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REDLINE VERSION

INTERNATIONAL STANDARD

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Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors

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Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors

INTERNATIONAL
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COMMISSION

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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.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60335-2-34:2012+AMD1:2015+AMD2:2016 CSV. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

This part of 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.

This sixth edition cancels and replaces the fifth edition published in 2012, Amendment 1:2015 and Amendment 2:2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– it aligns the text with IEC 60335-1, Ed 5.2;
– application categories and tests have been extended (3.1.102, Annex AA);
– use of a motorette for winding wire compatibility tests introduced (3.8.102, Annex BB);
– height of the triangle, symbol ISO 7010 W021 has been introduced (7.14);
– some notes are converted to normative text (1, 15.3, 22.21, 23.8, 29.3.4, Figure AA.1);
– note in Subclause 6.101 becomes normative in Clause 11;
– optional pressure endurance test introduced (18.101, Annex EE);
– compatibility test for insulation inside the housing clarified (22.9);
– clarification of clearances inside the housing for motor-compressors suitable for use at altitudes exceeding 2 000 m (29.1);
– normative references and associated text have been updated (24.101, Annex DD);
– breaking strength of tie cord after temperature heating cycle has been updated (Annex CC).

The text of this International Standard is based on the following documents:

Draft	Report on voting
61C/873/FDIS	61C/874/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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.

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 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 small 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.

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

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 part of IEC 60335 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**.

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.~~

– tumble dryers (IEC 60335-2-11);

– refrigerating appliances, ice-cream appliances and ice-makers (IEC 60335-2-24);

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

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

– commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or compressor (IEC 60335-2-89);

– electrical equipment for measurement, control, and laboratory use (IEC 61010-2-011);

– professional ice-cream makers (IEC 60335-2-118);

– refrigerating systems and heat pumps (ISO 5149-2).

This standard does not supersede the requirements of standards relevant to the particular appliance in which the **motor-compressor** is used. However, if the **motor-compressor** type used complies with this standard, the tests for the **motor-compressor** specified in the particular appliance standard may not need to be made in the particular appliance or assembly. If the **motor-compressor control system** is associated with the particular appliance control system, additional tests ~~may~~ could 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~~ could 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~~103 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 60079-1:2014, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

IEC 60079-15:~~2010~~2017, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 60851-4:2016, ~~*Methods of test for*~~ *Winding wires – Test methods – Part 4: Chemical properties*

IEC 60851-5:2008, *Winding wires – Test methods – Part 5: Electrical properties*
IEC 60851-5:2008/AMD1:2011
IEC 60851-5:2008/AMD2:2019

ISO 817:2014, *Refrigerants – Designation and safety classification*
ISO 817:2014/AMD1:2017

ISO 7010:2019, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

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.~~

[1] There exists a consolidated edition 4.2:2019 that includes Edition 4 and its Amendment 1 and Amendment 2.

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**~~

3.1 Definitions relating to physical characteristics

3.1.101
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.

3.1.102
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 maximum evaporation temperature:

– very low back pressure (VLBP): denotes a maximum evaporation temperature of –25 °C;
– low back pressure (LBP): denotes a maximum evaporation temperature of –15 °C;
– medium back pressure (MBP): denotes a maximum evaporation temperature of 0 °C;
– high back pressure (HBP): denotes a maximum evaporation temperature of +15 °C;
– very high back pressure (VHBP): denotes a maximum evaporation temperature of +30 °C;
– subcritical R-744 back pressure (SC R-744BP): denotes a maximum evaporation temperature of –15 °C;

3.5 Definitions relating to types of appliances

3.5.101
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 gasketed 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**.

3.5.102
two-stage motor-compressor
motor-compressor comprising two compressors and one motor in a single **housing**

3.6 Definitions relating to parts of an appliance

3.6.101
housing
sealed enclosure for the **motor-compressor**, which contains the compressor mechanism and the motor, and which is subjected to refrigerant pressures

3.6.102
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**

3.7 Definitions relating to safety components

3.7.101
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.

3.7.102
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.

3.7.103
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 7.104
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.

3.8 Definitions relating to miscellaneous matters

3.8.101
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

3.8.102
motorette
insulation system model made to embody all of the elements of a random wound insulation system

4 General requirement

This clause of Part 1 is applicable.

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.

5.6 *Addition:*

*Variable speed **motor-compressors** shall run at maximum speed.*

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.*

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**~~ subcritical **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~~ Warning sign ISO 7010 W021 (2011-05).

7.5 Not applicable.

7.6 Addition:

~~Symbol~~ [warning sign ISO 7010 W021 (2011-05)]

Warning; Risk of fire / Flammable material

7.7 Not applicable.

7.12 Not applicable, except 7.12.1, which is applicable.

7.13 Not applicable.

7.14 *Addition:*

The height of the triangle in the symbol ISO 7010 W021 (2011-05) shall be at least 15 mm.

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.~~

This clause of Part 1 is replaced by Annex AA. For motor compressors classified as tested without Annex AA, compliance with this clause shall be tested as a complete system in the final application in accordance with the appropriate appliance standard.

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.~~

The requirement shall be applied to **motor-compressors** not provided with glass-insulated terminals but intended for connection to external control devices, protectors or other components.

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, except as follows.

18.101 If requested by the manufacturer, the fatigue test specified in Annex EE shall be carried out.

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~~ Annex AA. 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~~ Table AA.2.*

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~~ Table AA.1. Any contactor or relay contact that operates under the conditions of ~~Clause~~ Table 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~~ under the conditions of Table 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~~101 For **motor-compressors** not classified as being tested with Annex AA, this test will be performed on the final product.

NOTE ~~2~~102 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.*

19.102 *The test of 19.101 is repeated for one operation of a **non-self-resetting motor-compressor protection system** or 3 h minimum for a **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.*~~
- *with motor starting capacitors and motor running capacitors open-circuited one at a time;*
- *with motor starting capacitors and motor running capacitors short-circuited one at a time, unless they have been tested and shown to comply with the requirements for protection class S2 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.*

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable.

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 or the test in Subclause 18.101 for refrigerants with minimum high side test pressure 10 MPa.

*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 (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.		

Refrigerant formulae	*Refrigerant number*	*Test pressure* *MPa*	*(bar)*
Subcritical			
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 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*	*(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 only 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	2,5 (24)
CF_3CH_2F	R-134a	2,5 (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	2,5 (18)
$CH(CH_3)_3$	R-600a	2,5 (25)
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.		

Refrigerant formulae	*Refrigerant number*	*Test pressure*	
		MPa	*(bar)*
Subcritical			
CF_3CH_2F	*R-134a*	*2,5*	*(25)*
$CHClF_2$	*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*	*2,5*	*(25)*
$CH(CH_3)_3$	*R-600a*	*2,5*	*(25)*
CO_2	*R-744*	*14,2*	*(142)*
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 side 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~~ leak 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.*

Where winding wire insulation has been tested for use with individual components in a refrigerant blend, it shall also be tested for use with the blend. If a tested blend comprises tested individual components, then other blends comprising the same components but in different quantities do not need to be retested.

For oils with the same chemical components, if the oil with the lowest viscosity is used for the tests, then the tests do not need to be repeated with oils having higher viscosities.

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.*

For each of the above tests, separate samples of the tested component shall be used.

22.14 Not applicable.

22.21 *Addition:*

~~NOTE 101 The requirement is applicable only to external parts of the **motor-compressor**.~~

The requirement shall only be applied 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~~ can be installed by either the **motor-compressor** manufacturer or the appliance manufacturer.

Compliance is checked by inspection.

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**.~~

This requirement does not apply to wiring inside the **housing**.

24 Components

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

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.

24.101 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 or the requirements for level protection "dc" of IEC 60079-1 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 and IEC 60079-1.

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.

For **motor-compressors** intended for use at altitudes exceeding 2 000 m, the relevant altitude correction factors in Table A.2 of IEC 60664-1:2007 are not applicable to **clearances** inside the **housing**.

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**.~~

For multi-phase appliances, the line to neutral or line to earth voltage shall be 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.

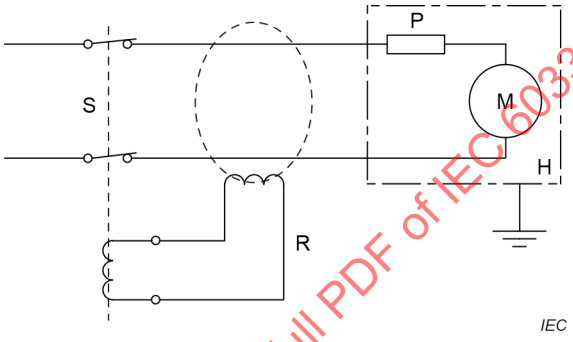
30.2.2 Not applicable.

31 Resistance to rusting

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

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 AC or AC with DC components, max. $I_{\Delta n}$ = 30 mA RMS or DC 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.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	Back pressure 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 (LBP) – max. load – max. cooling	–15	+65	+43	+43
5	Rated voltage	Low back pressure (LBP) – min. load – max. cooling	– 35	+49	+43	+25
4	Rated voltage	Medium back pressure (MBP) – max. load – max. cooling	0	+65	+43	+25
5	Rated voltage	Medium back pressure (MBP) – min. load – max. cooling	– 20	+55	+43	+25
4	Rated voltage	High back pressure (HBP) – max. load – max. cooling	+ 15	+65	+43	+25
5	Rated voltage	High back pressure (HBP) – 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 the 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 ºC 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 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 following conditions occurs:*

- *a **protective device** operates to disconnect the **motor compressor** from the supply,*
- *the **motor-compressor** stalls and steady conditions are reached.*

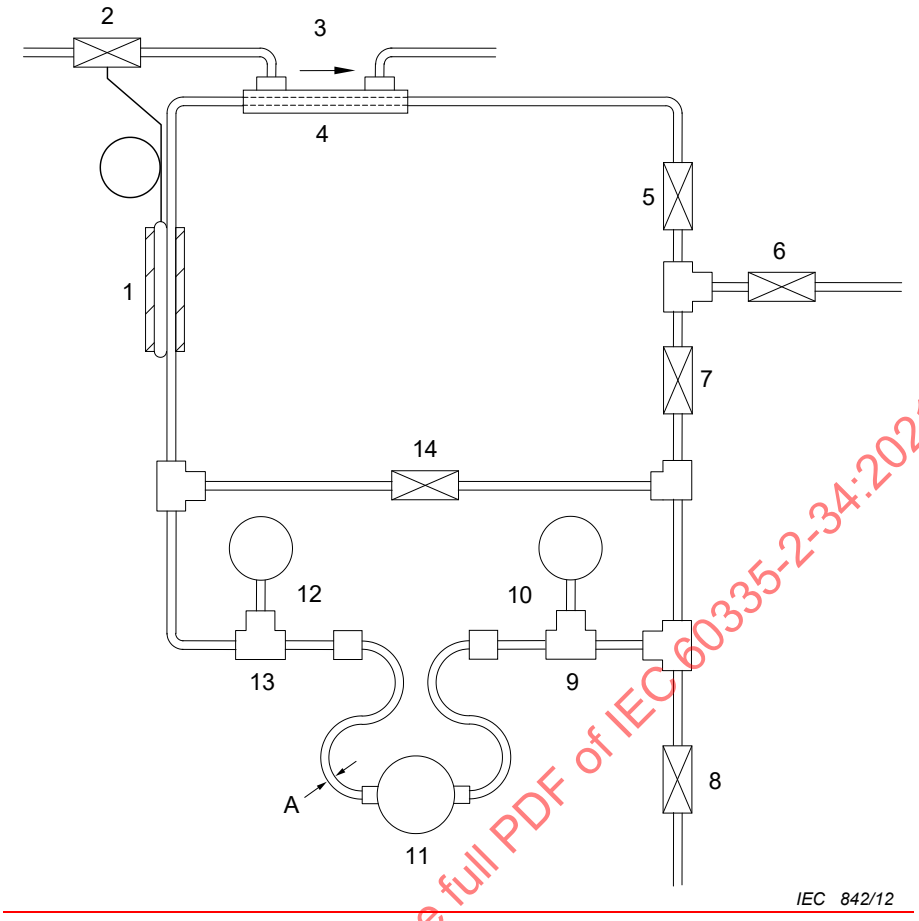
*In neither of these conditions shall the **motor-compressor** winding temperature exceed 160 °C for **motor-compressors** with synthetic insulation and 150 °C for **motor-compressors** with cellulosic insulation.*

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

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

AA.1 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.

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.

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.

When tested in accordance with its application category as indicated in Table AA.1, the motor-compressor/motor-compressor protection system combination shall not cause the motor winding temperature of motor-compressor to exceed the maximum values specified in Clause AA.3.

NOTE 1 A motor-compressor/motor compressor protection system combination complying with the requirements in Annex AA is considered as complying with the motor winding temperature requirements 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 2 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.

NOTE 3 For refrigerant blends, the saturated vapour pressure is taken as the pressure at the dew point temperature.

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

The test shall be carried out at a 43 °C ambient temperature so as to produce an overload on the motor-compressor.

NOTE 4 It is not intended that the 43 °C ambient temperature be the reference ambient temperature for the temperature rises given in Table 3 of Part 1.

NOTE 5 The requirements in Table 3 regarding winding temperatures of the different insulation classes are not applicable to the windings of motor-compressors.

The resistance of the windings at the end of a test shall be determined by taking resistance measurements as soon as possible after switching windings off. Resistance of the winding shall then be measured at short intervals of time so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching windings 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, shall be measured. If the motor-compressor is of the three-phase type with an internally mounted protective device, the trip point of the protected device shall first be established. The test shall then be reconducted and the resistance of the entire winding shall be measured after shut-down, just prior to the protective device activating.

NOTE 6 A continuous winding resistance recording technique can be used if the temperatures correlate properly with those obtained by the method of measuring the winding temperature at time intervals following the motor compressor shut-down.

AA.2 Unless otherwise specified, the tests in this annex are only applied if the **motor-compressor** is classified as being tested with Annex AA according to 6.101.

*Before testing in accordance with Clause AA.3 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 the substitute refrigeration circuit of Figure AA.1 under the conditions specified in Table AA.1 but at **rated voltage** for a period of not less than 2 h.*

During this two hour period, the maximum value of the current averaged over any 5 min period shall be recorded beginning not more than 60 s following the start of the two hours period. 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 The current is recorded to aid in checking reproducibility of test results.

AA.3 *For the tests in this subclause, steady conditions shall be considered reached if three successive readings of the temperature, taken at 10 min ± 1,0 minute intervals, and at the same point of any operating cycle, do not differ by more than 1 K.*

*The **motor-compressor** including the **motor-compressor protection system** or **motor-compressor control system**, if any, shall be connected to the substitute refrigeration circuit of Figure AA.1 and operated under the conditions of maximum load given in Table AA.1 until steady conditions are reached.*

Table AA.1 – Substitute refrigeration circuit conditions for operation under maximum load

Test number	*Applied voltage*	*Application category*	*Evaporation temperature* °C	*Condensation temperature* °C	*Return gas temperature* °C
1	1,06 **rated voltage**	VLBP	–25	+55	+43
1	1,06 **rated voltage**	LBP	–15	+65	+43
1	1,06 **rated voltage**	MBP	0	+65	+25
1	1,06 **rated voltage**	HBP	+ 15	+65	+25
1	1,06 **rated voltage**	VHBP	+ 30	+70	+43
2	0,94 **rated voltage**	VLBP	–25	+55	+43
2	0,94 **rated voltage**	LBP	–15	+65	+43
2	0,94 **rated voltage**	MBP	0	+65	+25
2	0,94 **rated voltage**	HBP	+ 15	+65	+25
2	0,94 **rated voltage**	VHBP	+ 30	+70	+43

*NOTE For all tests, the **motor compressor** ambient temperature is +43 °C.*

*For R-744 refrigerant intended for use in a subcritical **refrigeration system** (**application category** SC R-744BP), for all tests the evaporation temperature is –15 °C, the condensation temperature is +5 °C and the return gas temperature is +25 °C.*

*For R-744 refrigerant intended for use in a **transcritical refrigeration system**, for all tests the evaporation temperature is 0 °C, the discharge pressure is 12 MPa and the return gas temperature is +25 °C.*

The application category abbreviations can be found in 3.1.102.

*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.*

During tests under the conditions specified in Table AA.1,

– *the temperature rises of the **motor-compressor control system** and the **motor-compressor protection** system including those containing **electronic components** 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.*

The motor-compressor shall be then further tested as follows.

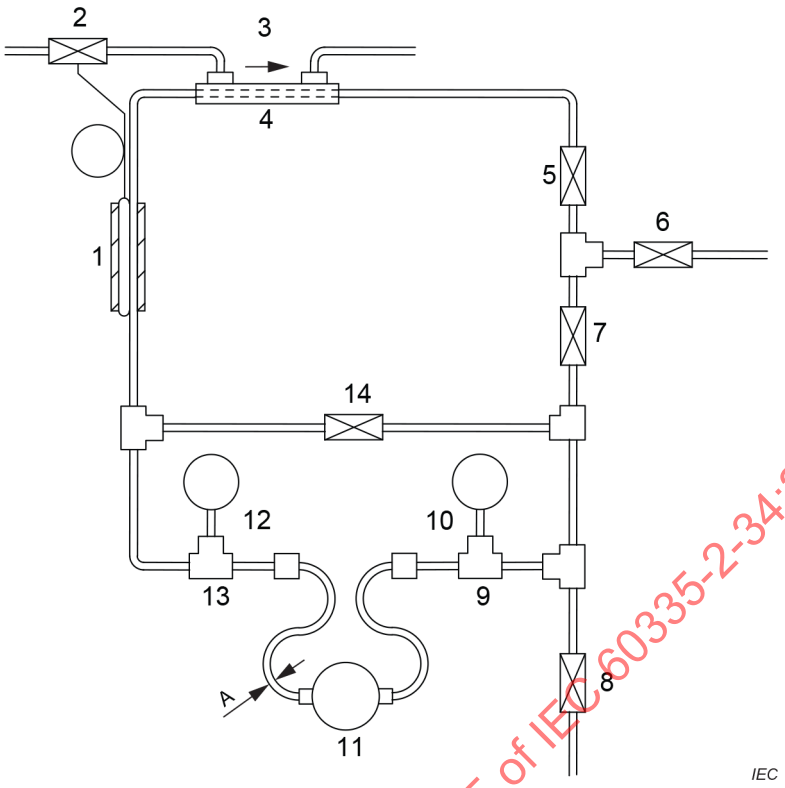
*Starting from conditions defined in Table AA.1, but at **rated voltage**, the **motor-compressor** load shall be increased by applying the applicable steps in sequence as indicated in Table AA.2 until steady conditions are reached. This procedure is continued until one of the following conditions occurs:*

– *a **protective device** operates to disconnect the **motor compressor** from the supply,*
– *the **motor-compressor** stalls and steady conditions are reached.*

*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.2 – Steps for increasing the load on the motor-compressor

Step	Procedure
1a	*For other than R-744 subcritical **refrigeration systems** or **transcritical refrigeration systems**, increase the condensing temperature to +70 °C*
1b	*For R-744 subcritical **refrigeration systems** (**application category** SC R-744BP), increase the condensing temperature to +10 °C*
1c	*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*
2a	*For other than R-744 subcritical **refrigeration systems** increase the evaporating temperature in steps of approximately 5 K for* – *VLBP up to –15 °C* – *LBP up to 0 °C* – *MBP up to +10 °C* – *HBP up to +20 °C* – *VHBP up to +35 °C*
2b	*For R-744 subcritical **refrigeration systems** (**application category** SC R-744BP), increase the evaporating temperature in steps of approximately 5 K up to 0 °C*
3	*For inverter driven **motor-compressors**, 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***
4a	*Starting from **rated voltage**, decrease the input voltage to the **motor-compressor** in steps of approximately 5 % of the **rated voltage** at a rate of approximately 2 V/min*
4b	*For inverter driven **motor-compressors** 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** at a rate of approximately 2 V/min*



Key

1	thermostat sensor	8	reclaim valve
2	thermostatically controlled water valve	9	discharge pressure line
3	cooling water	10	discharge
4	heat exchanger	11	motor-compressor
5	suction control	12	suction
6	charging valve	13	suction line
7	discharge pressure control	14	pressure equalizing valve

Point A from Figure AA.1 is the return gas temperature measuring point – and shall be located at 300 mm ($^{+0}_{-50}$ mm) from the **housing**.

The complete substitute cooling system can be located in the temperature controlled room or, alternately, only the **motor-compressor**, **motor-compressor control system** and the **motor-compressor protection** system including those containing **electronic components** need be in this controlled ambient.

NOTE 1 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 2 For some **motor-compressors**, an additional means for reducing the motor temperature, such as an injection cooler or 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 3 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~~ consist of either straight lengths of wire or **motorettes** (see Figure BB.1 and Figure BB.2).

Figure BB.1 shows typical components of the **motorette** before final assembly.

The finished **motorette** shown in Figure BB.2 consists of a rigid supporting metal frame with four suitable stand-off porcelain insulators bolted to one end and with a slot portion, made from an inner and outer plate, bolted to the other end. The **motorette** frame has holes for mounting the fixture during testing. The slot sections are fabricated from steel sheets approximately 1,5 mm thick. The assembled slot portion contains two coils insulated from ground by slot insulation, insulated from each other by phase insulation and held in place with slot wedges. These components are to be typical parts used in actual motors. The coils are each wound with two parallel wires so that conductor-to-conductor electrical tests may be made.

To establish uniformity and normality, the assembled **motorette** shall be subjected to the dielectric strength test of 16.3 without a prior humidity test. The test shall be carried out between the coils and then between each coil and the frame of the assembly and then between the parallel wires of each motorette coil. The applied voltage is that specified for basic insulation.

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

One set of two samples of the **motorette** shall be maintained in the as-prepared condition (no exposure to refrigerant and oil). Another set of two samples of the **motorette** 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.

The two as-received samples of **motorette** shall be subjected to the electric strength test of 16.3 without a prior humidity test. The test shall be carried out between the coils and then between each coil and the frame of the assembly and then between the two parallel wires of each **motorette** coil. The applied voltage is that specified for basic insulation at 125 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** winding and insulation is intended to be used. The **motorettes** tested shall withstand the application of the test voltage specified without breakdown.

BB.5 The set of six samples of winding wire 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.~~

The set of two samples of **motorette** 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.

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.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.

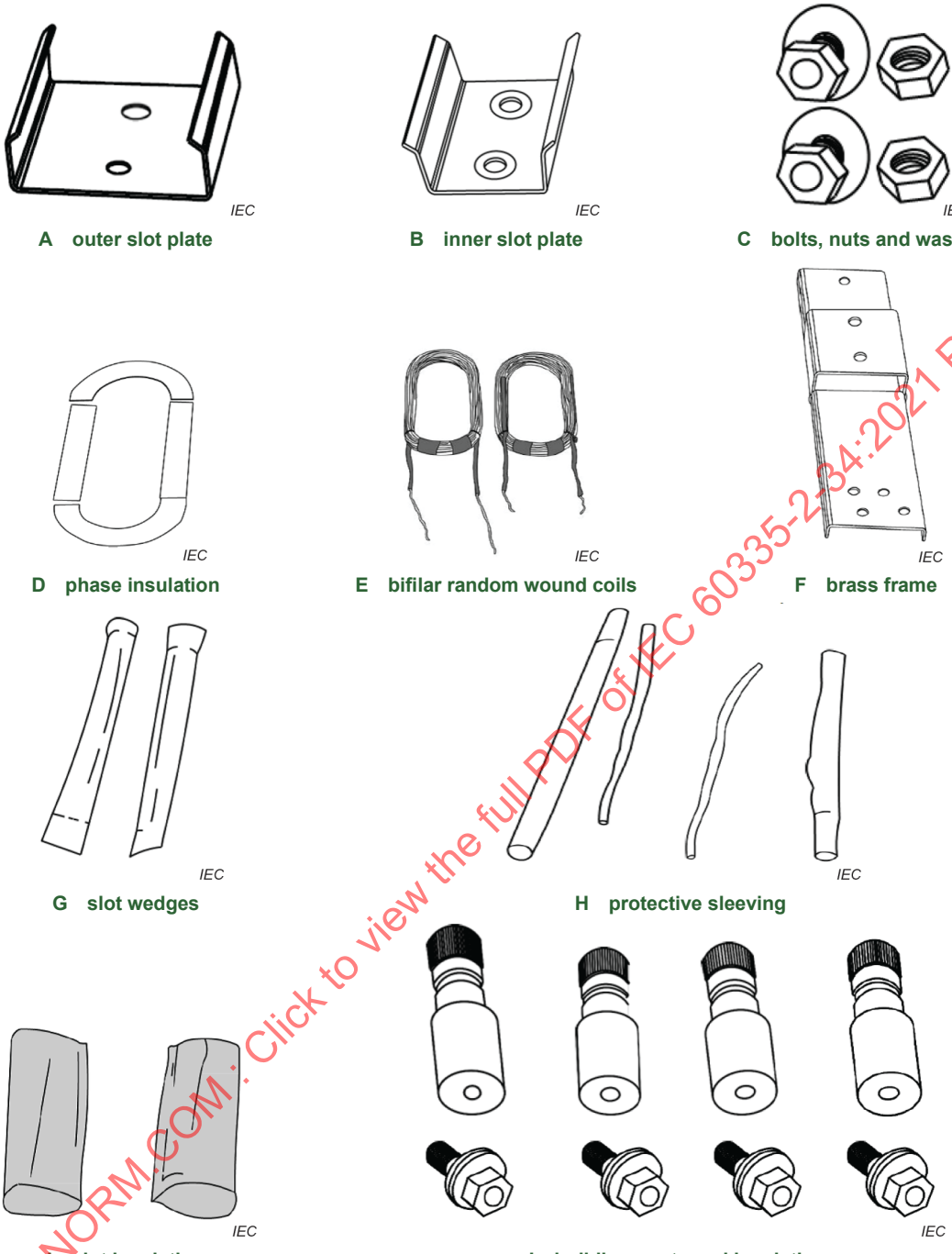
BB.10 The time temperature heating cycle used for the test is selected by the manufacturer.

Table BB.1 – Time temperature heating cycles

Heating temperature °C	Total heating time h	Heating period 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.

Immediately after being exposed to the refrigerant and oil, the two exposed samples of **motorette** shall be subjected to the electric strength test of 16.3 without a prior humidity test. The test shall be carried out between the coils and then between each coil and the frame of the assembly and then between the two parallel wires of each **motorette** coil. The applied voltage is that specified for basic insulation at 100 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** winding and insulation is intended to be used. The **motorettes** tested shall withstand the application of the test voltage specified without breakdown.



Key

A outer slot plate
B inner slot plate
C bolts, nuts and washers
D phase insulation
E bifilar random wound coils
F brass frame
G slot wedges
H protective sleeving
I slot insulation
J building posts and insulations

Figure BB.1 – Motorette components

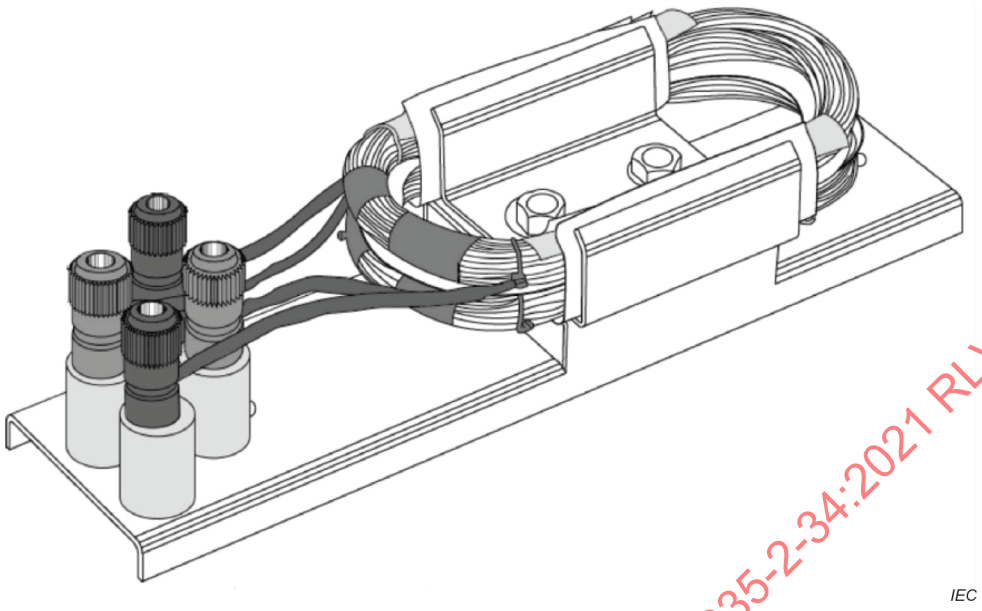


Figure BB.2 – Completely assembled motorette

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

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

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.~~

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.

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 °C	Total heating time h	Heating period 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~~ 50 % 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 and test condition for “dc” devices

Where within this standard reference is made to IEC 60079-15:2017, 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.~~

7 Requirements for non-incendive components

Clause 7 is applicable.

8 Requirements for hermetically sealed devices

Clause 8 is applicable.

9 Requirements for sealed devices

All of the subclauses of Clause 9 are applicable, except 9.1, which is replaced by the following.

9.1 Non-metallic materials

Seals are tested using 11.2.

10 Requirements for restricted-breathing enclosures

Clause 10 is applicable.

Where reference is made to IEC 60079-1:2014, the following clause is applicable as modified below.

15.5.3.1 General

Group IIA: (55 ± 0,5) % hydrogen/air at atmospheric pressure; or

Group IIA: (6,5 ± 0,5) % ethylene/air at atmospheric pressure.

Annex EE
(normative)

Fatigue test

EE.1 If subjected to the fatigue cycle test in Clause EE.4, a **motor-compressor** other than those specified in Clause EE.3 and EE.4 shall not rupture, burst, or leak. Two **motor-compressor** samples shall be completely filled with an incompressible, inert fluid to exclude all air, and connected to a hydraulic pump system. The pressure shall be raised gradually to the highest of 60 % of the test pressure required by Subclause 22.7 and maintained for 1 minute.

EE.2 A **motor-compressor** intended for use with refrigerants having a flammability classification of Class 1 in accordance with ISO 817 and employing a gasket or seal shall comply with Clause EE.1 and EE.4 even though visible leakage occurs at the gasket or seal.

EE.3 If visible leakage occurs as permitted by Clause EE.2, leakage shall not occur at or below 67% of the pressure used for the test in Clause EE.1.

EE.4 Fatigue cycle test is as follows.

EE.4.1 Three **motor compressor** samples shall be completely filled with an incompressible, inert fluid to exclude all air, and connected to a pressure driving source. The samples used for this part of the test shall be different from the ones used in the test described in Clause EE.1.

EE.4.2 The test pressure for the first cycle shall be the maximum pressure measured in Clause 11.

EE.4.3 For a **motor-compressor** intended for a subcritical **refrigeration system**, the test pressure for the remainder of the test cycles shall be as follows:

a) except as indicated in c), for a **motor-compressor** subject to high side pressures, the upper pressure value shall not be less than the saturated vapour pressure of the refrigerant at 50 °C, and the lower pressure value shall not be greater than the saturated vapour pressure of the refrigerant at 5 °C;

b) except as indicated in c), for a **motor-compressor** subjected to only low side pressures, the upper pressure value shall be not less than the saturated vapour pressure of the refrigerant at 30 °C, and the lower pressure value shall be any convenient value between 100 kPa, and the greater of either:

- 135,0 kPa; or
- the saturated vapour pressure of the refrigerant at –13 °C;

c) for a **motor-compressor** intended to utilize carbon dioxide (R744) in a cascade or booster system,

- **motor-compressor** subject to high side pressure, the upper pressure value shall not be less than 70 % of the pressure at 27 °C and the lower pressure shall not be more than 20 % of the pressure at 27 °C;
- **motor-compressor** subject to only low side pressure, the upper pressure value shall not be less than 70 % of the start-to-discharge value of the pressure regulating relief valve. The lower pressure shall be not less than 690 kPa.

NOTE When the saturated vapour pressure of the refrigerant at minus 13 °C is a negative value, then EE.4.3 b) is intended to permit the lower pressure value to be any convenient value between 100 kPa up to and including 135 kPa.

EE.4.4 For a **motor-compressor** intended for a **transcritical refrigeration system**, the testing in EE.4.3 applies, except that if a **motor-compressor** or part of a **motor-compressor** is exposed to high side pressure, the upper pressure value shall be not less than 31,7 % of the test pressure required by Clause EE.1.

EE.4.5 The pressure within each sample shall be raised and lowered such that the full specified upper and lower pressure cyclic values are maintained for at least 0,1 s. The rate at which the pressure is cycled between upper pressure and the lower pressure is unspecified.

EE.4.6 The number of cycles shall be not less than 500 000.

EE.4.7 Following the specified number of test cycles, the test pressure shall be increased and maintained for 1 minute without rupture, burst, or leak at the highest of two times the upper pressure values specified in:

a) EE.4.3 for **motor-compressors** exposed to subcritical **refrigeration systems**; or

b) EE.4.4 for **motor-compressors** exposed to **transcritical refrigeration systems**.

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

IEC 60335-2-11, *Household and similar electrical appliances – Safety – Part 2-11: Particular requirements for tumble dryers*

IEC 60335-2-24, *Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice-makers*

IEC 60335-2-40, *Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

IEC 60335-2-75, *Household and similar electrical appliances – Safety – Part 2-75: Particular requirements for commercial dispensing appliances and vending machines*

IEC 60335-2-89, *Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or motor-compressor*

~~ISO 817, *Refrigerants – Designation system*~~

IEC 60335-2-118, *Household and similar electrical appliances – Safety – Part 2-118: Particular requirements for professional ice-cream makers*

IEC 61010-2-011, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-011: Particular requirements for refrigerating equipment*

ISO 5149-2, *Refrigerating system and heat pumps – Safety and Environmental requirements – Part 2: Design, construction, testing, marking and documentation*

NIST Standard Reference Database 23, NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1

IEC 60335-2-34

Edition 6.0 2021-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors

Appareils électrodomestiques et analogues – Sécurité – Partie 2-34: Exigences particulières pour les motocompresseurs

IEC 60335-2-34:2021-03(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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.
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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 part of 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.

This sixth edition cancels and replaces the fifth edition published in 2012, Amendment 1:2015 and Amendment 2:2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– it aligns the text with IEC 60335-1, Ed 5.2;
– application categories and tests have been extended (3.1.102, Annex AA);
– use of a motorette for winding wire compatibility tests introduced (3.8.102, Annex BB);
– height of the triangle, symbol ISO 7010 W021 has been introduced (7.14);
– some notes are converted to normative text (1, 15.3, 22.21, 23.8, 29.3.4, Figure AA.1);

– note in Subclause 6.101 becomes normative in Clause 11;
– optional pressure endurance test introduced (18.101, Annex EE);
– compatibility test for insulation inside the housing clarified (22.9);
– clarification of clearances inside the housing for motor-compressors suitable for use at altitudes exceeding 2 000 m (29.1);
– normative references and associated text have been updated (24.101, Annex DD);
– breaking strength of tie cord after temperature heating cycle has been updated (Annex CC).

The text of this International Standard is based on the following documents:

Draft	Report on voting
61C/873/FDIS	61C/874/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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.

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 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 small 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.

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

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 part of IEC 60335 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**.

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

– tumble dryers (IEC 60335-2-11);

– refrigerating appliances, ice-cream appliances and ice-makers (IEC 60335-2-24);

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

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

– commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or compressor (IEC 60335-2-89);

– electrical equipment for measurement, control, and laboratory use (IEC 61010-2-011);

– professional ice-cream makers (IEC 60335-2-118);

– refrigerating systems and heat pumps (ISO 5149-2).

This standard does not supersede the requirements of standards relevant to the particular appliance in which the **motor-compressor** is used. However, if the **motor-compressor** type used complies with this standard, the tests for the **motor-compressor** specified in the particular appliance standard may not need to be made in the particular appliance or assembly. If the **motor-compressor control system** is associated with the particular appliance control system, additional tests could 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 could 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.

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 103 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 60079-1:2014, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

IEC 60079-15:2017, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 60851-4:2016, *Winding wires – Test methods – Part 4: Chemical properties*

IEC 60851-5:2008, *Winding wires – Test methods – Part 5: Electrical properties*
IEC 60851-5:2008/AMD1:2011
IEC 60851-5:2008/AMD2:2019[1]

ISO 817:2014, *Refrigerants – Designation and safety classification*
ISO 817:2014/AMD1:2017

ISO 7010:2019, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

3 Terms and definitions

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

3.1 Definitions relating to physical characteristics

3.1.101
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.

3.1.102
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 maximum evaporation temperature:

– very low back pressure (VLBP): denotes a maximum evaporation temperature of –25 °C;

[1] There exists a consolidated edition 4.2:2019 that includes Edition 4 and its Amendment 1 and Amendment 2.

– low back pressure (LBP): denotes a maximum evaporation temperature of –15 °C;
– medium back pressure (MBP): denotes a maximum evaporation temperature of 0 °C;
– high back pressure (HBP): denotes a maximum evaporation temperature of +15 °C;
– very high back pressure (VHBP): denotes a maximum evaporation temperature of +30 °C;
– subcritical R-744 back pressure (SC R-744BP): denotes a maximum evaporation temperature of –15 °C;

3.5 Definitions relating to types of appliances

3.5.101
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 gasketed 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**.

3.5.102
two-stage motor-compressor
motor-compressor comprising two compressors and one motor in a single **housing**

3.6 Definitions relating to parts of an appliance

3.6.101
housing
sealed enclosure for the **motor-compressor**, which contains the compressor mechanism and the motor, and which is subjected to refrigerant pressures

3.6.102
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**

3.7 Definitions relating to safety components

3.7.101
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.

3.7.102
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.

3.7.103
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 7.104
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.

3.8 Definitions relating to miscellaneous matters

3.8.101
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

3.8.102
motorette
insulation system model made to embody all of the elements of a random wound insulation system

4 General requirement

This clause of Part 1 is applicable.

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.

5.6 *Addition:*

*Variable speed **motor-compressors** shall run at maximum speed.*

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.*

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.

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 subcritical **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 Warning sign ISO 7010 W021 (2011-05).

7.5 Not applicable.

7.6 Addition:

[warning sign ISO 7010 W021 (2011-05)] Warning; Risk of fire / Flammable material

7.7 Not applicable.

7.12 Not applicable, except 7.12.1, which is applicable.

7.13 Not applicable.

7.14 *Addition:*

The height of the triangle in the symbol ISO 7010 W021 (2011-05) shall be at least 15 mm.

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 replaced by Annex AA. For motor compressors classified as tested without Annex AA, compliance with this clause shall be tested as a complete system in the final application in accordance with the appropriate appliance standard.

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:*

The requirement shall be applied to **motor-compressors** not provided with glass-insulated terminals but intended for connection to external control devices, protectors or other components.

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 applicable, except as follows.

18.101 If requested by the manufacturer, the fatigue test specified in Annex EE shall be carried out.

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 Annex AA. 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 Table AA.2.*

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 Table AA.1. Any contactor or relay contact that operates under the conditions of Table 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 under the conditions of Table 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 101 For **motor-compressors** not classified as being tested with Annex AA, this test will be performed on the final product.

NOTE 102 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.*

19.102 *The test of 19.101 is repeated for one operation of a **non-self-resetting motor-compressor protection system** or 3 h minimum for a **self-resetting motor-compressor protection system** under the following conditions:*

– *with motor starting capacitors and motor running capacitors open-circuited one at a time;*

– *with motor starting capacitors and motor running capacitors short-circuited one at a time, unless they have been tested and shown to comply with the requirements for protection class S2 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.*

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable.

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 or the test in Subclause 18.101 for refrigerants with minimum high side test pressure 10 MPa:

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			
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 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*	*(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 only 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			
CF_3CH_2F	*R-134a*	*2,5*	*(25)*
$CHClF_2$	*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*	*2,5*	*(25)*
$CH(CH_3)_3$	*R-600a*	*2,5*	*(25)*
CO_2	*R-744*	*14,2*	*(142)*
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 side 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 leak 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.*

Where winding wire insulation has been tested for use with individual components in a refrigerant blend, it shall also be tested for use with the blend. If a tested blend comprises tested individual components, then other blends comprising the same components but in different quantities do not need to be retested.

For oils with the same chemical components, if the oil with the lowest viscosity is used for the tests, then the tests do not need to be repeated with oils having higher viscosities.

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.*

For each of the above tests, separate samples of the tested component shall be used.

22.14 Not applicable.

22.21 *Addition:*

The requirement shall only be applied 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** can be installed by either the **motor-compressor** manufacturer or the appliance manufacturer.

Compliance is checked by inspection.

23 Internal wiring

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

23.8 *Addition:*

This requirement does not apply to wiring inside the **housing**.

24 Components

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

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.

24.101 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 or the requirements for level protection "dc" of IEC 60079-1 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 and IEC 60079-1.

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.

For **motor-compressors** intended for use at altitudes exceeding 2 000 m, the relevant altitude correction factors in Table A.2 of IEC 60664-1:2007 are not applicable to **clearances** inside the **housing**.

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.*

For multi-phase appliances, the line to neutral or line to earth voltage shall be 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.

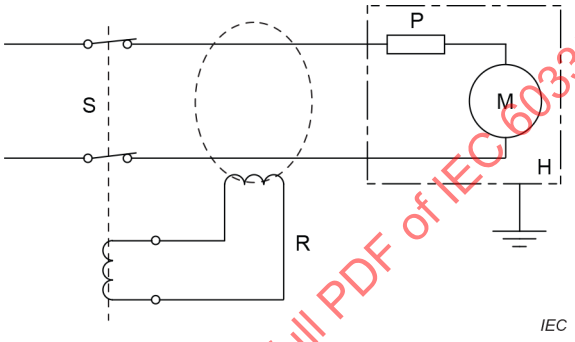
30.2.2 Not applicable.

31 Resistance to rusting

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

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 AC or AC with DC components, max. $I_{\Delta n}$ = 30 mA RMS or DC 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 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.

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.

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.

When tested in accordance with its application category as indicated in Table AA.1, the motor-compressor/motor-compressor protection system combination shall not cause the motor winding temperature of motor-compressor to exceed the maximum values specified in Clause AA.3.

NOTE 1 A motor-compressor/motor compressor protection system combination complying with the requirements in Annex AA is considered as complying with the motor winding temperature requirements 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 2 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.

NOTE 3 For refrigerant blends, the saturated vapour pressure is taken as the pressure at the dew point temperature.

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

The test shall be carried out at a 43 °C ambient temperature so as to produce an overload on the motor-compressor.

NOTE 4 It is not intended that the 43 °C ambient temperature be the reference ambient temperature for the temperature rises given in Table 3 of Part 1.

NOTE 5 The requirements in Table 3 regarding winding temperatures of the different insulation classes are not applicable to the windings of motor-compressors.

The resistance of the windings at the end of a test shall be determined by taking resistance measurements as soon as possible after switching windings off. Resistance of the winding shall then be measured at short intervals of time so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching windings 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, shall be measured. If the motor-compressor is of the three-phase type with an internally mounted protective device, the trip point of the protected device shall first be established. The test shall then be reconducted and the resistance of the entire winding shall be measured after shut-down, just prior to the protective device activating.

NOTE 6 A continuous winding resistance recording technique can be used if the temperatures correlate properly with those obtained by the method of measuring the winding temperature at time intervals following the motor compressor shut-down.

AA.2 Unless otherwise specified, the tests in this annex are only applied if the **motor-compressor** is classified as being tested with Annex AA according to 6.101.

*Before testing in accordance with Clause AA.3 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 the substitute refrigeration circuit of Figure AA.1 under the conditions specified in Table AA.1 but at **rated voltage** for a period of not less than 2 h.*

During this two hour period, the maximum value of the current averaged over any 5 min period shall be recorded beginning not more than 60 s following the start of the two hours period. 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 The current is recorded to aid in checking reproducibility of test results.

AA.3 *For the tests in this subclause, steady conditions shall be considered reached if three successive readings of the temperature, taken at 10 min ± 1,0 minute intervals, and at the same point of any operating cycle, do not differ by more than 1 K.*

*The **motor-compressor** including the **motor-compressor protection system** or **motor-compressor control system**, if any, shall be connected to the substitute refrigeration circuit of Figure AA.1 and operated under the conditions of maximum load given in Table AA.1 until steady conditions are reached.*

Table AA.1 – Substitute refrigeration circuit conditions for operation under maximum load

Test number	*Applied voltage*	*Application category*	*Evaporation temperature* °C	*Condensation temperature* °C	*Return gas temperature* °C
1	*1,06 **rated voltage***	*VLBP*	*–25*	*+55*	*+43*
1	*1,06 **rated voltage***	*LBP*	*–15*	*+65*	*+43*
1	*1,06 **rated voltage***	*MBP*	*0*	*+65*	*+25*
1	*1,06 **rated voltage***	*HBP*	*+ 15*	*+65*	*+25*
1	*1,06 **rated voltage***	*VHBP*	*+ 30*	*+70*	*+43*
2	*0,94 **rated voltage***	*VLBP*	*–25*	*+55*	*+43*
2	*0,94 **rated voltage***	*LBP*	*–15*	*+65*	*+43*
2	*0,94 **rated voltage***	*MBP*	*0*	*+65*	*+25*
2	*0,94 **rated voltage***	*HBP*	*+ 15*	*+65*	*+25*
2	*0,94 **rated voltage***	*VHBP*	*+ 30*	*+70*	*+43*

*NOTE For all tests, the **motor compressor** ambient temperature is +43 °C.*

*For R-744 refrigerant intended for use in a subcritical **refrigeration system** (**application category** SC R-744BP), for all tests the evaporation temperature is –15 °C, the condensation temperature is +5 °C and the return gas temperature is +25 °C.*

*For R-744 refrigerant intended for use in a **transcritical refrigeration system**, for all tests the evaporation temperature is 0 °C, the discharge pressure is 12 MPa and the return gas temperature is +25 °C.*

The application category abbreviations can be found in 3.1.102.

*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.*

During tests under the conditions specified in Table AA.1,

– *the temperature rises of the **motor-compressor control system** and the **motor-compressor protection** system including those containing **electronic components** 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.*

The motor-compressor shall be then further tested as follows.

*Starting from conditions defined in Table AA.1, but at **rated voltage**, the **motor-compressor** load shall be increased by applying the applicable steps in sequence as indicated in Table AA.2 until steady conditions are reached. This procedure is continued until one of the following conditions occurs:*

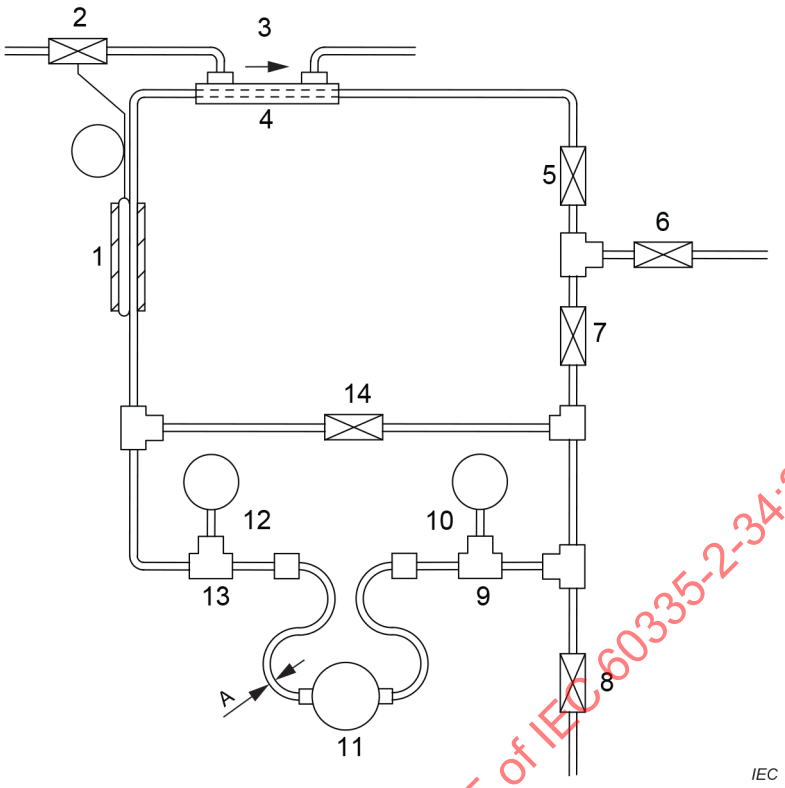
– *a **protective device** operates to disconnect the **motor compressor** from the supply,*

– *the **motor-compressor** stalls and steady conditions are reached.*

*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.2 – Steps for increasing the load on the motor-compressor

Step	Procedure
1a	*For other than R-744 subcritical **refrigeration systems** or **transcritical refrigeration systems**, increase the condensing temperature to +70 °C*
1b	*For R-744 subcritical **refrigeration systems** (**application category** SC R-744BP), increase the condensing temperature to +10 °C*
1c	*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*
2a	*For other than R-744 subcritical **refrigeration systems** increase the evaporating temperature in steps of approximately 5 K for* – *VLBP up to –15 °C* – *LBP up to 0 °C* – *MBP up to +10 °C* – *HBP up to +20 °C* – *VHBP up to +35 °C*
2b	*For R-744 subcritical **refrigeration systems** (**application category** SC R-744BP), increase the evaporating temperature in steps of approximately 5 K up to 0 °C*
3	*For inverter driven **motor-compressors**, 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***
4a	*Starting from **rated voltage**, decrease the input voltage to the **motor-compressor** in steps of approximately 5 % of the **rated voltage** at a rate of approximately 2 V/min*
4b	*For inverter driven **motor-compressors** 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** at a rate of approximately 2 V/min*



Key

1	thermostat sensor	8	reclaim valve
2	thermostatically controlled water valve	9	discharge pressure line
3	cooling water	10	discharge
4	heat exchanger	11	motor-compressor
5	suction control	12	suction
6	charging valve	13	suction line
7	discharge pressure control	14	pressure equalizing valve

Point A from Figure AA.1 is the return gas temperature measuring point – and shall be located at 300 mm ($^{+0}_{-50}$ mm) from the **housing**.

The complete substitute cooling system can be located in the temperature controlled room or, alternately, only the **motor-compressor**, **motor-compressor control system** and the **motor-compressor protection** system including those containing **electronic components** need be in this controlled ambient.

NOTE 1 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 2 For some **motor-compressors**, an additional means for reducing the motor temperature, such as an injection cooler or 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 3 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

BB.1 Testing of winding wire insulation shall be conducted on two sets of 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 consist of either straight lengths of wire or **motorettes** (see Figure BB.1 and Figure BB.2).

Figure BB.1 shows typical components of the **motorette** before final assembly.

The finished **motorette** shown in Figure BB.2 consists of a rigid supporting metal frame with four suitable stand-off porcelain insulators bolted to one end and with a slot portion, made from an inner and outer plate, bolted to the other end. The **motorette** frame has holes for mounting the fixture during testing. The slot sections are fabricated from steel sheets approximately 1,5 mm thick. The assembled slot portion contains two coils insulated from ground by slot insulation, insulated from each other by phase insulation and held in place with slot wedges. These components are to be typical parts used in actual motors. The coils are each wound with two parallel wires so that conductor-to-conductor electrical tests may be made.

To establish uniformity and normality, the assembled **motorette** shall be subjected to the dielectric strength test of 16.3 without a prior humidity test. The test shall be carried out between the coils and then between each coil and the frame of the assembly and then between the parallel wires of each motorette coil. The applied voltage is that specified for basic insulation.

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

One set of two samples of the **motorette** shall be maintained in the as-prepared condition (no exposure to refrigerant and oil). Another set of two samples of the **motorette** 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.

The two as-received samples of **motorette** shall be subjected to the electric strength test of 16.3 without a prior humidity test. The test shall be carried out between the coils and then between each coil and the frame of the assembly and then between the two parallel wires of each **motorette** coil. The applied voltage is that specified for basic insulation at 125 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** winding and insulation is intended to be used. The **motorettes** tested shall withstand the application of the test voltage specified without breakdown.

BB.5 The set of six samples of winding wire 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.

The set of two samples of **motorette** 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.

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

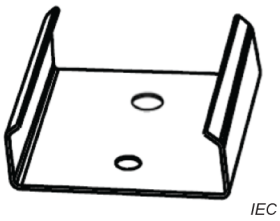
Table BB.1 – Time temperature heating cycles

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

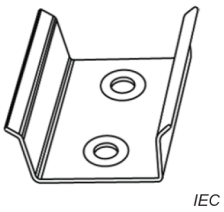
BB.11 Immediately after being exposed to the refrigerant and oil, the winding wire samples shall be subjected to the electric strength test of 16.3 except that the applied voltage shall be not less than 100 % of the maximum **working voltage** of the **motor-compressor** for which the winding wire is 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.

Immediately after being exposed to the refrigerant and oil, the two exposed samples of **motorette** shall be subjected to the electric strength test of 16.3 without a prior humidity test. The test shall be carried out between the coils and then between each coil and the frame of the assembly and then between the two parallel wires of each **motorette** coil. The applied voltage

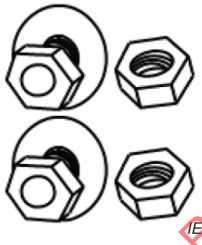
is that specified for basic insulation at 100 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** winding and insulation is intended to be used. The **motorettes** tested shall withstand the application of the test voltage specified without breakdown.



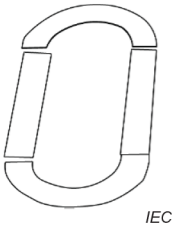
A outer slot plate



B inner slot plate

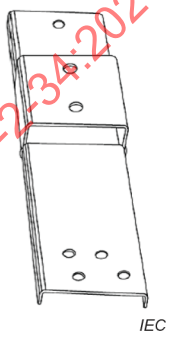


C bolts, nuts and washers

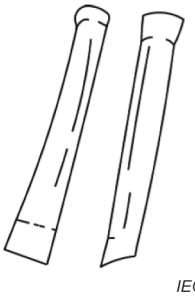


D phase insulation

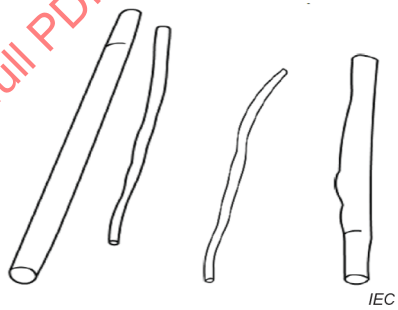
E bifilar random wound coils



F brass frame

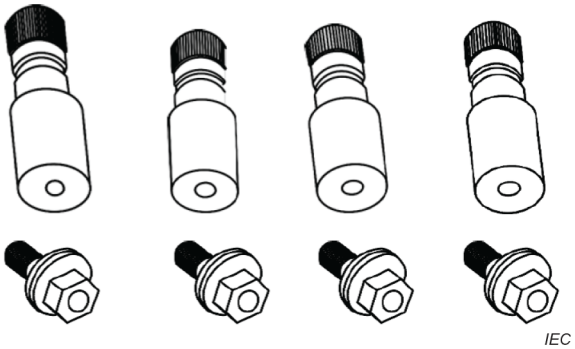


G slot wedges



H protective sleeving

I slot insulation



J building posts and insulations

Key

A outer slot plate
B inner slot plate
C bolts, nuts and washers
D phase insulation
E bifilar random wound coils
F brass frame
G slot wedges
H protective sleeving
I slot insulation
J building posts and insulations

Figure BB.1 – Motorette components

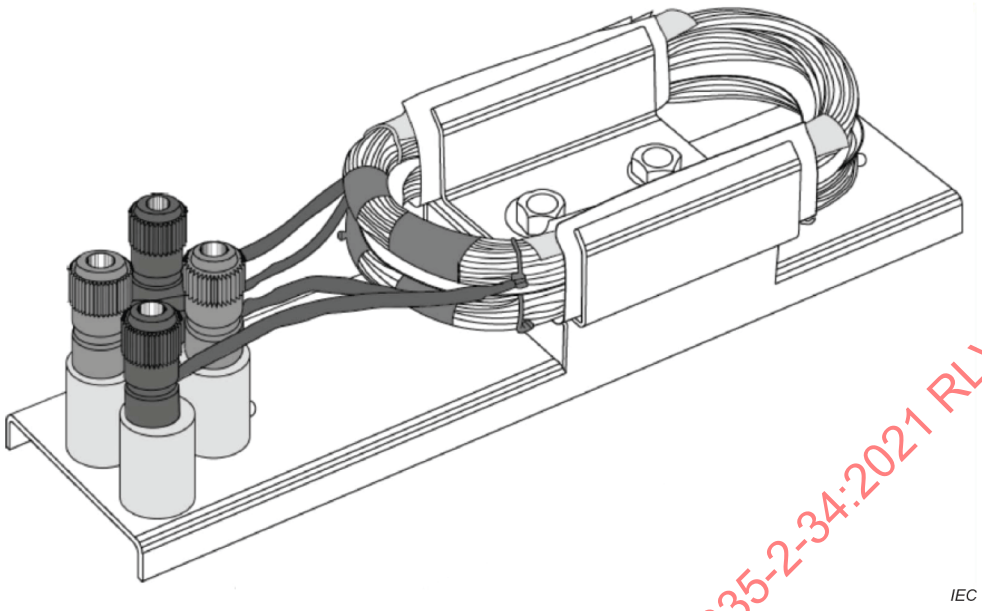


Figure BB.2 – Completely assembled motorette

Annex CC
(normative)

Tie cords and insulation compatibility tests

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

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

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.

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.

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 °C	Total heating time h	Heating period 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 50 % 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 and test condition for “dc” devices

Where within this standard reference is made to IEC 60079-15:2017, the following clauses are applicable.

7 Requirements for non-incendive components

Clause 7 is applicable.

8 Requirements for hermetically sealed devices

Clause 8 is applicable.

9 Requirements for sealed devices

All of the subclauses of Clause 9 are applicable, except 9.1, which is replaced by the following.

9.1 Non-metallic materials

Seals are tested using 11.2.

10 Requirements for restricted-breathing enclosures

Clause 10 is applicable.

Where reference is made to IEC 60079-1:2014, the following clause is applicable as modified below.

15.5.3.1 General

Group IIA: (55 ± 0,5) % hydrogen/air at atmospheric pressure; or

Group IIA: (6,5 ± 0,5) % ethylene/air at atmospheric pressure.

Annex EE
(normative)

Fatigue test

EE.1 If subjected to the fatigue cycle test in Clause EE.4, a **motor-compressor** other than those specified in Clause EE.3 and EE.4 shall not rupture, burst, or leak. Two **motor-compressor** samples shall be completely filled with an incompressible, inert fluid to exclude all air, and connected to a hydraulic pump system. The pressure shall be raised gradually to the highest of 60 % of the test pressure required by Subclause 22.7 and maintained for 1 minute.

EE.2 A **motor-compressor** intended for use with refrigerants having a flammability classification of Class 1 in accordance with ISO 817 and employing a gasket or seal shall comply with Clause EE.1 and EE.4 even though visible leakage occurs at the gasket or seal.

EE.3 If visible leakage occurs as permitted by Clause EE.2, leakage shall not occur at or below 67% of the pressure used for the test in Clause EE.1.

EE.4 Fatigue cycle test is as follows.

EE.4.1 Three **motor compressor** samples shall be completely filled with an incompressible, inert fluid to exclude all air, and connected to a pressure driving source. The samples used for this part of the test shall be different from the ones used in the test described in Clause EE.1.

EE.4.2 The test pressure for the first cycle shall be the maximum pressure measured in Clause 11.

EE.4.3 For a **motor-compressor** intended for a subcritical **refrigeration system**, the test pressure for the remainder of the test cycles shall be as follows:

a) except as indicated in c), for a **motor-compressor** subject to high side pressures, the upper pressure value shall not be less than the saturated vapour pressure of the refrigerant at 50 °C, and the lower pressure value shall not be greater than the saturated vapour pressure of the refrigerant at 5 °C;

b) except as indicated in c), for a **motor-compressor** subjected to only low side pressures, the upper pressure value shall be not less than the saturated vapour pressure of the refrigerant at 30 °C, and the lower pressure value shall be any convenient value between 100 kPa, and the greater of either:

- 135,0 kPa; or
- the saturated vapour pressure of the refrigerant at –13 °C;

c) for a **motor-compressor** intended to utilize carbon dioxide (R744) in a cascade or booster system,

- **motor-compressor** subject to high side pressure, the upper pressure value shall not be less than 70 % of the pressure at 27 °C and the lower pressure shall not be more than 20 % of the pressure at 27 °C;
- **motor-compressor** subject to only low side pressure, the upper pressure value shall not be less than 70 % of the start-to-discharge value of the pressure regulating relief valve. The lower pressure shall be not less than 690 kPa.

NOTE When the saturated vapour pressure of the refrigerant at minus 13 °C is a negative value, then EE.4.3 b) is intended to permit the lower pressure value to be any convenient value between 100 kPa up to and including 135 kPa.

EE.4.4 For a **motor-compressor** intended for a **transcritical refrigeration system**, the testing in EE.4.3 applies, except that if a **motor-compressor** or part of a **motor-compressor** is exposed to high side pressure, the upper pressure value shall be not less than 31,7 % of the test pressure required by Clause EE.1.

EE.4.5 The pressure within each sample shall be raised and lowered such that the full specified upper and lower pressure cyclic values are maintained for at least 0,1 s. The rate at which the pressure is cycled between upper pressure and the lower pressure is unspecified.

EE.4.6 The number of cycles shall be not less than 500 000.

EE.4.7 Following the specified number of test cycles, the test pressure shall be increased and maintained for 1 minute without rupture, burst, or leak at the highest of two times the upper pressure values specified in:

a) EE.4.3 for **motor-compressors** exposed to subcritical **refrigeration systems**; or

b) EE.4.4 for **motor-compressors** exposed to **transcritical refrigeration systems**.

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

IEC 60335-2-11, *Household and similar electrical appliances – Safety – Part 2-11: Particular requirements for tumble dryers*

IEC 60335-2-24, *Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice-makers*

IEC 60335-2-40, *Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

IEC 60335-2-75, *Household and similar electrical appliances – Safety – Part 2-75: Particular requirements for commercial dispensing appliances and vending machines*

IEC 60335-2-89, *Household and similar electrical appliances – Safety – Part 2-89: Particular requirements for commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or motor-compressor*

IEC 60335-2-118, *Household and similar electrical appliances – Safety – Part 2-118: Particular requirements for professional ice-cream makers*

IEC 61010-2-011, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-011: Particular requirements for refrigerating equipment*

ISO 5149-2, *Refrigerating system and heat pumps – Safety and Environmental requirements – Part 2: Design, construction, testing, marking and documentation*

NIST Standard Reference Database 23, NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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APPAREILS ÉLECTRODOMESTIQUES ET ANALOGUES – SÉCURITÉ –

Partie 2-34: Exigences particulières pour les motocompresseurs

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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La présente partie de l'IEC 60335 a été établie par le sous-comité 61C: Sécurité des appareils de réfrigération à usage domestique et commercial, du comité d'études 61 de l'IEC: Sécurité des appareils électrodomestiques et analogues.

Cette sixième édition annule et remplace la cinquième édition parue en 2012, l'Amendement 1:2015 et l'Amendement 2:2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

– le texte a été aligné sur l'IEC 60335-1, Ed 5.2;
– les catégories d'applications et les essais ont été élargis (3.1.102, Annexe AA);

– l'emploi d'une motorette a été ajouté pour les essais de compatibilité des fils de bobinage (3.8.102, Annexe BB);
– la hauteur du triangle, symbole ISO 7010 W021, a été ajoutée (7.14);
– certaines notes ont été converties en texte normatif (1, 15.3, 22.21, 23.8, 29.3.4, Figure AA.1);
– la note du 6.101 a été convertie en texte normatif à l'Article 11;
– introduction d'essais d'endurance sous pression facultatifs (18.101, Annexe EE);
– les essais de compatibilité pour l'isolation à l'intérieur du boîtier ont été clarifiés (22.9);
– les distances d'isolement dans l'air à l'intérieur du boîtier ont été clarifiées pour les motocompresseurs adaptés pour une utilisation à des altitudes supérieures à 2 000 m (29.1);
– les références normatives et le texte associé ont été mis à jour (24.101, Annexe DD);
– la résistance à la rupture du cordon d'attache après le cycle de chauffage a été mise à jour (Annexe CC).

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
61C/873/FDIS	61C/874/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2 et a été élaboré selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles à l'adresse www.iec.ch/members_experts/refdocs. Les principaux types de documents élaborés par l'IEC sont décrits de manière plus approfondie à l'adresse www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 60335, publiées sous le titre général *Appareils électrodomestiques et analogues – Sécurité*, peut être consultée sur le site web de l'IEC.

La présente partie 2 doit être utilisée conjointement avec la dernière édition de l'IEC 60335-1 et ses amendements. Elle a été établie sur la base de la cinquième édition (2010) de cette norme.

NOTE 1 L'expression "la Partie 1" utilisée dans la présente norme fait référence à l'IEC 60335-1.

La présente partie 2 complète ou modifie les articles correspondants de l'IEC 60335-1, de façon à transformer cette publication en norme IEC: Exigences de sécurité pour les motocompresseurs.

Lorsqu'un paragraphe particulier de la Partie 1 n'est pas mentionné dans cette partie 2, ce paragraphe s'applique pour autant que cela soit raisonnable. Lorsque la présente norme mentionne "addition", "modification" ou "remplacement", le texte correspondant de la Partie 1 doit être adapté en conséquence.

NOTE 2 Le système de numérotation suivant est utilisé:

– les paragraphes, tableaux et figures qui s'ajoutent à ceux de la Partie 1 sont numérotés à partir de 101;
– à l'exception de celles qui sont dans un nouveau paragraphe ou de celles qui concernent des notes de la Partie 1, les notes sont numérotées à partir de 101, y compris celles des articles ou paragraphes qui sont remplacés;
– les annexes qui sont ajoutées sont désignées AA, BB, etc.

NOTE 3 Les caractères d'imprimerie suivants sont utilisés:

– exigences: caractères romains;
– *modalités d'essais: caractères italiques;*
– notes: petits caractères romains.

Les termes en **gras** dans le texte sont définis à l'Article 3. Lorsqu'une définition concerne un adjectif, l'adjectif et le nom associé figurent également en gras.

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Le comité recommande que le contenu de cette publication soit entériné au niveau national au plus tôt 12 mois et au plus tard 36 mois après la date de publication.

Les différences suivantes existent dans les pays indiqués ci-après.

– 7.1: le marquage du courant à rotor bloqué est exigé pour certains motocompresseurs (Etats-Unis);

– 22.7: les pressions d'essai utilisées sont différentes (Japon, Etats-Unis).

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

Il a été considéré en établissant cette Norme internationale que l'exécution de ses dispositions était confiée à des personnes expérimentées et ayant une qualification appropriée.

La présente norme reconnaît le niveau de protection internationalement accepté contre les dangers électriques, mécaniques, thermiques, liés au feu et au rayonnement des appareils, lorsqu'ils fonctionnent comme en usage normal en tenant compte des instructions du fabricant. Elle couvre également les situations anormales auxquelles on peut s'attendre dans la pratique et elle tient compte de la façon dont les phénomènes électromagnétiques peuvent affecter le fonctionnement sûr des appareils.

Cette norme tient compte autant que possible des exigences de l'IEC 60364, de façon à rester compatible avec les règles d'installation quand l'appareil est raccordé au réseau d'alimentation. Cependant, des règles nationales d'installation peuvent être différentes.

Si un appareil relevant du domaine d'application de la présente norme comporte également des fonctions couvertes par une autre partie 2 de l'IEC 60335, la partie 2 correspondante est appliquée à chaque fonction séparément, dans la limite du raisonnable. Si cela est applicable, on tient compte de l'influence d'une fonction sur les autres fonctions.

Lorsqu'une partie 2 ne comporte pas d'exigences complémentaires pour couvrir les risques traités dans la Partie 1, la Partie 1 s'applique.

NOTE 1 Cela signifie que les comités d'études responsables pour les parties 2 ont déterminé qu'il n'était pas nécessaire de spécifier des exigences particulières pour l'appareil en question en plus des exigences générales.

Cette norme est une norme de famille de produits traitant de la sécurité d'appareils et a préséance sur les normes horizontales et génériques couvrant le même sujet.

NOTE 2 Les normes horizontales et génériques couvrant un risque ne sont pas applicables parce qu'elles ont été prises en considération lorsque les exigences générales et particulières ont été étudiées pour la série de normes IEC 60335. Par exemple, dans le cas des exigences de température de surface pour de nombreux appareils, des normes génériques, comme l'ISO 13732-1 pour les surfaces chaudes, ne sont pas applicables en plus de la Partie 1 ou des parties 2.

Un appareil conforme au texte de la présente norme ne sera pas nécessairement jugé conforme aux principes de sécurité de la norme si, lorsqu'il est examiné et soumis aux essais, il apparaît qu'il présente d'autres caractéristiques qui compromettent le niveau de sécurité visé par ces exigences.

Un appareil utilisant des matériaux ou présentant des modes de construction différents de ceux décrits dans les exigences de cette norme peut être examiné et essayé en fonction de l'objectif poursuivi par ces exigences et, s'il est jugé pratiquement équivalent, il peut être estimé conforme aux principes de sécurité de la norme.

Si les essais du **motocompresseur** incluent les essais de l'Annexe AA, les températures des enroulements du **motocompresseur**, du **boîtier** et des autres pièces associées au **motocompresseur** telles que les bornes, le câblage interne ou l'isolation, ne sont pas mesurées lorsque l'appareil complet dans lequel se trouve le **motocompresseur** est soumis aux essais.

Ces exigences s'appliquent aux **motocompresseurs** étanches (de type hermétique et hermétique accessible) et à leurs dispositifs de démarrage, de contrôle de puissance frigorifique et de protection associés, soumis à l'essai séparément dans les conditions de fonctionnement les plus défavorables du système de réfrigération qui, dans des limites raisonnables, peuvent se produire dans les applications pour lesquelles ils sont utilisés.

En particulier, l'examen des détails de construction et les essais à rotor bloqué peuvent être effectués séparément sur le **motocompresseur**, ce qui élimine la nécessité de soumettre à l'essai et de contrôler le **motocompresseur** lorsqu'il est utilisé sur différents appareils et sur différents ensembles montés en usine.

Les essais opérationnels peuvent également être effectués séparément sur le **motocompresseur** dans certains cas. Les spécifications pour ces essais de type sont fournies à l'Annexe AA. Toutefois, il peut être nécessaire d'effectuer les essais décrits dans les normes existantes relatives à ce type d'application, comme l'IEC 60335-2-24 et l'IEC 60335-2-40, sur l'application finale et d'utiliser ces essais pour la détermination finale d'acceptabilité.

APPAREILS ÉLECTRODOMESTIQUES ET ANALOGUES – SÉCURITÉ –

Partie 2-34: Exigences particulières pour les motocompresseurs

1 Domaine d'application

L'article de la Partie 1 est remplacé par le texte suivant.

La présente partie de l'IEC 60335 traite de la sécurité des **motocompresseurs** étanches (de type hermétique et hermétique accessible) et, le cas échéant, de leurs systèmes de protection et de commande, qui sont destinés à être utilisés sur les appareils électrodomestiques et analogues et qui sont conformes aux normes applicables à de tels matériels. Elle s'applique aux **motocompresseurs** soumis à l'essai séparément, dans les conditions les plus défavorables qui peuvent se produire en usage normal, dont la **tension assignée** est inférieure ou égale à 250 V pour les **motocompresseurs** monophasés et à 600 V pour les autres **motocompresseurs**.

La présente norme couvre également:

– les **motocompresseurs** à plusieurs vitesses, qui sont des **motocompresseurs** dont la vitesse peut être réglée sur différentes valeurs;

– les **motocompresseurs** à capacité variable, qui sont des **motocompresseurs** dont la capacité du compresseur est contrôlée à des vitesses fixes.

NOTE 101 Des exemples d'appareils équipés de motocompresseurs sont:

– les sèche-linge (IEC 60335-2-11);

– les appareils de réfrigération, les sorbetières et les fabriques de glace (IEC 60335-2-24);

– les pompes à chaleur électriques, les climatiseurs et les déshumidificateurs (IEC 60335-2-40);

– les distributeurs commerciaux avec ou sans moyen de paiement (IEC 60335-2-75);

– les appareils de réfrigération et fabriques de glace à usage commercial avec une unité de fluide frigorigène ou un motocompresseur incorporés ou à distance (IEC 60335-2-89);

– les appareils électriques de mesurage, de régulation et de laboratoire (IEC 61010-2-011);

– les fabriques de crème glacée à usage professionnel (IEC 60335-2-118);

– les systèmes frigorifiques et pompes à chaleur (ISO 5149-2).

La présente norme ne remplace pas les exigences des normes applicables aux appareils dans lesquels sont utilisés les **motocompresseurs**. Toutefois, si le type de **motocompresseur** utilisé est conforme à la présente norme, il peut ne pas être nécessaire d'effectuer les essais sur l'appareil ou l'ensemble particulier pour les **motocompresseurs** spécifiés dans les normes applicables à ces appareils. Si le **dispositif de commande du motocompresseur** est associé au dispositif de commande d'un appareil particulier, il peut être nécessaire d'effectuer des essais supplémentaires sur l'appareil final.

Dans la mesure du possible, la présente norme traite des dangers courants que présentent les **motocompresseurs** utilisés dans des appareils et auxquels sont exposés tous les individus situés à l'intérieur et autour de l'habitation. Cependant, cette norme ne tient pas compte en général:

– de l'utilisation des appareils par de jeunes enfants ou des personnes handicapées sans surveillance;

– de l'utilisation des appareils comme jouet par de jeunes enfants.

NOTE 102 L'attention est attirée sur le fait que:

– pour les **motocompresseurs** destinés à être utilisés dans des véhicules ou à bord de navires, des exigences supplémentaires peuvent être nécessaires;

– dans de nombreux pays, des exigences supplémentaires sont spécifiées par les organismes nationaux de la santé, par les organismes nationaux responsables de la protection des travailleurs et par des organismes similaires.

La présente norme ne s'applique pas:

– aux **motocompresseurs** prévus exclusivement pour des usages industriels;

– aux **motocompresseurs** utilisés dans des appareils destinés à être employés dans des locaux qui présentent des conditions particulières, telles que la présence d'une atmosphère corrosive ou explosive (poussière, vapeur ou gaz).

NOTE 103 Si les **motocompresseurs** pour le fluide frigorigène R-744 utilisé dans les appareils équipés d'un **système de réfrigération transcritique** comportent des **limiteurs de pression**, la conformité de ces dispositifs aux exigences établies est vérifiée pendant les essais sur l'appareil final.

2 Références normatives

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

Addition:

IEC 60079-1:2014, *Atmosphères explosives – Partie 1: Protection du matériel par enveloppes antidéflagrantes "d"*

IEC 60079-15:2017, *Atmosphères explosives – Partie 15: Protection du matériel par mode de protection "n"*

IEC 60851-4:2016, *Fils de bobinage – Méthodes d'essai – Partie 4: Propriétés chimiques*

IEC 60851-5:2008, *Fils de bobinage – Méthodes d'essai – Partie 5: Propriétés électriques*
IEC 60851-5:2008/AMD1:2011
IEC 60851-5:2008/AMD2:2019[1]

ISO 817:2014, *Fluides frigorigènes – Désignation et classification de sûreté (disponible en anglais seulement)*
ISO 817:2014/AMD1:2017

ISO 7010:2019, *Symboles graphiques – Couleurs de sécurité et signaux de sécurité – Signaux de sécurité enregistrés*

3 Termes et définitions

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

3.1 Définitions relatives aux caractéristiques physiques

3.1.101
pression nominale
pression manométrique attribuée à un **système de réfrigération transcritique**

Note 1 à l'article: Elle est spécifiée pour le côté haute pression d'un système de réfrigération.

[1] Il existe une édition consolidée 4.2:2019 qui comprend l'édition 4 et ses Amendements 1 et 2.

3.1.102
catégorie d'application
contre-pression qui correspond à la plage des températures d'évaporation dans laquelle le **motocompresseur** fonctionne

Note 1 à l'article: Dans le cadre de la présente norme, les classifications suivantes de **catégories d'applications** sont établies d'après la température d'évaporation maximale:

– très basse contre-pression (VLBP, *Very Low Back Pressure*): température d'évaporation maximale de –25 °C;
– basse contre-pression (LBP, *Low Back Pressure*): température d'évaporation maximale de –15 °C;
– moyenne contre-pression (MBP, *Medium Back Pressure*): température d'évaporation maximale de 0 °C;
– haute contre-pression (HBP, *High Back Pressure*): température d'évaporation maximale de +15 °C;
– très haute contre-pression (VHBP, *Very High Back Pressure*): température d'évaporation maximale de +30 °C;
– contre-pression R-744 sous-critique (SC R-744BP): température d'évaporation maximale de –15 °C.

3.5 Définitions relatives aux types d'appareils

3.5.101
motocompresseur
appareil composé du mécanisme mécanique du compresseur et du moteur, enfermés ensemble dans un même **boîtier** étanche, sans joints d'arbre extérieurs, où le moteur fonctionne dans une atmosphère de fluide frigorigène, avec ou sans huile

Note 1 à l'article: Le **boîtier** peut être scellé de façon permanente par soudage ou par brasage (**motocompresseur hermétique**) ou peut être scellé par des joints d'étanchéité (**motocompresseur hermétique accessible**). Une boîte de raccordement, un couvercle de boîte de raccordement et d'autres composants électriques ou un dispositif de commande électronique peuvent également être inclus.

Note 2 à l'article: Dans le présent document, le terme **motocompresseur** est utilisé pour désigner indifféremment un **motocompresseur hermétique** ou un **motocompresseur hermétique accessible**.

3.5.102
motocompresseur biétagé
motocompresseur qui comporte deux compresseurs et un moteur au sein d'un même **boîtier**

3.6 Définitions relatives aux parties d'un appareil

3.6.101
boîtier
enveloppe étanche de l'ensemble **motocompresseur** qui renferme le mécanisme du compresseur et le moteur, et qui est soumise aux pressions du fluide frigorigène

3.6.102
relais de démarrage
dispositif de commande électrique conçu pour être intégré ou incorporé dans un **motocompresseur** et utilisé dans le circuit de commande du **motocompresseur** pour commander le démarrage des **motocompresseurs** monophasés

3.7 Définitions relatives aux composants de sécurité

3.7.101
protecteur thermique du moteur
commande automatique montée dans ou sur le **motocompresseur**, qui est conçue spécifiquement pour protéger le **motocompresseur** contre les surchauffes dues aux surcharges et les défaillances de démarrage

Note 1 à l'article: Ce dispositif est traversé par le courant du **motocompresseur** et est sensible à l'un des éléments suivants ou aux deux:

– la température du **motocompresseur**;
– l'intensité du courant du **motocompresseur**.

Note 2 à l'article: Ce dispositif peut être réarmé (soit manuellement, soit automatiquement) lorsque sa température redescend à la valeur de réarmement.

3.7.102
dispositif de protection du motocompresseur
protecteur thermique du moteur et ses composants associés éventuels, ou **dispositif électronique de protection** complètement ou partiellement séparé, ou intégré dans le **dispositif de commande du motocompresseur**, qui est conçu spécifiquement pour protéger le **motocompresseur** contre les surchauffes dues aux surcharges et les défaillances de démarrage

Note 1 à l'article: Ce dispositif est traversé par le courant du **motocompresseur** et est sensible à l'un des éléments suivants ou aux deux:

– la température du **motocompresseur**;

– l'intensité du courant du **motocompresseur**.

3.7.103
dispositif de commande du motocompresseur
dispositif qui comporte un ou plusieurs **composants électroniques** ou électriques, ou des **circuits électroniques**, et qui assure au moins l'une des fonctions suivantes:

– fonctions de commande de démarrage du **motocompresseur**;

– fonctions de commande de la puissance frigorifique du **motocompresseur**

3.7.104
limiteur de pression
dispositif de détection de la pression dont la fonction est de réduire automatiquement la pression lorsque les pressions à l'intérieur du système de réfrigération dépassent la pression préréglée du dispositif

Note 1 à l'article: Ce dispositif ne comporte aucune fonction de réglage par l'utilisateur final.

3.8 Définitions relatives à des sujets divers

3.8.101
système de réfrigération transcritique
système de réfrigération dans lequel la pression du côté haute pression est supérieure à la pression pour laquelle les états liquide et de vapeur du fluide frigorigène peuvent coexister en équilibre thermodynamique

3.8.102
motorette
modèle de système d'isolation conçu pour représenter l'ensemble des éléments d'un système d'isolation à fils jetés

4 Exigences générales

L'article de la Partie 1 est applicable.

5 Conditions générales d'essais

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

5.2 *Addition:*

Au moins un échantillon supplémentaire est exigé pour les essais de l'Article 19. Cependant, d'autres échantillons peuvent également être fournis ou sont nécessaires.

Pour l'essai du 22.7, deux échantillons du boîtier sont exigés.

5.6 *Addition:*

*Les **motocompresseurs** à vitesse variable doivent fonctionner à la vitesse maximale.*

5.7 *Remplacement:*

Les essais sont effectués à une température ambiante de 20 °C ± 5 °C.

5.8.2 *Addition:*

*Les **motocompresseurs** qui sont équipés de **dispositifs de protection du motocompresseur à réarmement automatique** et qui sont conçus pour fonctionner à plusieurs **tensions assignées**, sont soumis aux essais du 19.101 et du 19.103 en appliquant la tension la plus élevée.*

5.10 *Addition:*

*Pour les essais de l'Article 19, le ou les échantillons supplémentaires doivent être identiques à tous égards à l'échantillon d'essai; ils sont chargés d'huile, si nécessaire, et de fluide frigorigène sous forme de vapeur. L'échantillon doit être équipé du **dispositif de protection du motocompresseur**, du **relais de démarrage**, du condensateur de démarrage, du condensateur de marche et, le cas échéant, du dispositif de commande, spécifiés par le fabricant, mais le rotor doit avoir été bloqué par le fabricant.*

*Le fabricant ou l'agent responsable doit fournir les informations suivantes pour chaque type de **motocompresseur** soumis aux essais:*

- *le type d'isolation de l'enroulement (synthétique ou cellulosique);*
- *l'identification du fluide frigorigène:*
  - a) *pour un fluide frigorigène qui comporte un seul composant, au moins l'une des informations suivantes:*
    - *dénomination chimique;*
    - *formule chimique;*
    - *numéro du fluide frigorigène;*
  - b) *pour un mélange de fluides frigorigènes, au moins l'une des informations suivantes:*
    - *dénomination chimique et proportion nominale de chacun des composants;*
    - *formule chimique et proportion nominale de chacun des composants;*
    - *numéro du fluide frigorigène et proportion nominale de chacun des composants;*
    - *numéro de fluide frigorigène du mélange de fluides frigorigènes;*
- *les types et la quantité d'huile à utiliser si les échantillons d'essai ne sont pas déjà chargés;*
- *la ou les **catégories d'applications** pour les motocompresseurs classés comme ayant été soumis aux essais spécifiés à l'Annexe AA;*
- *une indication qui précise si un **câble d'alimentation** peut être raccordé directement aux bornes du **motocompresseur**;*
- *pour les motocompresseurs destinés à être utilisés avec des appareils équipés d'un système de réfrigération transcritique, la pression d'essai pour le côté haute pression si celle-ci est supérieure à la pression d'essai minimale.*

5.11 *Remplacement*:

*Pour les **motocompresseurs** qui peuvent être utilisés dans des appareils dont le **câble d'alimentation** est raccordé directement aux bornes du **motocompresseur**, l'échantillon d'essai doit être équipé d'un **câble d'alimentation**.*

NOTE 101 Il n'est pas nécessaire que les échantillons supplémentaires éventuellement exigés pour les essais comportent des **câbles d'alimentation**.

5.101 *Les **motocompresseurs**, y compris ceux qui comportent des réchauffeurs de carter, sont soumis à l'essai comme des **appareils à moteur**.*

5.102 *Conformément au 6.104, les **dispositifs de protection** autres que le dispositif à l'essai déclaré doivent être désactivés pendant les essais spécifiés à l'Annexe AA et à l'Article 19. Si plusieurs **dispositifs de protection** sont déclarés, chacun doit être soumis à l'essai séparément.*

5.103 *Pour les systèmes en cascade qui comportent deux ou plusieurs circuits de motocompresseur, chaque circuit de* ***motocompresseur*** *est soumis à l'essai séparément dans le produit final. L'IEC 60335-2-34 n'est pas applicable pour le système, mais chaque* ***motocompresseur*** *peut être soumis à l'essai conformément à la présente norme.*

6 Classification

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

6.101 Les **motocompresseurs** qui ne comportent pas de **circuit électronique** incorporé ou associé sont classés comme ayant été soumis à l'essai avec ou sans l'Annexe AA.

Les **motocompresseurs** qui comportent un **circuit électronique** incorporé ou associé sont classés comme ayant été soumis aux essais de l'Annexe AA.

Les **motocompresseurs** peuvent être classés comme ayant été soumis aux essais de l'Annexe AA, uniquement si le **motocompresseur** associé au **dispositif de protection du motocompresseur** ou au **dispositif de commande du motocompresseur**, le cas échéant, peut être configuré de manière à fonctionner en délivrant la puissance frigorifique maximale, indépendamment des capteurs éventuels qui sont fournis uniquement dans le cadre de l'application finale.

6.102 Les **motocompresseurs** sont classés comme étant:

– prévus pour un raccordement direct du **câble d'alimentation** de l'appareil aux bornes du **motocompresseur**; ou

– non prévus pour un raccordement direct du **câble d'alimentation** de l'appareil aux bornes du **motocompresseur**.

NOTE 1 Dans les deux cas, les **motocompresseurs** peuvent être livrés avec ou sans les composants externes nécessaires au raccordement du **câble d'alimentation**.

NOTE 2 Les **motocompresseurs** prévus pour un raccordement direct du **câble d'alimentation** de l'appareil à leurs bornes peuvent également être utilisés sans raccorder le **câble d'alimentation** directement à leurs bornes.

NOTE 3 Si le **motocompresseur** est utilisé sans les composants adéquats ou avec des composants différents de ceux spécifiés par le fabricant, il peut être nécessaire d'effectuer des essais supplémentaires conformément à la norme applicable à l'appareil considéré.

La conformité est vérifiée par un examen et par les essais applicables.

6.103 Les **motocompresseurs** sont classés comme étant protégés ou non par des **circuits électroniques de protection**.

Cela n'exclut pas l'incorporation des **circuits électroniques de protection** fournis dans le produit final; dans ce cas, plusieurs des essais de la présente norme doivent être effectués sur le produit final.

La conformité est vérifiée par un examen et par les essais applicables.

6.104 Le fabricant du **motocompresseur** doit déclarer les dispositifs de protection du moteur, le **protecteur thermique du moteur**, la protection par impédance, le **circuit électronique de protection**, ou une combinaison de ces éléments.

La conformité est vérifiée par un examen et par les essais applicables.

6.105 Les **motocompresseurs** qui utilisent le fluide frigorigène R744 doivent être classés comme étant utilisés dans un **système de réfrigération transcritique** ou dans un **système de réfrigération** sous-critique.

La conformité est vérifiée par un examen et par les essais applicables.

7 Marquage et instructions

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

7.1 *Modification:*

Il n'est pas nécessaire de marquer la **puissance assignée** ou le **courant assigné** sur l'appareil.

Addition:

Les **motocompresseurs** adaptés pour une utilisation avec des fluides frigorigènes inflammables doivent être marqués du symbole d'avertissement ISO 7010 W021 (2011-05).

7.5 Non applicable.

7.6 *Addition:*

[signal d'avertissement ISO 7010 W021 (2011-05)]

Mise en garde: risque d'incendie/matière inflammable

7.7 Non applicable.

7.12 Non applicable, à l'exception du 7.12.1 qui est applicable.

7.13 Non applicable.

7.14 *Addition:*

La hauteur du triangle du symbole ISO 7010 W021 (2011-05) doit être d'au moins 15 mm.

7.101 Les fluides frigorigènes qui peuvent être utilisés avec le **motocompresseur** doivent être répertoriés dans les instructions.

La conformité est vérifiée par un examen.

8 Protection contre l'accès aux parties actives

L'article de la Partie 1 est applicable.

9 Démarrage des appareils à moteur

L'article de la Partie 1 n'est pas applicable.

10 Puissance et courant

L'article de la Partie 1 n'est pas applicable.

11 Echauffements

L'article de la Partie 1 est remplacé par l'Annexe AA. Pour les motocompresseurs classés comme ayant été soumis à l'essai sans l'Annexe AA, la conformité à cet article doit être vérifiée en soumettant à l'essai un système complet dans l'application finale conformément à la norme applicable à l'appareil considéré.

12 Vacant

13 Courant de fuite et rigidité diélectrique à la température de régime

L'article de la Partie 1 n'est pas applicable, à l'exception du 13.3, comme exigé en 19.104.

13.3 *Addition:*

Dans le Tableau 4, ajouter le texte suivant dans la note de bas de tableau a:

*La tension d'essai pour les appareils multiphasés de 600 V est celle spécifiée pour une **tension de service** > 250 V, où U est la **tension assignée**.*

14 Surtensions transitoires

L'article de la Partie 1 est applicable.

15 Résistance à l'humidité

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

15.3 *Addition:*

L'exigence doit s'appliquer pour les **motocompresseurs** qui ne comportent pas de bornes isolées par du verre, mais qui sont destinés à être raccordés à des dispositifs de commande, des dispositifs de protection ou d'autres composants externes.

16 Courant de fuite et rigidité diélectrique

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

16.3 *Addition:*

Dans le Tableau 7, ajouter le texte suivant dans la note de bas de tableau a:

*La tension d'essai pour les appareils multiphasés de 600 V est celle spécifiée pour une **tension de service** > 250 V, où U est la **tension assignée**.*

17 Protection contre la surcharge des transformateurs et des circuits associés

L'article de la Partie 1 est applicable.

18 Endurance

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

18.101 Si le fabricant le demande, l'essai d'endurance spécifié à l'Annexe EE doit être effectué.

19 Fonctionnement anormal

L'article de la Partie 1 est applicable, avec les exceptions suivantes.

19.1 *Modification:*

Remplacer les modalités d'essais par le texte suivant:

*Les **motocompresseurs** sont soumis aux essais du 19.14, du 19.15, du 19.101, du 19.102, du 19.103 et, si la classification du 6.101 l'exige, aux essais spécifiés à l'Annexe AA.*

*Les **motocompresseurs** qui incorporent des **circuits électroniques** sont également soumis aux essais du 19.11 et du 19.12.*

Une seule condition anormale est simulée à chaque fois.

La conformité aux essais du 19.11 et du 19.12 est vérifiée comme décrit en 19.13. La conformité aux essais du 19.101, du 19.102 et du 19.103 est vérifiée comme décrit en 19.104. La conformité aux essais de l'Annexe AA est vérifiée comme décrit à l'Annexe AA.

19.2 à **19.10** Non applicables.

19.11.2 *Addition:*

*Pour simuler les conditions de défaut, un **motocompresseur** avec son **circuit électronique** incorporé ou associé est raccordé au circuit de réfrigération de substitution de la Figure AA.1 et mis en fonctionnement dans les conditions spécifiées à l'Annexe AA. Les conditions appliquées constituent l'étape qui précède celle qui a provoqué le déclenchement du **dispositif de protection** ou le blocage du motocompresseur lors des essais du Tableau AA.2.*

19.11.3 *Remplacement:*

*Si le **motocompresseur** est classé comme étant protégé par un **circuit électronique de protection** et que celui-ci fonctionne de façon à assurer la conformité à l'Article 19 et à l'Annexe AA, les essais du 19.101, du 19.102, du 19.103 et de l'Annexe AA sont répétés en simulant un seul défaut, comme indiqué de a) à g) en 19.11.2.*

*Cependant, l'essai spécifié à l'Annexe AA n'est pas répété si pendant l'essai de l'Annexe AA, pour les **motocompresseurs** classés comme ayant été soumis à l'essai de l'Annexe AA, le **dispositif de protection du motocompresseur** ne s'est pas déclenché. L'essai de l'Annexe AA n'est également pas répété sur les **motocompresseurs** qui sont classés comme ayant été soumis à l'essai sans l'Annexe AA.*

19.11.4 *Addition:*

Si les essais doivent être effectués, ceux-ci doivent être réalisés dans l'application du produit final.

NOTE 101 La réalisation de ces essais dans la présente partie 2 n'est pas obligatoire dans la mesure où ils sont effectués dans l'application du produit final.

19.13 *Addition:*

*Si le **motocompresseur** est destiné à utiliser des fluides frigorigènes inflammables, et que pendant les essais du 19.11.2 et du 19.11.3 un composant électrique a produit des étincelles ou des arcs, cela doit être consigné à moins que le composant soit une **partie intentionnellement faible** ou un **dispositif de protection du motocompresseur sans réarmement automatique**.*

19.14 *Remplacement:*

*Les **motocompresseurs** sont mis en fonctionnement dans les conditions indiquées dans le Tableau AA.1. Tout contacteur ou contact de relais qui fonctionne dans les conditions indiquées dans le Tableau AA.1 est mis en court-circuit.*

Si un relais ou un contacteur à plusieurs contacts est utilisé, tous les contacts sont mis en court-circuit simultanément.

*Tout relais ou contacteur qui fonctionne uniquement pour assurer l'alimentation du **motocompresseur** en fonctionnement normal et qui ne fonctionne pas en usage normal n'est pas mis en court-circuit.*

Si plusieurs relais ou contacteurs fonctionnent dans les conditions indiquées dans le Tableau AA.1, chacun de ces relais ou contacteurs est mis en court-circuit successivement.

*Pour les **motocompresseurs** qui utilisent d'autres condensateurs de démarrage, l'essai doit être effectué en utilisant chaque condensateur de démarrage successivement.*