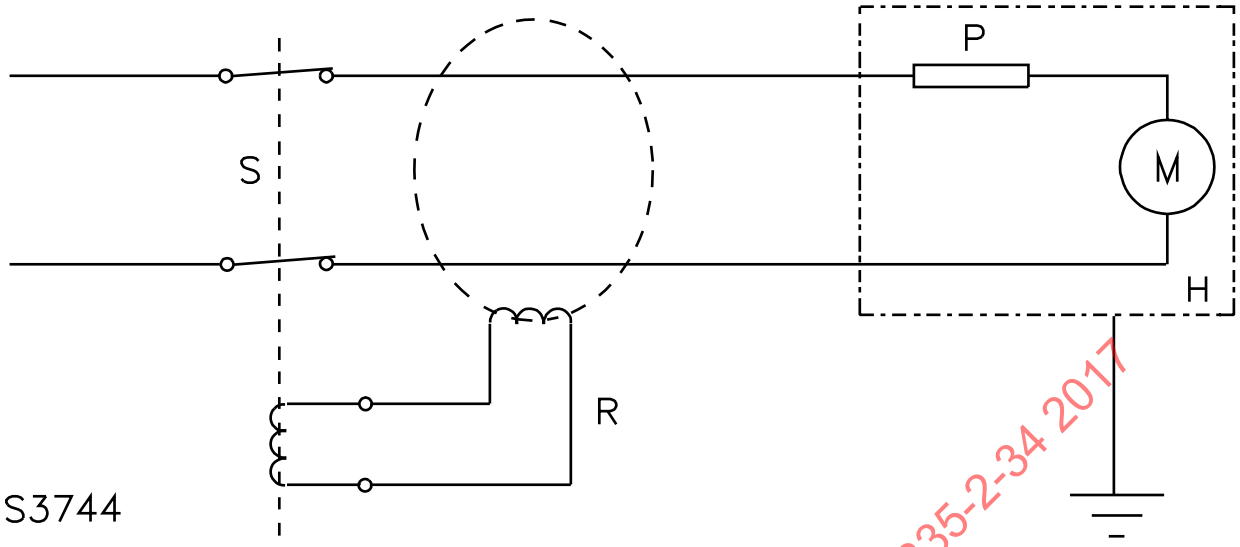
Compliance shall be checked by the salt mist test of IEC 60068-2-52, severity 2 being applicable. Before the test, coatings shall be scratched by means of a hardened steel pin, the end of which has the form of a cone with an angle of 40°. Its tip shall be rounded with a radius of 0,25 mm ± 0,02 mm. The pin shall be loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches shall be made by drawing the pin along the surface of the coating at a speed of approximately 20 mm/s. Five scratches shall be made at least 5 mm apart and at least 5 mm from the edges. After the test, the appliance shall not have deteriorated to such an extent that compliance with this standard, in particular with Clauses 8 and 27, is impaired. The coating shall not be broken and shall not have loosened from the metal surface.

31.101DV.2 As an alternate, compressor metal electrical enclosures that are intended for outdoor use may be protected against corrosion with a coating designation G90 per ASTM A90/A90M or by other metallic or non-metallic coatings that provide equivalent protection.

31.101DV.3 The compressor HOUSING shall be protected by an organic or equivalent type coating.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is not applicable.



Key

S Supply

H HOUSING

R Residual current device that can detect a.c. or a.c. with d.c. components, max. $I_{\Delta n}$ = 30 mA r.m.s. or d.c. max. $I_{\Delta n}$ = 30 mA

P MOTOR-COMPRESSOR PROTECTION SYSTEM (external or internal)

M MOTOR-COMPRESSOR

Figure 101 – Supply circuit for the locked-rotor test of a single-phase motor-compressor

Annexes

The annexes of Part 1 are applicable, except as follows:

Annex C
(normative)
Ageing test on motors

This annex of Part 1 is not applicable.

Annex D
(normative)
Thermal motor protectors

This annex of Part 1 is not applicable.

Annex AA
(normative)
Running overload tests for motor-compressors classified as tested with Annex AA

AA.1 Unless otherwise stated, the tests in this annex are only applied if the MOTOR-COMPRESSOR is classified as being tested with Annex AA according to 6.101.

Excluding starting current, the maximum value of the current averaged over any 5 min period is recorded. The interval between current measurements shall not exceed 30 s. The starting current is considered to be excluded if the first current measurement is made approximately 1 min after starting.

NOTE 1 The current is recorded to aid in checking reproducibility of test results.

Before testing in accordance with this annex is started, it shall be verified that the MOTOR-COMPRESSOR is in working order by applying the test of 16.3 and then by operating it in a substitute refrigeration circuit

– under the conditions specified in Table AA.1 but at RATED VOLTAGE; or

– the maximum load – maximum cooling conditions specified in Table AA.2;

as appropriate for a period of not less than 2 h.

If the MOTOR-COMPRESSOR PROTECTION SYSTEM or MOTOR-COMPRESSOR CONTROL SYSTEM contains an ELECTRONIC CIRCUIT the tests in Clauses AA.4 and AA.5 are to be conducted, otherwise, the tests in Clauses AA.2 and AA.3 are to be conducted. If two stage MOTOR-COMPRESSORS are to be tested in accordance with Clauses AA.2 and AA.3, they have to be tested under the most onerous conditions of operation.

NOTE 2 For most applications of MOTOR-COMPRESSORS, it is possible to simulate an actual refrigerant circuit and its corresponding effect on the MOTOR-COMPRESSOR operation, by the use of a calorimeter or substitute refrigeration circuit (see Figure AA.1 for such a typical circuit). By so doing, it is possible to determine the maximum motor temperature that would be attained with a given MOTOR-COMPRESSOR/MOTOR-COMPRESSOR PROTECTION SYSTEM combination.

NOTE 3 The temperatures of the MOTOR-COMPRESSOR are affected by the varying parameters of suction pressure, discharge pressure, return gas temperature, MOTOR-COMPRESSOR ambient temperature and amount of air movement over the MOTOR-COMPRESSOR. It is generally possible to simulate the maximum conditions that will be imposed by a general class of appliances, with a calorimeter or substitute refrigeration circuit.

NOTE 4 On those refrigerator and freezer applications that employ additional cooling means, such as an injection cooler or an oil cooler tube in the MOTOR-COMPRESSOR, to reduce the motor temperature in cases where the temperature limits specified in Clause AA.2 would otherwise be exceeded, tests in the actual application can be required, as the exact effect of the additional cooling means may not be able to be simulated.

NOTE 5 As the MOTOR-COMPRESSOR PROTECTION SYSTEM is the motor temperature limiting device, measuring the motor temperature at the ultimate trip point is all that is required to establish the maximum motor winding temperature.

NOTE 6 If the motor winding temperature of the MOTOR-COMPRESSOR does not exceed the maximum value specified in Clause AA.3 and Clause AA.5 when tested in accordance with its APPLICATION CATEGORY as indicated in Table AA.1, the MOTOR-COMPRESSOR/ MOTOR-COMPRESSOR PROTECTION SYSTEM combination is considered as meeting the requirements for motor winding temperatures in related standards, such as IEC 60335-2-11, IEC 60335-2-24, IEC 60335-2-40, IEC 60335-2-75 and IEC 60335-2-89.

NOTE 7 Fixed speed MOTOR-COMPRESSORS that are tested in accordance with Clauses AA.4 and AA.5 need only be tested at the fixed speed since there are no minimum and maximum cooling conditions.

AA.1DV D1 *Addition of Clause AA.1DV.1 and Table AADV.1 as follows:*

AA.1DV.1 If a compressor is not able to be tested to the conditions set forth in Tables AA.1 and AA.2, testing can be completed using the optional test conditions in Table AADV.1. A compressor tested to the optional test conditions shall be deemed to comply with Annex AA.

Table AADV.1 – Optional test conditions

Test conditions	Evaporation temperature °C	Condensation temperature °C	Motor-compressor ambient temperature °C	Return gas temperature °C
1	–25	+55	+43	+43
2	–25	+60	+43	+43
3	–15	+65	+43	+43
4	–0	+65	+43	+25
5	+15	+65	+43	+25
6	+30	+70	+43	+43

AA.2 *The* MOTOR-COMPRESSOR *including the* MOTOR-COMPRESSOR PROTECTION SYSTEM *or* MOTOR-COMPRESSOR CONTROL SYSTEM*, if any, is connected to the substitute refrigeration circuit of Figure AA.1 and operated under the appropriate conditions given in Table AA.1 for tests 1 and 2. However, for R-744 refrigerant intended for use in a* TRANSCRITICAL REFRIGERATION SYSTEM*, for all tests the maximum operating discharge pressure is 12 MPa and the return gas temperature is +25 °C. The tests are continued until steady conditions are reached. If the* MOTOR-COMPRESSOR *cooling capacity is variable, the tests are carried out at maximum and minimum cooling conditions.*

NOTE 1 Special arrangements for the MOTOR-COMPRESSOR CONTROL SYSTEM can be needed in order to obtain the maximum value of the cooling capacity.

NOTE 2 Steady conditions are considered to be obtained when three successive readings of the temperature, taken at approximately 10 min intervals, at the same point of any operating cycle, do not differ by more than 1 K.

Table AA.1 – Substitute refrigeration circuit conditions for operating under running overload conditions

Test number	Applied voltage	Application category	Evaporation temperature °C	Condensation temperature °C	Motor-compressor ambient temperature °C	Return gas temperature °C
1	1,06 RATED VOLTAGE	Low back pressure – max. cooling	–15	+65	+43	+43
1	1,06 RATED VOLTAGE	Low back pressure – min. cooling	–15	+65	+43	+43
1	1,06 RATED VOLTAGE	Medium back pressure – max. cooling	0	+65	+43	+25
1	1,06 RATED VOLTAGE	Medium back pressure – min. cooling	0	+65	+43	+25
1	1,06 RATED VOLTAGE	High back pressure – max. cooling	+15	+65	+43	+25
1	1,06 RATED VOLTAGE	High back pressure – min. cooling	+15	+65	+43	+25
2	0,94 RATED VOLTAGE	Low back pressure – max. cooling	–15	+65	+43	+43
2	0,94 RATED VOLTAGE	Low back pressure – min. cooling	–15	+65	+43	+43
2	0,94 RATED VOLTAGE	Medium back pressure – max. cooling	0	+65	+43	+25
2	0,94 RATED VOLTAGE	Medium back pressure – min. cooling	0	+65	+43	+25
2	0,94 RATED VOLTAGE	High back pressure – max. cooling	+15	+65	+43	+25
2	0,94 RATED VOLTAGE	High back pressure – min. cooling	+15	+65	+43	+25
3	0,85 RATED VOLTAGE	Low back pressure – max. cooling	–15	+65	+43	+43
3	0,85 RATED VOLTAGE	Low back pressure – min. cooling	–15	+65	+43	+43
3	0,85 RATED VOLTAGE	Medium back pressure – max. cooling	0	+65	+43	+25
3	0,85 RATED VOLTAGE	Medium back pressure – min. cooling	0	+65	+43	+25
3	0,85 RATED VOLTAGE	High back pressure – max. cooling	+15	+65	+43	+25
3	0,85 RATED VOLTAGE	High back pressure – min. cooling	+15	+65	+43	+25

NOTE For R-744 refrigerant intended for use in a non-TRANSCRITICAL REFRIGERATION SYSTEM, for all tests the evaporation temperature is –15 °C, the condensation temperature is +20 °C , the MOTOR COMPRESSOR ambient temperature is +43 °C and the return gas temperature is +2 °C.

NOTE 3 The tolerances on the temperatures in Table AA.1 are ±2 K for the MOTOR-COMPRESSOR ambient temperature, condensation and return gas temperatures, and ±1 K for the evaporation temperature.

NOTE 4 For some MOTOR-COMPRESSORS, an injection cooler or an oil cooler and air flow over the MOTOR-COMPRESSOR can be required as recommended by the MOTOR-COMPRESSOR manufacturer.

NOTE 5 The evaporation and condensation temperatures relate to the corresponding saturated vapour pressures of the refrigerant in use, and are measured by means of the pressure gauges as ″suction″ and ″discharge″ respectively in Figure AA.1. For refrigerant blends, the saturated vapour pressure is taken as the pressure at the dew point temperature.

NOTE 6 The return gas temperature is measured by means of a thermocouple, situated in the suction line at point A as shown in Figure AA.1.

NOTE 7 The test is carried out at a 43 °C ambient temperature so as to produce an overload on the MOTOR-COMPRESSOR. It is not intended that this be the reference ambient temperature for the temperature rises given in Table 3 of Part 1.

During tests 1 and 2,

– the temperature rises are measured and shall not exceed the values given in the Table 3 of Part 1 reduced by 7 K;

– the MOTOR-COMPRESSOR PROTECTION SYSTEM shall not operate to disconnect the MOTOR-COMPRESSOR from the supply;

– the temperature of the HOUSING and the temperature of the accessible surfaces of associated components shall not exceed 150 °C.

NOTE 8 The requirements in Table 3, regarding winding temperatures of the different insulation classes are not applicable to the windings of MOTOR-COMPRESSORS.

AA.3 *Immediately after the tests of Clause AA.2, the* MOTOR-COMPRESSOR *including the* MOTOR-COMPRESSOR PROTECTION SYSTEM *or* MOTOR-COMPRESSOR CONTROL SYSTEM, *if any, is operated under the appropriate conditions given in Table AA.1 for test 3 so as to cause the* MOTOR-COMPRESSOR PROTECTION SYSTEM *to operate or to reach steady conditions with the* MOTOR-COMPRESSOR *in the stalled or running condition.*

During test 3, if the MOTOR-COMPRESSOR PROTECTION SYSTEM *does not operate, the voltage is reduced in steps of 4 % ± 1 % of the* RATED VOLTAGE, *at a rate of approximately 2 V/min, until steady conditions are reached at each step. This procedure is continued until one of the following conditions occurs:*

– the MOTOR-COMPRESSOR *protection system operates;*

– the MOTOR-COMPRESSOR *stalls and steady conditions are reached.*

NOTE 1 If the cooling capacity is influenced by the adjustment of the voltage, the MOTOR-COMPRESSOR CONTROL SYSTEM is not adjusted during the test in an attempt to maintain the cooling capacity as it was when the test was started.

In neither of these conditions shall the MOTOR-COMPRESSOR *winding temperature exceed 160 °C for* MOTOR-COMPRESSORS *with synthetic insulation and 150 °C for* MOTOR-COMPRESSORS *with cellulosic insulation.*

NOTE 2 The resistance of the windings at the end of the test can be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

If the MOTOR-COMPRESSOR is of the single-phase type with an internally mounted MOTOR-COMPRESSOR PROTECTION SYSTEM, the combined resistance of the main winding and start winding, in series, is used. If the MOTOR-COMPRESSOR is of the three-phase type with an internally mounted MOTOR-COMPRESSOR PROTECTION SYSTEM, it will be necessary to first establish the trip point then re-run the test and measure the resistance after shut-down, just prior to the MOTOR-COMPRESSOR PROTECTION SYSTEM tripping. A continuous resistance recording technique may be used if the temperatures correlate properly with those obtained by the shut-down resistance method.

AA.4 *The* MOTOR-COMPRESSOR *including the* MOTOR-COMPRESSOR PROTECTION SYSTEM *and* MOTOR-COMPRESSOR CONTROL SYSTEM, *if any, is connected to the substitute refrigeration circuit of Figure AA.1 and operated under the appropriate conditions given in Table AA.2. However, for R-744 refrigerant intended for use in a* TRANSCRITICAL REFRIGERATION SYSTEM, *for all tests the operating discharge pressure is 12 MPa and for test 4 the return gas temperature is +25 °C. The tests are continued until steady conditions are reached.*

Table AA.2 – Substitute refrigeration circuit conditions for operating under maximum load conditions

Test number	Applied voltage	Back pressure application category	Evaporation temperature °C	Condensation temperature °C	Motor-compressor ambient temperature °C	Return gas temperature °C
4	RATED VOLTAGE	Low back pressure – max. load – max. cooling	–15	+65	+43	+43
5	RATED VOLTAGE	Low back pressure – min. load – max. cooling	–35	+49	+43	+25
4	RATED VOLTAGE	Medium back pressure – max. load – max. cooling	0	+65	+43	+25
5	RATED VOLTAGE	Medium back pressure – min. load – max. cooling	–20	+55	+43	+25
4	RATED VOLTAGE	High back pressure – max. load – max. cooling	+15	+65	+43	+25
5	RATED VOLTAGE	High back pressure – min. load – max. cooling	–5	+55	+43	+25

During tests 4 and 5,

– the temperature rises of the MOTOR-COMPRESSOR CONTROL SYSTEM *and the* MOTOR-COMPRESSOR PROTECTION SYSTEM *containing* ELECTRONIC COMPONENTS *are measured and shall not exceed the values given in Table 3 of Part 1, reduced by 7 K;*

– the PROTECTIVE DEVICE *shall not operate to disconnect the* MOTOR-COMPRESSOR *from the supply;*

– the temperature of the HOUSING *and the temperature of the accessible surfaces of associated components shall not exceed 150 °C.*

NOTE 1 Steady conditions are considered to be obtained when three successive readings of the temperature, taken at approximately 10 min intervals, at the same point of any operating cycle, do not differ by more than 1 K.

NOTE 2 The tolerances on the temperatures in Table AA.2 are ±2 K for the MOTOR-COMPRESSOR ambient temperature, condensation and return gas temperatures, and ±1 K for the evaporation temperature.

NOTE 3 For some MOTOR-COMPRESSORS, an injection cooler or an oil cooler and air flow over the MOTOR-COMPRESSOR may be required as recommended by the MOTOR-COMPRESSOR manufacturer.

NOTE 4 The evaporation and condensation temperatures relate to the corresponding saturated vapour pressures of the refrigerant in use, and are measured by means of the pressure gauges as ″suction″ and ″discharge″ respectively in Figure AA.1. For refrigerant blends, the saturated vapour pressure is taken as the pressure at the dew point temperature.

NOTE 5 The return gas temperature is measured by means of a thermocouple, situated in the suction line at point A as shown in Figure AA.1.

NOTE 6 The test is carried out at a 43 °C ambient temperature so as to produce a maximum load on the MOTOR-COMPRESSOR. It is not intended that this be the reference ambient temperature for the temperature rises given in Table 3 of Part 1.

NOTE 7 The requirements in Table 3 regarding winding temperatures of the different insulation classes are not applicable to the windings of MOTOR-COMPRESSORS.

AA.5 Starting from the conditions defined in Table AA.2 increase the MOTOR-COMPRESSOR load by applying the steps in sequence as indicated in Table AA.3 until steady conditions are reached at each step or until one of the following conditions occurs:

– a PROTECTIVE DEVICE operates to disconnect the MOTOR COMPRESSOR from the supply

– the MOTOR-COMPRESSOR stalls and steady conditions are reached.

AA.5DV D1 *Modification of Clause AA.5 to add the following:*

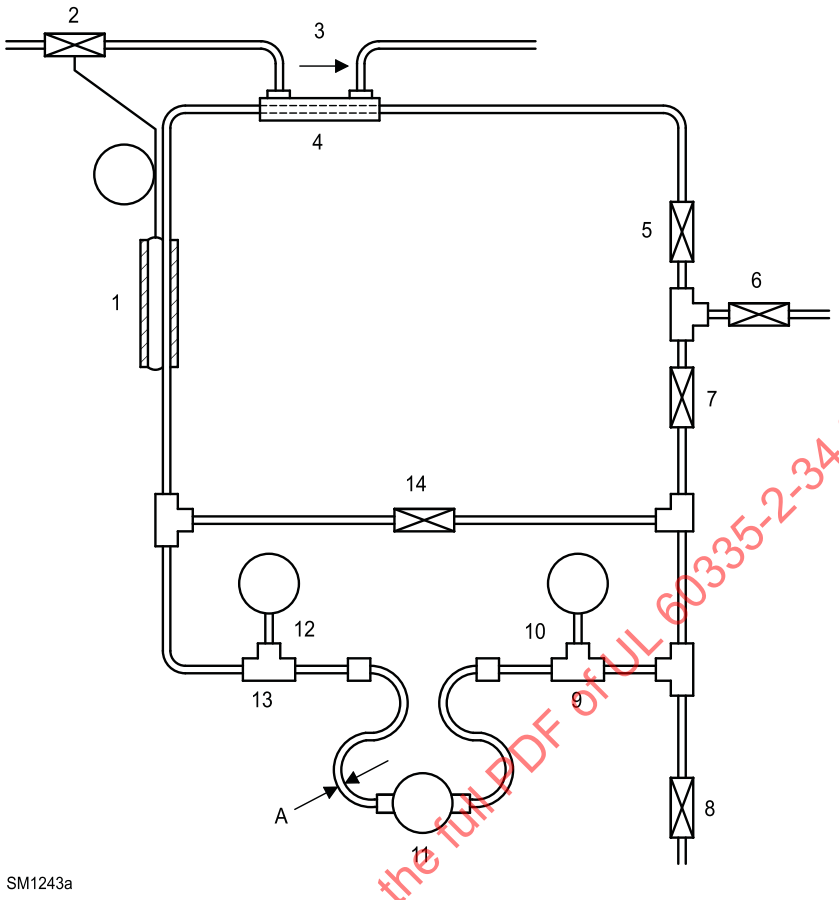
In neither of these conditions shall the motor-compressor winding temperature exceed 160 °C for motor-compressors with synthetic insulation and 150 °C for motor-compressors with cellulosic insulation.

Table AA.3 – Steps for increasing the load on the motor-compressor

STEPS	PROCEDURE
1a	*For other than R-744 TRANSCRITICAL REFRIGERATION SYSTEMS, increase the condensing temperature to 70 °C.*
1b	*For R-744 TRANSCRITICAL REFRIGERATION SYSTEMS, increase the discharge pressure in steps of approximately 0,05 MPa up to a discharge pressure of 13 MPa.*
2	*Increase the evaporating temperature in steps of approximately 5 K for a* *– LBP application category: up to 0°C* *– MBP application category: up to +10°C* *– HBP application category: up to +20°C*
3	*Increase the input voltage to the inverter in steps of approximately 6 % of the input voltage to the inverter at RATED VOLTAGE, up to 1,12 times the input voltage to the inverter at RATED VOLTAGE.*
4	*Starting from RATED VOLTAGE, decrease the input voltage to the inverter in steps of approximately 5 % of the input voltage to the inverter at RATED VOLTAGE.*

NOTE The resistance of the windings at the end of the test can be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

If the MOTOR-COMPRESSOR is of the single-phase type with an internally mounted PROTECTIVE DEVICE, the combined resistance of the main winding and start winding, in series, is used. If the MOTOR-COMPRESSOR is of the three-phase type with an internally mounted PROTECTIVE DEVICE, it will be necessary to first establish the trip point then re-run the test and measure the resistance after shut-down, just prior to the PROTECTIVE DEVICE tripping. A continuous resistance recording technique may be used if the temperatures correlate properly with those obtained by the shut-down resistance method.



Key

1 Thermostat sensor
2 Thermostatically controlled water valve
3 Cooling water
4 Heat exchanger
5 Suction control
6 Charging valve
7 Discharge pressure control
8 Reclaim valve
9 Discharge pressure line
10 Discharge
11 Motor-compressor
12 Suction
13 Suction line
14 Pressure equalizing valve

NOTE 1 Point A is the return gas temperature measuring point – approximately 300 mm from the HOUSING.

NOTE 2 The complete substitute cooling system can be located in the temperature controlled room (see Table AA.1) or, alternately, only the MOTOR-COMPRESSOR need be in this controlled ambient.

NOTE 3 Additional components, such as discharge line heaters or suction return gas heaters and coolers can be added as needed, as long as the specified temperatures and conditions of Table AA.1 are maintained. A replaceable filter dryer can be added between the discharge pressure gauge and the discharge pressure control valve.

NOTE 4 For some MOTOR-COMPRESSORS, an additional means for reducing the motor temperature, such as an oil cooler and air flow over the MOTOR-COMPRESSOR, can be required as recommended by the MOTOR-COMPRESSOR manufacturer. The heat removal will be done in conformity with the MOTOR-COMPRESSOR manufacturer's recommendations.

NOTE 5 In case an oil separator is required by the MOTOR-COMPRESSOR manufacturer, it can be incorporated in the substitute cooling system, as recommended by the MOTOR-COMPRESSOR manufacturer.

Figure AA.1 – Substitute refrigeration circuit

Annex BB
(normative)
Winding wire insulation compatibility tests

NOTE CAUTION: Extreme care should be taken when conducting this test. There are elevated pressure levels within the test vessels which are also under elevated ambient conditions. In addition, mixing of some chemicals and/or lubricants followed by exposure to high temperatures could produce toxic fumes and/or materials.

BB.1 Testing of winding wire insulation shall be conducted on two sets of six representative samples as follows:

a) Film-coated winding wire shall be prepared in accordance with 4.4.1 of IEC 60851-5:2008 except that samples for the refrigerant and oil exposure shall not have the loop at the end removed until after the refrigerant and oil exposure.

b) Other winding wires shall be straight lengths of wire.

BB.1DV D1 *Add the following:*

BB.1DV.1 If motor-compressors are not used, either two or six (at the manufacturer's option) motorettes or coilettes or samples as shown in Annex BB shall be prepared for this test.

BB.1DV.2 For winding wires over 600 volts refer to IEEE 1776.

BB.2 The size of the test samples shall be the smallest nominal wire size (diameter) intended for use on the MOTOR-COMPRESSOR.

BB.3 One set of six samples shall be maintained in the as-received condition (no exposure to refrigerant and oil). Another set of six samples shall be prepared for the refrigerant and oil exposure testing.

BB.4 The six as-received samples of winding wire shall be subjected to the electric strength test of 16.3 except that the applied voltage shall be 125 % of the maximum WORKING VOLTAGE of the MOTOR-COMPRESSOR, but not less than 500 V. The test voltage is applied between the conductors of the wires. The winding wire tested shall withstand the application of the test voltage specified without breakdown.

BB.5 The set of six samples prepared for the refrigerant and oil exposure testing shall be placed in test vessel(s) and each test vessel shall be provided with a pressure relief device. Each test vessel shall then be sealed, evacuated to 100 µm of mercury or less and heated to not less than 150 °C for at least 1 h.

NOTE A safety control other than a pressure relief device can be used if it serves the purpose of preventing excessive pressure build-up within a test vessel.

BB.6 The oil shall be added within each test vessel so that all samples will remain partially immersed in the refrigerant-oil-mixture throughout the duration of the test, including during the no heat period.

BB.7 Each test vessel shall then be re-sealed, evacuated and heated in accordance with Clause BB.5.

BB.8 Each test vessel shall then be charged with the refrigerant vapour in a manner which does not permit air to be introduced into the test vessel. The pressure of the refrigerant vapour shall be any convenient pressure between 1,0 MPa and 2,4 MPa for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa.

BB.9 The test samples shall be tested as detailed in Table BB.1. The time of heating shall be divided into five equal heating periods. Each heating period is followed by a period without heating. The period without heating shall be at a temperature of approximately 25 °C for 48 h.

BB.9DV D2 *Modification by adding the following note:*

NOTE 1DV: To shorten the test time and at the manufacturer's option, the minimum 48-hour cool-down period between each heat exposure may be omitted.

BB.10 The time temperature heating cycle used for the test is selected by the manufacturer.

Table BB.1 – Time temperature heating cycles

Heating temperature	Total heating time	Heating period
°C	h	h
140	1 440	288
145	1 080	216
150	720	144
155	540	108
160	360	72
175	240	48

BB.11 Immediately after being exposed to the refrigerant and oil, the winding wire samples shall be subjected to the electric strength test of 16.3 except that the applied voltage shall be not less than 100 % of the maximum WORKING VOLTAGE of the MOTOR-COMPRESSOR for which the winding wire is intended to be used. The test voltage is applied between the conductors of the wires. The winding wire tested shall withstand the application of the test voltage specified without breakdown.

Figure BB.101DV.1 D2 *Add the following figure:*

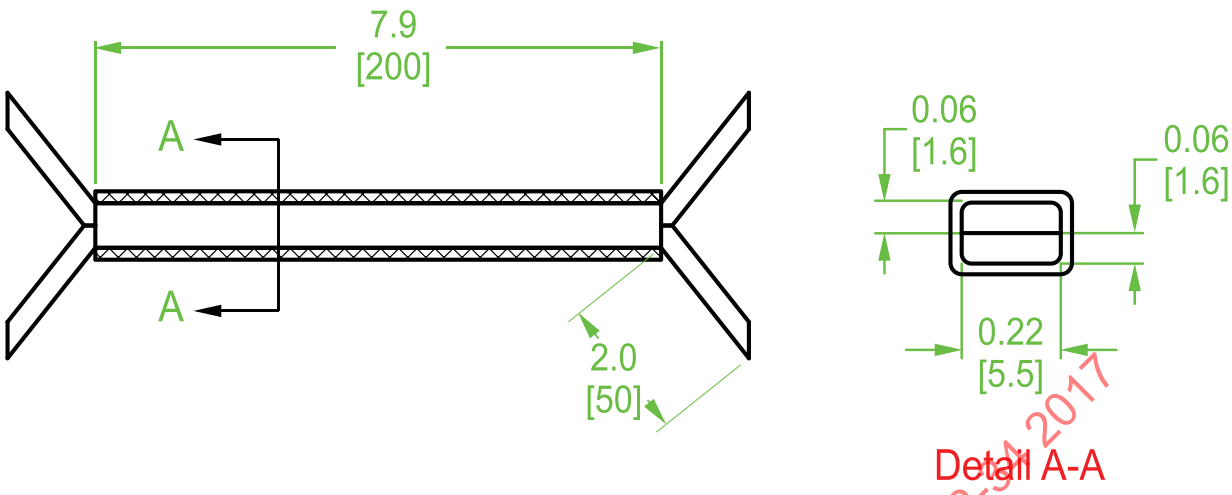


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Figure BB.101DV.1 – Illustration of turn to turn test specimen

Figure BB.101DV.2 D2 *Add the following figure:*

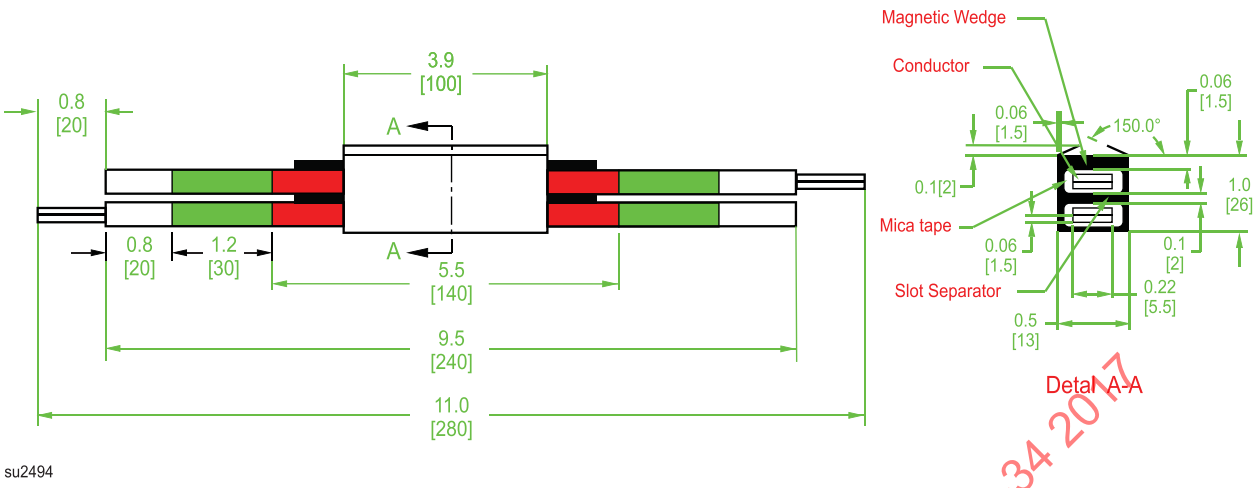

Figure BB.101DV.2 – Illustration of Formette test specimen

Annex CC
(normative)
Tie cords and insulation compatibility tests

NOTE 1 CAUTION: Extreme care should be taken when conducting this test. There are elevated pressure levels within the test vessels which are also under elevated ambient conditions. In addition, mixing of some chemicals and/or lubricants followed by exposure to high temperatures could produce toxic fumes and/or materials.

NOTE 2 Annex CC is not applicable to winding wire insulation.

CC.1 Testing of tie cords, insulating system materials or parts shall be conducted on two sets of six representative samples as follows:

a) Tie cords shall be at least 500 mm long and of the minimum nominal thickness intended for use on the MOTOR-COMPRESSOR.

b) Insulating system materials shall be of an amount approximately proportional to their use in the system. They shall be of the minimum nominal thickness intended for use on the MOTOR-COMPRESSOR and having an overall size so the test in Clause CC.3 can be conducted without flashover.

c) Parts such as an internal motor terminal assembly or lead connection block shall be the actual type and size as intended for use in the MOTOR-COMPRESSOR.

NOTE A suggested overall size for the other insulating system materials is approximately 50 mm × 50 mm.

CC.2 One set of six samples shall be maintained in the as-received condition (no exposure to refrigerant and oil). Another set of six samples shall be prepared for the refrigerant and oil exposure testing.

CC.3 The six as-received samples of insulating materials or parts shall be subjected to the electric strength test of 16.3 except that the applied voltage shall be not less than 125 % of the maximum WORKING VOLTAGE of the circuit for which the materials are intended, but not less than 500 V.

CC.4 If the parts to be tested are:

a) insulating materials other than tubing or leads, the test electrodes shall be opposing cylindrical rods, sized 5 mm diameter with edges rounded to a 1 mm radius;

NOTE The electrode size can be varied from the size specified to accommodate testing of small parts.

b) tubing, the test electrodes shall be a copper conductor and spherical metal shot. The copper conductor shall be of a size approximately equal to the tubing internal diameter and then inserted into the tubing. The tubing and conductor shall be bent 180° over a mandrel having a diameter of not more than 10 mm. The metal shot shall be sized 2 mm to 3 mm diameter. The tubing and conductor shall be inserted into the metal shot such that the test voltage is applied between the conductor within the tubing and the metal shot;

c) leads, the tests electrodes shall be the wire within the lead and metal foil 50 mm long, wrapped around the lead and centred on the lead length. The test voltage shall be applied between the wire within the lead and the metal foil.

CC.5 The insulation or parts tested shall withstand the application of the test voltage specified without breakdown.

CC.6 The six as-received sample tie cords shall be subjected to a breaking test as follows:

a) Tie cord breaking strength shall be determined by using constant rate of specimen extension tensile testing machine. Clamping jaws, such as of the drum or capstan type to prevent slippage or breakage of the tie cord, shall be used. The distance between the contact points of the jaws shall be adjusted to 250 mm ±10 mm.

b) Tie cord samples shall be installed and aligned in the test machine jaws. The movable jaw shall be operated at a speed of 300 mm/min ±10 mm/min. If a sample breaks within 10 mm of the jaw contact point, the results shall be disregarded and another sample tested.

CC.7 The average tie cord breaking strength shall be recorded.

CC.8 The set of six samples prepared for the refrigerant and oil exposure testing shall be placed in test vessel(s) and each test vessel shall be provided with a pressure relief device. Each test vessel shall then be sealed, evacuated to 100 µm of mercury or less and heated to not less than 150 °C for at least 1 h.

NOTE A safety control other than a pressure relief device can be used if it serves the purpose of preventing excessive pressure build-up within a test vessel.

CC.9 The oil shall be added within each test vessel so that all samples will remain partially immersed in the refrigerant-oil-mixture throughout the duration of the test, including during the no heat period.

CC.10 Each test vessel shall then be re-sealed, evacuated and heated in accordance with Clause CC.8.

CC.11 Each test vessel shall then be charged with the refrigerant vapour in a manner which does not permit air to be introduced into the test vessel. The pressure of the refrigerant vapour shall be any convenient pressure between 1,0 MPa and 2,4 MPa for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa.

CC.12 The test samples shall be tested as detailed in Table CC.1. The time of heating shall be divided into five equal heating periods. Each heating period is followed by a period without heating. The period without heating shall be at a temperature of approximately 25 °C for 48 h.

CC.13 The time temperature heating cycle used for the test is selected by the manufacturer.

Table CC.1 – Time temperature heating cycles

Heating temperature	Total heating time	Heating period
°C	h	h
140	1 440	288
145	1 080	216
150	720	144
155	540	108
160	360	72
175	240	48

CC.14 Immediately after being exposed to the refrigerant and oil:

a) Tie cord samples shall be subjected to the breaking strength test in accordance with Clause CC.6. Not less than five of the six tie cord samples exposed to refrigerant and oil shall have a breaking strength of at least 80 % of the average as-received tie cord breaking strength.

b) Other insulation samples shall be subjected to the strength test of 16.3 except that the applied voltage shall be not less than 100 % of the maximum WORKING VOLTAGE of the circuit for which the materials are intended. The insulation or parts tested shall withstand the application of the test voltage specified without breakdown.

Annex DD
(normative)
Non-sparking "n" electrical apparatus

Where within this standard reference is made to IEC 60079-15, the following clauses are applicable.

16 General supplementary requirements for equipment producing arcs, sparks or hot surfaces

Clause 16 is applicable.

17 Supplementary requirements for enclosed-break devices and non-incendive components producing arcs, sparks or hot surfaces

Clause 17 is applicable.

18 Supplementary requirements for hermetically sealed devices producing arcs, sparks or hot surfaces

Clause 18 is applicable.

19 Supplementary requirements for sealed devices producing arcs, sparks or hot surfaces

Clause 19 is applicable.

20 Supplementary requirements for restricted-breathing enclosures protecting apparatus producing arcs, sparks or hot surfaces

Clause 20 is applicable.

Annex DVA
(normative)
North American additional requirements

Annex DVA DC *Modification of Table DVA.1 of the Part 1 by adding the following components references:*

Table DVA.1 – Component Standards Cross Reference

Component	North American Standards	
	Canada	United States
Crankcase Heaters	CSA C22.2 No. 64, Household Cooking and Liquid-Heating Appliances	UL 499, Electric Heating Appliances
Refrigerant-Containing Components	CSA C22.2 No. 140.3, Refrigerant-Containing Components for use in Electrical Equipment	UL 207, Refrigerant-Containing Components and Accessories, Nonelectrical
Organic Coatings	–	UL 1332, Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment

Annex 101.DVA
(normative)
Accelerated Aging Tests – Gaskets

Annex 101.DVA D1 ***Add a new Annex 101.DVA as follows:***

101.DVA.1 Rubber or neoprene compounds, except foamed materials, used for gaskets to seal electrical enclosures of outdoor equipment shall have physical properties as indicated in Table 101.DVA.1 before and after accelerated aging under the conditions indicated in Table 101.DVA.2.

101.DVA.2 Foamed neoprene or rubber compounds forming gaskets to seal an electrical enclosure of outdoor equipment shall not harden or otherwise deteriorate to a degree that will affect their sealing properties after accelerated aging under the conditions indicated in Table 101.DVA.2.

101.DVA.3 Thermoplastic materials forming gaskets to seal an electrical enclosure of outdoor equipment shall not deform, melt, or otherwise deteriorate to a degree that will affect their sealing properties after accelerated aging under the conditions indicated in Table 101.DVA.2. Solid polyvinyl chloride gasket material shall have physical properties as indicated in Table 101.DVA.1 before and after the accelerated aging.

101.DVA.4 Gaskets of materials other than those mentioned in Clauses 101.DVA.1 to 101.DVA.3 shall be non-absorptive, and shall provide equivalent resistance to aging and temperatures. The temperatures indicated in Table 101.DVA.2 correspond to the maximum temperatures measured on the gasket during the end use application tests.

Table 101.DVA.1
Physical properties for gaskets

	Neoprene or rubber compound		Polyvinyl chloride materials	
	Before test	After test	Before test	After test
Recovery – Maximum set when 25,4 mm (1 in) gauge marks are stretched to 63,5 mm (2-1/2 in), held for 2 min and measured 2 min after release	6,4 mm (1/4 in)	–	Not specified	
Elongation – Minimum increase in distance between 25,4 mm (1 in) gauge marks at break	250% 25,4 – 88,9 mm (1 – 3-1/2 in)	65% of original	250% 25,4 – 88,9 mm (1 – 3-1/2 in)	75% of original
Tensile strength – Minimum force at breaking point	5,86 MPa (850 psi)	75% of original	8,27 MPa (1200 psi)	90% of original

Table 101.DVA.2
Accelerated aging conditions for gaskets

Measured temperature °C (°F)		Material	Test program
60	(140)	Rubber or neoprene	70 hours in an air-circulating oven at 100°C ±2°C (212°F ±3,6°F)
60	(140)	Thermoplastic	7 days in air-circulating oven 87°C (189°F)
75	(167)	Rubber or neoprene	168 hours in an air-circulating oven at 100°C ±2°C (212°F ±3,6°F)
75	(167)	Thermoplastic	10 days in an air-circulating oven at 100°C (212°F)
80	(176)	Rubber, neoprene, or thermoplastic	7 days in an air-circulating oven at 113°C (235,4°F)
90	(194)	Rubber or neoprene	10 days in an air-circulating oven at 121°C (249,8°F)
90	(194)	Thermoplastic	7 days at 121°C (249,8°F) or 60 days at 97°C (206,6°F) in an air-circulating oven
105	(221)	Rubber, neoprene, or thermoplastic	7 days in an air-circulating oven at 136°C (276,8°F)

101.DVA.5 At least three samples of neoprene, rubber, or polyvinyl chloride materials shall be used for each of the following tests:

a) Recovery

b) Before Elongation

c) After Elongation

d) Before Tensile Strength

e) After Tensile Strength

101.DVA.6 A neoprene, rubber or polyvinyl chloride gasket material shall be considered as complying if the average results for all samples comply with the physical properties to which they were subjected as specified in Table 101.DVA.1.

Annex 101.DVB
(informative)
Pressure code

Annex 101.DVB DR *Add a new Annex 101.DVB as follows:*

For the U.S., the applicable national pressure code is the ASME Boiler and Pressure Vessel Code, Section VIII, and "UV" is the applicable code symbol.

Annex 101.DVC
(normative)
Nonmetallic materials

Annex 101.DVC D2 ***Add a new Annex 101.DVC as follows:***

101.DVC.1 General

101.DVC.1.1 Non-metallic materials employed in the construction of the product shall have adequate mechanical, electrical, and thermal properties. In addition to the requirements of this standard, the requirements in Clauses 101.DVC.2 – 101.DVC.5 shall be considered in the evaluation.

101.DVC.2 Electrical properties

101.DVC.2.1 If a non-metallic material is in direct contact with an uninsulated part, the material shall be evaluated for:

a) Electric voltage withstand: at a minimum of 5 000 volts per IEC 60243-1 and IEC 60243-2 and

b) Comparative tracking index: Shall be greater than 175 for outdoor use materials and greater than 100 for other materials – IEC 60112.

101.DVC.3 Mechanical properties

101.DVC.3.1 Non-metallic structural parts that are subjected to long-term loading and whose change in dimensions or shape could result in an unsafe condition shall be evaluated as specified in Clause 101.DVC.3.2.

101.DVC.3.2 ***If the loading is self-relieving, such that the stress on the part is eliminated due to the change in dimensions of the polymeric part, then the part shall be subjected to the maximum load for not less than 300 hours at normal operating temperature.***

If the loading is not self-relieving, such as when the part is subjected to gravity as the external force, then the part shall be subjected to the maximum load for not less than 1000 hours at normal operating temperature.

Following the test, the equipment shall comply with the requirements in this standard.