

INTERNATIONAL STANDARD



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

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INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-34: Particular requirements for motor-compressors

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This commented version (CMV) of the official standard IEC 60335-2-34:2024 edition 7.0 allows the user to identify the changes made to the previous IEC 60335-2-34:2021 edition 6.0. Furthermore, comments from IEC SC 61C experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 60335-2-34 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. It is an International Standard.

This seventh edition cancels and replaces the sixth edition published in 2021. This edition constitutes a technical revision.

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

- a) alignment with IEC 60335-1:2020;
- b) in the scope added the rating up to 600 V (Clause 1);
- c) the definition of design pressure has been changed in maximum allowable pressure (3.1.101, 7.102, 22.7);
- d) introduction of maximum load conditions (MLC) as declared by the manufacturer (3.1.103, 5.6, 7.12, Annex AA);
- e) transcritical back pressure categories (R-744) have been introduced (3.1.102, Table AA.1, Table AA.2);
- f) new definition of coilette has been introduced (3.8.103);
- g) new definition of bypass valve has been introduced (3.8.104);
- h) the evaluation of motor-compressors using a motor-compressor control system has been clarified (6.101, 6.103, 6.104, 19.1);
- i) modification of electric strength test has been added (16.2);
- j) reference to the fatigue test has been deleted (Clause 18);
- k) compliance for pressure tests has been updated (22.7, Annex EE);
- l) reference for the motorette has been transferred from Annex BB to the new Annex FF;
- m) annex for insulation materials and parts has been updated and tie cord relaxation has been removed (Annex CC);
- n) new annex for motorette or coilette has been introduced (Annex FF).

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

Draft	Report on voting
61C/924/FDIS	61C/926/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/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 unless that edition precludes it; in that case, the latest edition that does not preclude it is used. It was established on the basis of the sixth edition (2020) 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: Particular 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations can 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 document 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.

Guidance documents concerning the application of the safety requirements for appliances can be accessed via TC 61 supporting documents on the IEC website

<https://www.iec.ch/tc61/supportingdocuments>

This information is given for the convenience of users of this International Standard and does not constitute a replacement for the normative text in this standard.

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~~ can 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~~ Horizontal publications, basic safety publications and group safety publications 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~~ can be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, ~~may~~ can be considered to comply with the standard.

NOTE 3 Standards dealing with non-safety aspects of household appliances are:

- IEC standards published by TC 59 concerning methods of measuring performance;
- CISPR 11, CISPR 14-1 and relevant IEC 61000-3 series standards concerning electromagnetic emissions;
- CISPR 14-2 concerning electromagnetic immunity;
- IEC standards published by TC 111 concerning environmental matters

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~~ can 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~~ can also be conducted on the **motor-compressor** separately in certain circumstances. The specification for this type testing is provided in Annex AA. However, it is possible that 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~~ will be conducted on the ~~final application~~ end product and used as the final determination of acceptability.

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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~~ **can** 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~~ multi-phase, 600 V direct-current (DC) **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~~ refrigerating equipment for measurement, control, and laboratory use (IEC 61010-2-011);
- professional ice-cream makers (IEC 60335-2-118);
- ~~refrigerating~~ professional 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, **it will not be necessary** for 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~~ **end product**.

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;
- **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), 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 purposes¹.
- ~~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/AMD2:2019¹

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

ISO 817:2014/AMD1:2017

ISO 817:2014/AMD2:2021

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.

¹ ~~There exists A consolidated edition 4-2:2019 that includes Edition 4 and its Amendment 1 and Amendment 2. A consolidated version of this document exists, comprising IEC 60851-5:2008, IEC 60851-5:2008/AMD1:2011 and IEC 60851-5:2008/AMD2:2019.~~

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.~~

3.1.101 **1**

maximum allowable pressure

PS

maximum pressure for which **motor-compressor** is designed, as specified by the manufacturer, taking into account expected end-use appliance conditions

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 $-25\text{ }^{\circ}\text{C}$;
- low back pressure (LBP): denotes a maximum evaporation temperature of $-15\text{ }^{\circ}\text{C}$;
- medium back pressure (MBP): denotes a maximum evaporation temperature of $0\text{ }^{\circ}\text{C}$;
- high back pressure (HBP): denotes a maximum evaporation temperature of $+15\text{ }^{\circ}\text{C}$;
- very high back pressure (VHBP): denotes a maximum evaporation temperature of $+30\text{ }^{\circ}\text{C}$;
- subcritical R-744 low back pressure (SC R-~~744BP~~744LBP): denotes a maximum evaporation temperature of $-15\text{ }^{\circ}\text{C}$;
- transcritical low back pressure (TC R-744LBP): denotes a maximum evaporation temperature of $-15\text{ }^{\circ}\text{C}$; **2**
- transcritical medium back pressure (TC R-744MBP): denotes a maximum evaporation temperature of $0\text{ }^{\circ}\text{C}$;
- transcritical high back pressure (TC R-744HBP): denotes a maximum evaporation temperature of $+15\text{ }^{\circ}\text{C}$;
- **maximum load condition (MLC)** declared by the manufacturer.

3.1.103

maximum load condition **3**

MLC

maximum application conditions at which the **motor-compressor** is allowed to operate as declared by the manufacturer

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~~ can be permanently sealed, such as by welding or brazing (**hermetic motor-compressor**) or ~~may~~ can 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~~ can 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

Note 1 to entry: All connecting tubes to the **motor-compressor** (e.g.: process tube, discharge tube, suction tube) are part of the **housing**.

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~~ **Motor-compressor protection system** 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~~ **Motor-compressor protection system** 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

Note 1 to entry: Random wound is used to describe a motor winding in which round insulated conductors occupy random positions in a slot.

3.8.103

coilette 4

modified arrangement of a **motorette** resembling a partially assembled motor

Note 1 to entry: **Coilette** is a **motorette** without the frame.

3.8.104

bypass valve 5

device that relieves high-side pressure into the low-side at a predetermined pressure differential

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~~ can also be provided or are needed.

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

*For the test of normative Annex EE, three samples of the **empty housing** are required.*

5.6 Addition:

*Variable speed **motor-compressors** shall run at maximum speed unless specified differently in declared **maximum load conditions (MLC)**.*

5.7 Replacement:

Tests are carried out in an ambient temperature of $20\text{ °C} \pm 5\text{ °C}$ unless specified differently in the standard.

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~~ one or more samples (running and locked rotor) shall be ~~identical in all respects to the test sample~~ provided, and if necessary, shall be charged with oil and vapour refrigerant. The sample ~~has to~~ shall 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 **normative 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 is 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~~ will not necessarily 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 **normative 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 or without **normative 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~~ **motor-compressor protection system** or not being protected by ~~protective electronic circuits~~ **motor-compressor protection system**.

This does not preclude the ~~protective electronic circuits~~ **motor-compressor protection system** 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~~ or 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.

6.106 The manufacturer shall declare any substitute material being used in normative Annex BB or normative Annex CC or normative Annex FF as previously tested.

Compliance is checked by inspection.

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.

Addition:

- When the **maximum load condition (MLC)** is declared by the manufacturer, the operating conditions shall be included in the manufacturer's instructions for the refrigerants used.

NOTE 1 Examples of operating conditions are:

- maximum evaporation temperature;
- maximum condensation temperature;
- maximum discharge pressure for transcritical system;
- maximum return gas temperature;
- maximum ambient temperature;
- maximum speed of inverter if 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.

7.102 The **maximum allowable pressure (PS)** for low and high side shall be indicated in the manufacturer's instruction.

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 **normative** 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~~ end product in accordance with the appropriate appliance standard.

12 ~~Void~~ Charging of metal-ion batteries

This clause of Part 1 is not applicable.

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 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.

15.1 Modification:

Replace the third paragraph with:

*After carefully wiping the external enclosure to remove any surplus water, an inspection shall show that there is no trace of water on insulation which could result in a reduction of **clearances** or **creepage distances** below the values specified in Clause 29. For appliances and parts of*

appliances with pins for insertion into socket-outlets an inspection shall show that no water has entered the enclosure.

~~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.

16.2 Modification:

The first sentence "*An AC test voltage is applied between **live parts** and:*" is replaced with:

*For **motor-compressors** for AC only or for both AC and DC, an AC test voltage is applied. For **motor-compressors** for DC only, a DC test voltage is applied. The test voltage is applied between **live parts** and:*

16.3 Addition:

In Table 7, add the following to 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:

*If the **motor-compressor** is classified as being protected by a **motor-compressor protection system**, the **motor-compressors** and the **motor-compressor protection system** ~~are~~ shall be 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 **normative Annex AA**.*

*If the **motor-compressor** is classified as not being protected by a **motor-compressor protection system** and such a system is not incorporated or associated with the **motor-***

*compressor in accordance with 6.103, the **motor-compressor** shall be submitted to the tests of 19.11, 19.12, 19.14, 19.15, 19.101, 19.102, 19.103 during the end product testing.*

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~~ *the component shall comply with 24.101, 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~~ end 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 with the locked-rotor**, 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 electromechanical 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~~ tested while cycling 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~~ may 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 60252-1:2010 including IEC 60252-1:2010/AMD1:2013.

NOTE 1 The test with the capacitors open-circuited ~~need~~ will not necessarily 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** with the **locked-rotor**, 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 them. In the **motor-compressor** originally tested, the **motor-compressor protection system** can be replaced 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, except as follows.

20.1 Not 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~~ normative Annex EE.

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) or an alternate test of 3,5 times the **maximum allowable pressure (PS)**. **6**
- 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~~290 **7** (subcritical):

Saturated vapour pressure at 70 °C (gauge with respect to atmospheric pressure at STP) = ~~2,89 MPa (28,9 bar)~~
2,486 MPa (24,86 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).~~

= 3,5 × 2,486 MPa (24,86 bar)
= 8,7 MPa (87 bar)
= 9,0 MPa (90 bar) when rounded up to the next 0,5 MPa (5 bar).

- for **transcritical refrigeration systems**, the highest of

- 3 times the ~~design~~ **maximum allowable pressure (PS)**; 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 manufacturer.

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 the following but not less than 2,5 MPa (25 bar):

- 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 an alternate test of 3 times the maximum allowable pressure (PS);~~
 - ~~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) or an alternate test 3 times the **maximum allowable pressure (PS)**;
- for **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~~ 3 times the ~~design pressure~~ **maximum allowable pressure (PS)**; 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 manufacturer.

NOTE 102 Example of test pressure calculation for R-~~22~~290 (subcritical):

Saturated vapour pressure at 20 °C (gauge with respect to atmospheric pressure at STP) = ~~0,81 MPa (8,1 bar)~~
0.736 MPa (7.36 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).~~
= 5 × 0.736 MPa (7,36 bar)
= 3,68 MPa (36,8 bar)
= 3,8 MPa (38 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)	
<i>Subcritical</i>			
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)
<i>Transcritical</i>			
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~~ shall 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 **normative Annex BB** or **motor-compressors** that do not use oil by test 16 in IEC 60851-4:2016 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 60851-4:2016, 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 **normative Annex CC**.

Testing according to **normative Annex BB** and **normative Annex CC** may be conducted simultaneously in one vessel.

Testing according to **normative Annex BB** and **normative Annex CC** may be replaced by **normative Annex FF**.

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

Substituting another film-coated winding wire that is similar with respect to properties being considered, such as top and bottom insulation coats, temperature class and other similar characteristics (e.g. "ANSI designation") is possible without the need for additional tests.

Substituting an identical insulation system part from an alternate supplier is possible by subjecting the part to a series of short-term tests, such as infrared analysis, thermo gravimetric analysis, electric strength or similar tests.

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~~ can arc or spark during **normal operation** ~~of the end product~~ and **abnormal operation** **8** shall comply with the requirements of IEC 60079-15:2017 or the requirements for level protection "dc" of IEC 60079-1:2014, as modified by **normative** 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~~ 600 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 $\leq \text{346 600 V}$, 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.

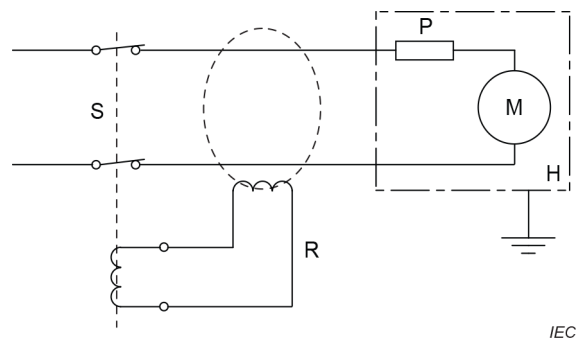
30.2.2 Not applicable.

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. $I_{\Delta n} = 30 \text{ mA RMS or DC max.}$
 $I_{\Delta n} = 30 \text{ mA}$

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

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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.

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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, IEC 60335-2-118.

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 shutdown.

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 2 h 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 2 h 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 $10 \text{ min} \pm 1,0 \text{ min}$ 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 <i>rated voltage</i>	VLBP	–25	+55	+43
1	1,06 <i>rated voltage</i>	LBP	–15	+65	+43
1	1,06 <i>rated voltage</i>	SC R-744 LBP	–15	+5	+25
1	1,06 <i>rated voltage</i>	MBP	0	+65	+25
1	1,06 <i>rated voltage</i>	HBP	+15	+65	+25
1	1,06 <i>rated voltage</i>	VHBP	+30	+70	+43
1	1,06 <i>rated voltage</i>	MLC	Defined by the manufacturer 9		
2	0,94 <i>rated voltage</i>	VLBP	–25	+55	+43
2	0,94 <i>rated voltage</i>	LBP	–15	+65	+43
2	0,94 <i>rated voltage</i>	SC R-744 LBP	–15	+5	+25
2	0,94 <i>rated voltage</i>	MBP	0	+65	+25
2	0,94 <i>rated voltage</i>	HBP	+15	+65	+25
2	0,94 <i>rated voltage</i>	VHBP	+30	+70	+43
2	0,94 <i>rated voltage</i>	MLC	Defined by the manufacturer		
Condition for transcritical R744 (CO2) systems					
Test Number	Applied Voltage	Application category	Evaporation temperature °C	Discharge Pressure MPa	Return gas temperature °C
1	1,06 <i>rated Voltage</i>	TC R-744LBP	–15	7,5	+25
1	1,06 <i>rated Voltage</i>	TC R-744MBP	0	10,0	+25
1	1,06 <i>rated Voltage</i>	TC R-744HBP	+15	13,5	+25
1	1,06 <i>rated Voltage</i>	MLC	Defined by the manufacturer		
2	0,94 <i>rated Voltage</i>	TC R-744LBP	–15	7,5	+25
2	0,94 <i>rated Voltage</i>	TC R-744MBP	0	10,0	+25
2	0,94 <i>rated Voltage</i>	TC R-744HBP	+15	13,5	+25
2	0,94 <i>rated Voltage</i>	MLC	Defined by the manufacturer		
The application category abbreviations can be found in 3.1.102.					
Definition of maximum load condition (MLC) can be found in 3.1.103.					
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 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, and the discharge pressure of the transcritical condition R744 system is $\pm 0,1$ MPa (1 bar).

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.~~

Starting from conditions defined in Table AA.1, but at **rated voltage**, the **motor-compressor** load shall be increased by applying the steps in sequence until steady conditions are reached. Load increment follows the applicable steps as indicated in Table AA.2 except when the **maximum load conditions (MLC)** are declared by the manufacturer only voltage reduction starting from 94 % of rated voltage is required.

Procedure is continued until one of the following conditions occurs:

- **motor-compressor protection system** operates to disconnect the **motor-compressor** from the supply,
- **motor-compressor** stalls and steady conditions are reached.

NOTE For centrifugal **motor compressors**, aerodynamic surge, defined as the lowest flow condition at a compressor operating point, is equivalent to stall for the purpose of this test.

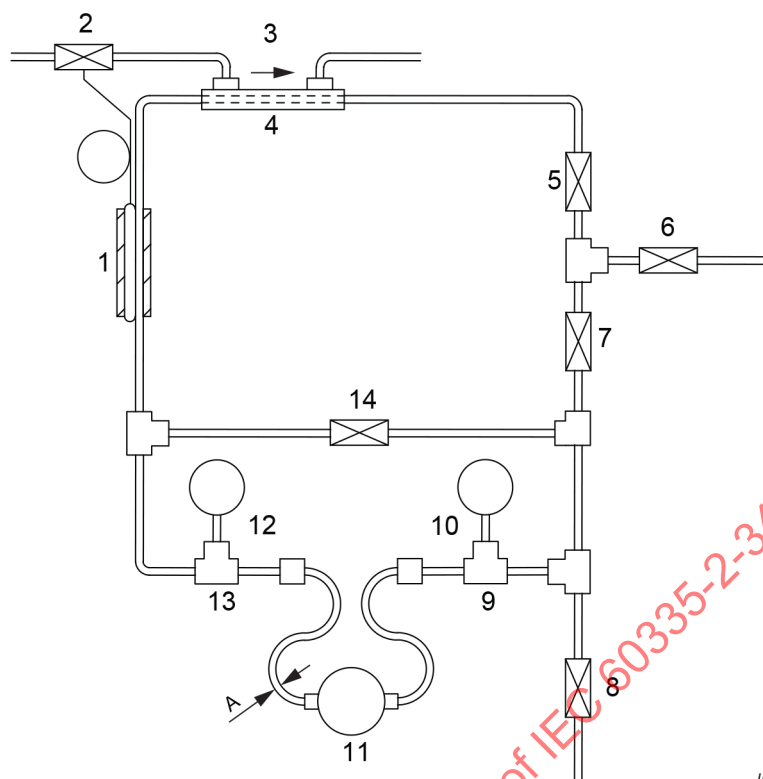
For a **motor-compressor** in which insulating materials were evaluated to Level 1 of Annex BB and Annex CC or Annex FF, the winding temperature at which one of the conditions occurred shall not exceed 150 °C for **motor-compressors** with cellulosic insulation or 160 °C for a **motor-compressor** with synthetic insulation. For a **motor-compressor** with synthetic insulating materials tested to Level 2 or 3 of Annex BB and Annex CC or Annex FF, the winding temperature shall not exceed 170 °C or 180 °C, respectively.

In addition, the maximum input current to the **motor-compressor** or the maximum input current to the electronic **control system**, if used, measured during any step of this clause testing, shall be recorded.

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

Step	Without electronic control system	With electronic control system	Procedure
For motor-compressors for subcritical application categories other than R-744			
1	A.	A.	Increase the condensing temperature to +70 °C
2	A.	A.	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
3	N.A	A.	Increase the input voltage to the electronic control system in steps of approximately 6 % of the rated voltage , up to 1,12 times the rated voltage
4	A.	A.	Starting from rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
For R-744 motor-compressors for subcritical application categories (SC R-744LBP)			
1	A.	A.	Increase the condensing temperature to +10 °C
2	A.	A.	Increase the evaporating temperature in steps of approximately 5 K up to 0 °C
3	N.A.	A.	Increase the input voltage to the electronic control system in steps of approximately 6 % of the rated voltage , up to 1,12 times the rated voltage
4	A.	A.	Starting from rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
For R-744 motor-compressors for transcritical application categories			
1	A.	A.	Increase the discharge pressure in steps of approximately 0,05 MPa up to the values indicated in Table AA.1 increased by 1 MPa
2	A.	A.	Increase the evaporating temperature in steps of approximately 5 K for
			– TC R-744LBP up to 0 °C
			– TC R-744MBP up to +10 °C
			– TC R-744HBP up to +20 °C
3	N.A	A.	Increase the input voltage to the electronic control system in steps of approximately 6 % of the rated voltage , up to 1,12 times the rated voltage
4	A.	A.	Starting from rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
For motor-compressors when maximum load conditions (MLC) are declared by the manufacturer			
1	A.	A.	Starting from 94 % of rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
NOTE A: Applicable; N.A: Not applicable.			



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 return gas temperature measuring point 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 to 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 IEC 60851-5:2008, 4.4.1 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).~~ **10**

~~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.~~

Winding wire insulation shall be described in the test report with the temperature limits and minimum thickness.

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 13,33 Pa (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 (10 bar) and 2,4 MPa (24 bar) for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa (73 bar).

BB.9 The ~~test~~ samples shall be tested as detailed in Table BB.1 using one of the following methods:

- a) The total heating time shall be divided into five equal heating periods. Each heating period is followed by a period ~~without~~ in which heating is not to be applied. The period without heating shall be at a temperature of ~~approximately~~ 25 °C ± 5 °C for not less than 48 h; or
- a) Heating shall be applied continuously for the entire total heating time.

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

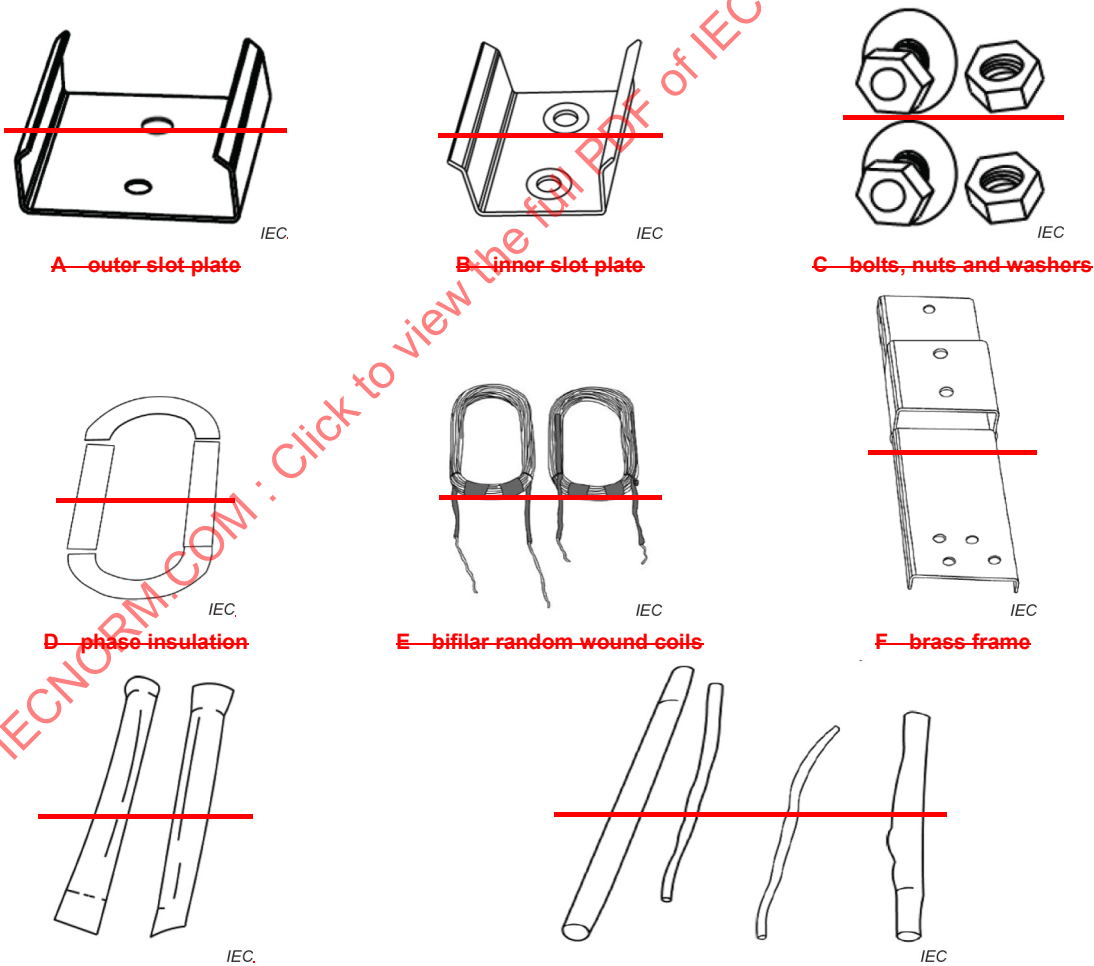
Table BB.1 – Time temperature heating cycles

Heating temperature °C	Total heating time h	Heating period h
Level 1		
140	1 440	288
145	4 080 1 018	216 204
150	720	144
155	540 509	108 102
Level 2		
150	1 440	288
155	1 018	204
160	360 720	72 144
165	509	102
Level 3		
160	1 440	288

165	1 018	204
170	720	144
175	240 509	48 102

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.~~



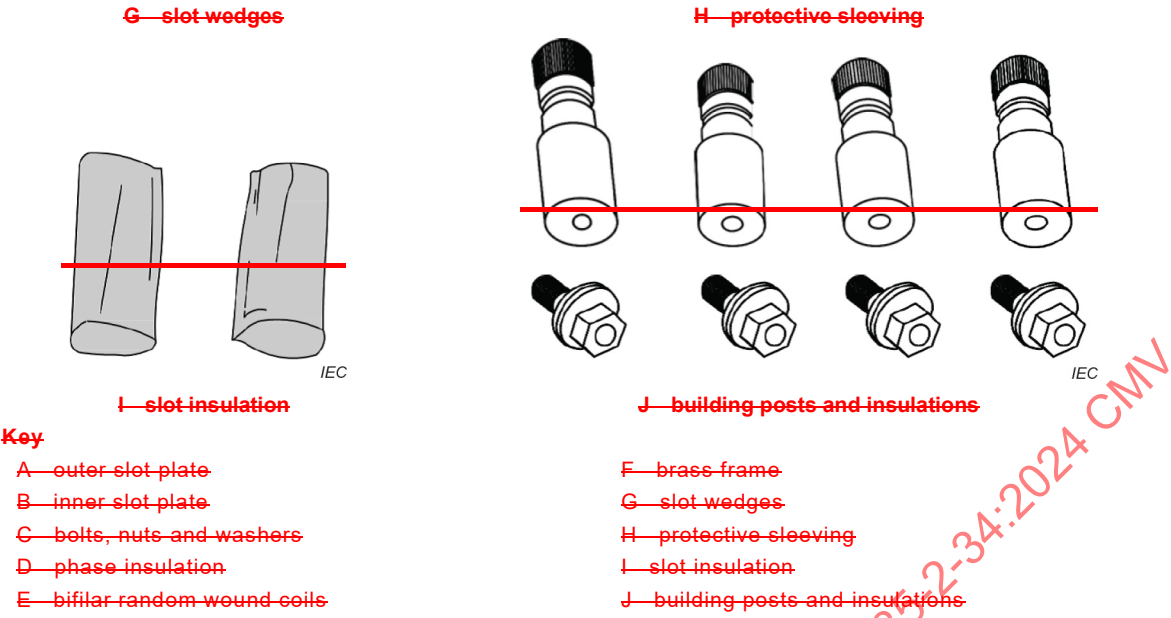
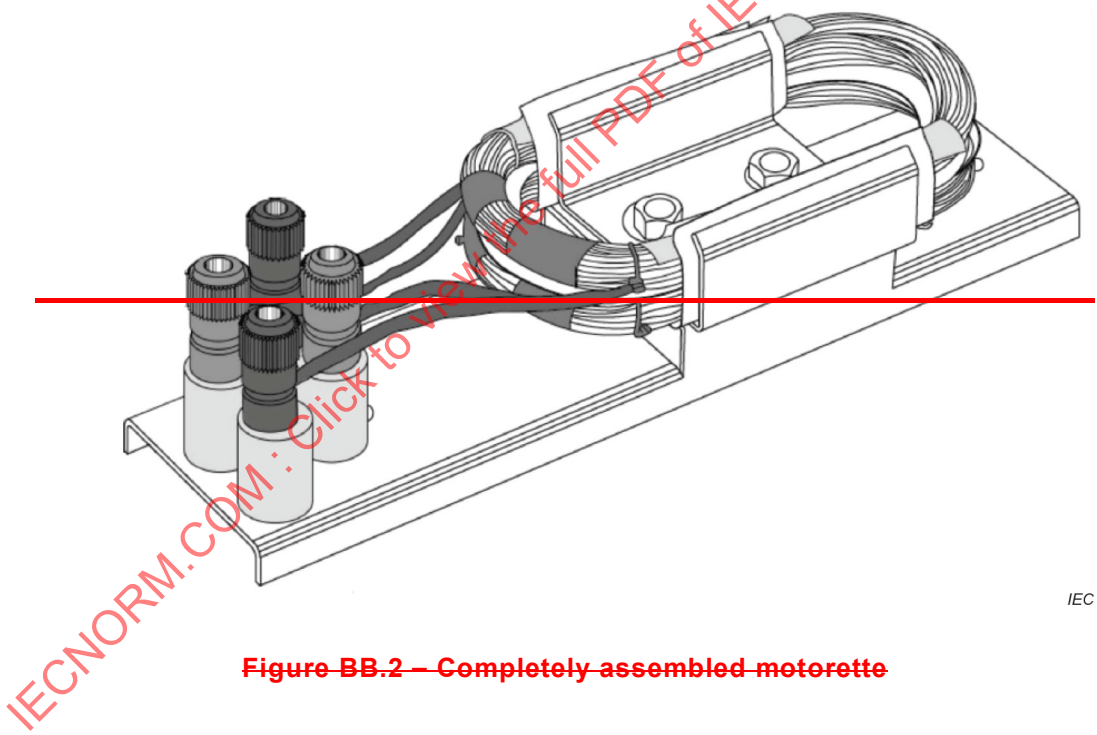


Figure BB.1— Motorette components



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**.

All insulation components shall be described in the test report with the temperature limits and minimum thickness.

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 test 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:~~ **11**

- 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 $\pm$ 10 mm/min. If a sample breaks within 10 mm of the jaw contact point, the results shall be disregarded and another sample tested.~~

Void

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

Void

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 13,33 Pa (100 μ m 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 (10 bar) and 2,4 MPa (24 bar) for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa (73 bar).

CC.12 The ~~test~~ samples shall be tested as detailed in ~~Table CC.1~~ Table BB.1 using one of the following methods:

- the **total** heating time shall be divided into five equal heating periods. Each heating period is followed by a period ~~without~~ in which heating is not to be applied. The period without heating shall be at a temperature of ~~approximately~~ 25 °C $\pm$ 5 °C for not less than 48 h; or
- heating shall be applied continuously for the entire total heating time.

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;~~
- a) void;
- 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.

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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: $(55 \pm 0,5)$ % hydrogen/air at atmospheric pressure; or

Group IIA: $(6,5 \pm 0,5)$ % 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.~~

EE.1 If subjected to the test specified in this annex, the **housing** shall not rupture, burst, or leak.

The pressures referenced in this annex shall be the specified percentage of the hydrostatic test pressures defined in 22.7.

EE.2 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 Clause EE.1 and maintained for 1 minute.

A **motor-compressor** employing a gasket or seal shall comply with Clause EE.2 and EE.3 even though visible leakage occurs at the gasket or seal. If visible leakage occurs, leakage shall not occur at or below 40 % of the test pressure required by Clause EE.1.

EE.3 Fatigue cycle test is as follows.

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.2.

The test pressure for the first cycle shall be 30 % of the test pressure defined in Clause EE.1.

The test pressure within each sample, for the remainder of the test cycles, shall be raised to not less than 26 % of the test pressure for low side defined by Clause EE.1 and lowered to not more than 6 % of the test pressure defined by Clause EE.1 for high side parts and not more than 0.1 MPa (1 bar) for low side parts, 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.

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

EE.4 Following the specified number of test cycles, the test pressure shall be increased to 45 % of the test pressure defined in Clause EE.1 and maintained for 1 minute without rupture, burst, or leak.

Annex FF (normative)

Motorette or coilette compatibility test 12

NOTE 1 Parts and materials that are not fabricated as part of the **motorette** or **coilette** but which are used inside a **motor-compressor housing** such as electrical insulating materials, tubing, wiring leads, terminal blocks and tie cords are evaluated using the method of Annex FF but can be included within the same test vessel(s) along with the **motorettes** or **coillettes** being tested according to this annex.

NOTE 2 Actual **motor-compressor** motors with windings arranged to allow the turn-to-turn tests can be substituted for this testing in place of **motorettes** or **coillettes**.

FF.1 Motorettes or coillettes shall be used for this test and be assembled with components representing the materials and parts used on the actual **motor-compressor**. Their construction shall be as follows:

- a) If **motorettes** are used, they shall be uniformly constructed but can vary slightly from the following description: The component parts of a **motorette** are as shown in Figure FF.1. Figure FF.3 shows a typical completely assembled **motorette**. A **motorette** 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 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 having minimum 15 tight turns each, insulated from ground by slot insulation, insulated from each other by phase insulation and held in place with slot wedges. The coils are each wound with two parallel wires so that conductor-to-conductor electrical tests can be made.
- b) If **coillettes** are used, they are not necessarily consistent in their construction but are typically described as follows: The component parts of a **coilette** are as shown in Figure FF.2. Figure FF.4 shows a typical completely assembled **coilette** consisting of a rigid supporting metal frame bolted together, made from an inner and outer plate fabricated from steel sheets approximately 1,5 mm thick. The assembled slot portion shall contain two coils having minimum 15 tight turns each, insulated from ground by slot cells, insulated from each other by phase insulation if used in the motor application, and held in place with slot wedges. Each coil shall be wound with two parallel wires so that turn-to-turn tests can be made.

All insulation components shall be described in the test report with the temperature limits and minimum thickness.

The components shown on Figure FF.1, Figure FF.2 and Figure FF.3 shall be disposed after the test is finished and shall not be used for any further test.

NOTE The **motorette** or **coilette** samples can be tested with or without the film-coating (varnish).

FF.2 Six samples of **motorettes** or **coillettes** shall be maintained in the as-received condition (no exposure to refrigerant and oil). Another six samples shall be prepared for the refrigerant and oil exposure testing.

FF.3 To establish uniformity, the six as-received samples of **motorettes** or **coillettes** shall be subjected to the electric strength test using the method of 16.3 except that the applied voltage shall be that specified for basic insulation at not less than 125 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** or **coilette** winding and insulation are intended to be used, but not less than 500 V. 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** or **coilette** coil. No breakdown shall occur on any of the samples.

The leakage test in 16.2 is not be conducted.

FF.4 The six **motorette** or **coilette** samples prepared for the refrigerant and oil exposure testing, along with any additional motor non-metallic materials, 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 13,33 Pa (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.

FF.5 The oil shall be added within each test vessel so that all samples will remain partially or fully immersed in the refrigerant-oil-mixture throughout the duration of the test, including during the no heat period, if any.

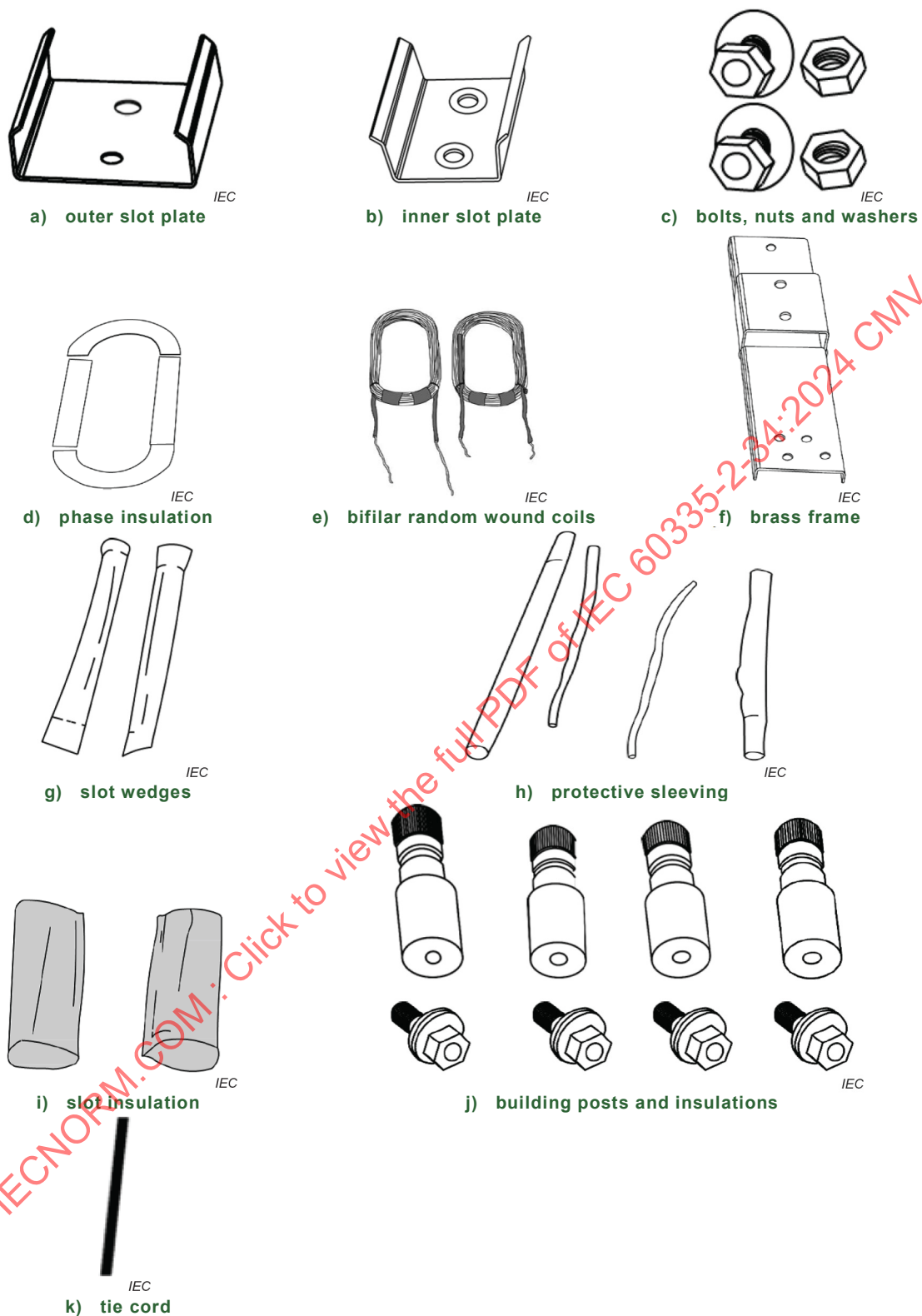
FF.6 Each test vessel shall then be re-sealed, evacuated and heated in accordance with Clause FF.4.

FF.7 For a single component refrigerant, each test vessel shall then be charged with the refrigerant vapor in a manner which does not permit air to be introduced into the test vessel. The pressure of the refrigerant vapor shall be any convenient pressure between 1,0 MPa (10 bar) and 2,4 MPa (24 bar) for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa (73 bar). For refrigerant blends, the test vessels shall be charged in a similar manner except that liquid refrigerant shall be used to prevent fractionation.

FF.8 The samples shall be tested as detailed in Table BB.1 using one of the following methods:

- a) The total heating time shall be divided into five equal heating periods. Each heating period is followed by a period in which heating is not to be applied. The period without heating shall be at a temperature of 25 °C ± 5 °C for not less than 48 h; or,
- b) Heating shall be applied continuously for the entire total heating time.

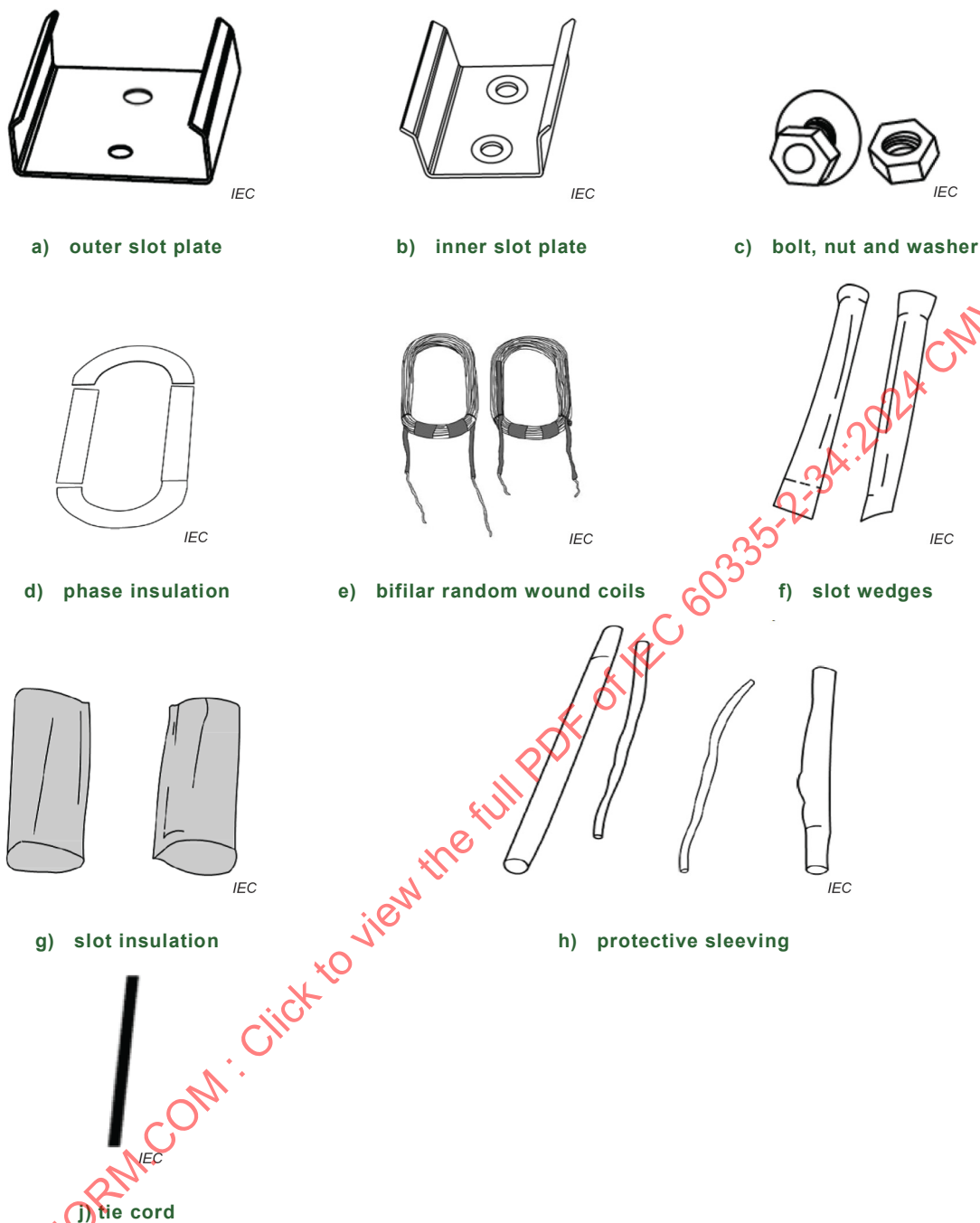
FF.9 Immediately after being exposed to the refrigerant and oil, the six samples of **motorettes** or **coilettes** shall be subjected to the electric strength test specified in Clause FF.3 except that the applied voltage shall be that specified for basic insulation at not less than 100 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** or **coilette** winding and insulation are intended to be used. 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** or **coilette** coil. Not less than five of the six samples shall withstand the application of the electric voltage without breakdown.



Key

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

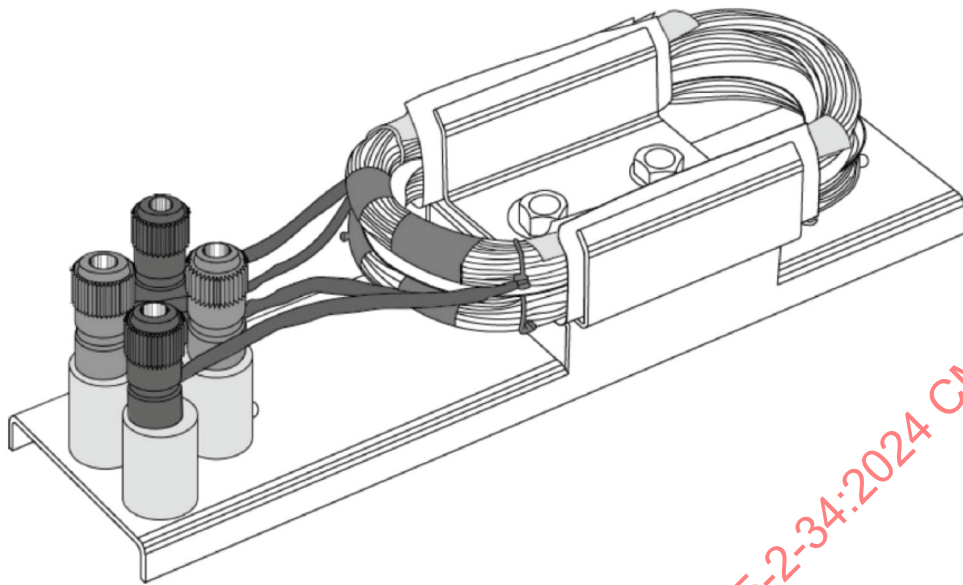
Figure FF.1 – Motorette components



Key

- | | |
|------------------------------|-----------------------|
| A outer slot plate | F slot wedges |
| B inner slot plate | G slot insulation |
| C bolt, nut and washer | H protective sleeving |
| D phase insulation | J tie cord |
| E bifilar random wound coils | |

Figure FF.2 – Coillette components



IEC

Figure FF.3 – Completely assembled motorette



IEC

Figure FF.4 – Completely assembled coilette

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~~

List of comments

- 1 Replacement of term “design pressure” with “maximum allowable pressure (PS)” to be used with all refrigerants and not for transcritical refrigeration systems as defined in the previous edition.

Introduction of alternative hydrostatic test using multiple for declared maximum allowable pressure (PS), see Subclause 22.7.
- 2 Transcritical back pressure categories (R-744) are introduced. See new categories in 3.1.102, Table AA.1 and Table AA.2.
- 3 Introduction of maximum load conditions (MLC) as declared by the manufacturer. This revision offers the alternate path to comply with Annex AA requirements instead of being held the limited conditions in the previous edition. See revisions in Annex AA.

See Subclause 7.12 for additional requirement when the MLC is used.
- 4 Coilette is just a different arrangement of a motorette defined in Subclause 3.8.102. See constructions and figures in Annex FF.
- 5 The definition of bypass valves is added considered they are mentioned in the text.
- 6 Introduction of alternative hydrostatic test using multiple for declared maximum allowable pressure (PS). See similar revisions in Subclause 22.7.

The maximum allowable pressure (PS) for low and high side shall be indicated in the manufacturer’s instruction (Subclause 7.102).
- 7 The R-22 is forbidden for a long time. Example is revised using the R-290. See also Note 102.
- 8 Considering that the Standards for the end products (e.g. IEC 60335-2-24, IEC 60335-2-89) require that components that arc/spark both during normal and abnormal operation, it is appropriate that this new edition of 60335-2-34 includes also the “abnormal operation”.
- 9 Revision of the Annex AA with introduction of maximum load conditions (MLC) as declared by the manufacturer. This revision offers the alternate path to comply with Annex AA requirements instead of being held the limited conditions in the previous edition. See similar revisions in Table AA.2.
- 10 Reference for the motorette is transferred from Annex BB to new Annex FF.
- 11 Tie cord requirement for Annex CC is deleted. The tie cord is used only for being present in the vessels, but no further tests are required for it.
- 12 Reference for the motorette is transferred from Annex BB to the new Annex FF. Also the coilette has been added (see definition in 3.8.103).

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES –
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IEC 60335-2-34 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. It is an International Standard.

This seventh edition cancels and replaces the sixth edition published in 2021. This edition constitutes a technical revision.

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

- a) alignment with IEC 60335-1:2020;
- b) in the scope added the rating up to 600 V (Clause 1);

- c) the definition of design pressure has been changed in maximum allowable pressure (3.1.101, 7.102, 22.7);
- d) introduction of maximum load conditions (MLC) as declared by the manufacturer (3.1.103, 5.6, 7.12, Annex AA);
- e) transcritical back pressure categories (R-744) have been introduced (3.1.102, Table AA.1, Table AA.2);
- f) new definition of coilette has been introduced (3.8.103);
- g) new definition of bypass valve has been introduced (3.8.104);
- h) the evaluation of motor-compressors using a motor-compressor control system has been clarified (6.101, 6.103, 6.104, 19.1);
- i) modification of electric strength test has been added (16.2);
- j) reference to the fatigue test has been deleted (Clause 18);
- k) compliance for pressure tests has been updated (22.7, Annex EE);
- l) reference for the motorette has been transferred from Annex BB to the new Annex FF;
- m) annex for insulation materials and parts has been updated and tie cord relaxation has been removed (Annex CC);
- n) new annex for motorette or coilette has been introduced (Annex FF).

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

Draft	Report on voting
61C/924/FDIS	61C/926/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/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 unless that edition precludes it; in that case, the latest edition that does not preclude it is used. It was established on the basis of the sixth edition (2020) 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: Particular 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

NOTE 4 The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations can 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 document 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.

Guidance documents concerning the application of the safety requirements for appliances can be accessed via TC 61 supporting documents on the IEC website

<https://www.iec.ch/tc61/supportingdocuments>

This information is given for the convenience of users of this International Standard and does not constitute a replacement for the normative text in this standard.

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 can 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 publications, basic safety publications and group safety publications 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.

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 can be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, can be considered to comply with the standard.

NOTE 3 Standards dealing with non-safety aspects of household appliances are:

- IEC standards published by TC 59 concerning methods of measuring performance;
- CISPR 11, CISPR 14-1 and relevant IEC 61000-3 series standards concerning electromagnetic emissions;
- CISPR 14-2 concerning electromagnetic immunity;
- IEC standards published by TC 111 concerning environmental matters

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 can 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 can also be conducted on the **motor-compressor** separately in certain circumstances. The specification for this type testing is provided in Annex AA. However, it is possible that the tests of the existing standards relevant to the given kind of application, such as IEC 60335-2-24 and IEC 60335-2-40, will be conducted on the end product and used as the final determination of acceptability.

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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 can 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 multi-phase, 600 V direct-current (DC) **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);
- refrigerating equipment for measurement, control, and laboratory use (IEC 61010-2-011);
- professional ice-cream makers (IEC 60335-2-118);
- professional 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, it will not be necessary for the tests for the **motor-compressor** specified in the particular appliance standard 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 end product.

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;
- **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), 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.

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/AMD2:2019¹

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

ISO 817:2014/AMD1:2017

ISO 817:2014/AMD2:2021

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

maximum allowable pressure

PS

maximum pressure for which **motor-compressor** is designed, as specified by the manufacturer, taking into account expected end-use appliance conditions

¹ A consolidated version of this document exists, comprising IEC 60851-5:2008, IEC 60851-5:2008/AMD1:2011 and IEC 60851-5:2008/AMD2:2019.

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 $-25\text{ }^{\circ}\text{C}$;
- low back pressure (LBP): denotes a maximum evaporation temperature of $-15\text{ }^{\circ}\text{C}$;
- medium back pressure (MBP): denotes a maximum evaporation temperature of $0\text{ }^{\circ}\text{C}$;
- high back pressure (HBP): denotes a maximum evaporation temperature of $+15\text{ }^{\circ}\text{C}$;
- very high back pressure (VHBP): denotes a maximum evaporation temperature of $+30\text{ }^{\circ}\text{C}$;
- subcritical R-744 low back pressure (SC R-744LBP): denotes a maximum evaporation temperature of $-15\text{ }^{\circ}\text{C}$;
- transcritical low back pressure (TC R-744LBP): denotes a maximum evaporation temperature of $-15\text{ }^{\circ}\text{C}$;
- transcritical medium back pressure (TC R-744MBP): denotes a maximum evaporation temperature of $0\text{ }^{\circ}\text{C}$;
- transcritical high back pressure (TC R-744HBP): denotes a maximum evaporation temperature of $+15\text{ }^{\circ}\text{C}$;
- **maximum load condition (MLC)** declared by the manufacturer.

3.1.103

maximum load condition

MLC

maximum application conditions at which the **motor-compressor** is allowed to operate as declared by the manufacturer

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** can be permanently sealed, such as by welding or brazing (**hermetic motor-compressor**) or can 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 can 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

Note 1 to entry: All connecting tubes to the **motor-compressor** (e.g.: process tube, discharge tube, suction tube) are part of the **housing**.

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: **Motor-compressor protection system** 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: **Motor-compressor protection system** 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

Note 1 to entry: Random wound is used to describe a motor winding in which round insulated conductors occupy random positions in a slot.

3.8.103

coilette

modified arrangement of a **motorette** resembling a partially assembled motor

Note 1 to entry: **Coilette** is a **motorette** without the frame.

3.8.104**bypass valve**

device that relieves high-side pressure into the low-side at a predetermined pressure differential

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 can also be provided or are needed.

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

*For the test of normative Annex EE, three samples of the empty **housing** are required.*

5.6 Addition:

*Variable speed **motor-compressors** shall run at maximum speed unless specified differently in declared **maximum load conditions (MLC)**.*

5.7 Replacement:

Tests are carried out in an ambient temperature of $20\text{ °C} \pm 5\text{ °C}$ unless specified differently in the standard.

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, one or more samples (running and locked rotor) shall be provided, and if necessary, shall be charged with oil and vapour refrigerant. The sample shall be provided with the **motor-compressor protection system**, **starting relay**, start capacitor, run capacitor and control system, if any, as specified 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 normative Annex AA;
 - whether a **supply cord** can be connected directly to terminals on the **motor-compressor**.

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 will not necessarily 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 normative Annex AA and Clause 19. If multiple **protective devices** are declared, each shall be tested independently.

6 Classification

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

6.101 Motor-compressors are classified as being tested with or without normative 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 **motor-compressor protection system** or not being protected by **motor-compressor protection system**.

This does not preclude the **motor-compressor protection system** being provided in the end product, in which case many of the tests of this standard shall be conducted on the end product.

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 or 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.

6.106 The manufacturer shall declare any substitute material being used in normative Annex BB or normative Annex CC or normative Annex FF as previously tested.

Compliance is checked by inspection.

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.

Addition:

- When the **maximum load condition (MLC)** is declared by the manufacturer, the operating conditions shall be included in the manufacturer's instructions for the refrigerants used.

NOTE 1 Examples of operating conditions are:

- maximum evaporation temperature;
- maximum condensation temperature;
- maximum discharge pressure for transcritical system;
- maximum return gas temperature;
- maximum ambient temperature;
- maximum speed of inverter if 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.

7.102 The **maximum allowable pressure (PS)** for low and high side shall be indicated in the manufacturer's instruction.

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 normative Annex AA. For **motor-compressors** classified as tested without Annex AA, compliance with this clause shall be tested as a complete system in the end product in accordance with the appropriate appliance standard.

12 Charging of metal-ion batteries

This clause of Part 1 is not applicable.

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 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.

15.1 Modification:

Replace the third paragraph with:

*After carefully wiping the external enclosure to remove any surplus water, an inspection shall show that there is no trace of water on insulation which could result in a reduction of **clearances** or **creepage distances** below the values specified in Clause 29. For appliances and parts of appliances with pins for insertion into socket-outlets an inspection shall show that no water has entered the enclosure.*

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.2 Modification:

The first sentence "An AC test voltage is applied between **live parts** and:" is replaced with:

*For **motor-compressors** for AC only or for both AC and DC, an AC test voltage is applied. For **motor-compressors** for DC only, a DC test voltage is applied. The test voltage is applied between **live parts** and:*

16.3 Addition:

In Table 7, add the following to footnote a:

*The test voltage for 600 V multi-phase appliances is that specified for a **working voltage** > 250 V where U is taken as the **rated voltage**.*

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is not applicable.

19 Abnormal operation

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

19.1 Modification:

Replace the test specification by the following:

*If the **motor-compressor** is classified as being protected by a **motor-compressor protection system**, the **motor-compressor** and the **motor-compressor protection system** shall be 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 normative Annex AA.*

If the **motor-compressor** is classified as not being protected by a **motor-compressor protection system** and such a system is not incorporated or associated with the **motor-compressor** in accordance with 6.103, the **motor-compressor** shall be submitted to the tests of 19.11, 19.12, 19.14, 19.15, 19.101, 19.102, 19.103 during the end product testing.

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, the component shall comply with 24.101, 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 end 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** with the locked-rotor, 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 electromechanical 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 tested while cycling 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 may 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 60252-1:2010 including IEC 60252-1:2010/AMD1:2013.

NOTE 1 The test with the capacitors open-circuited will not necessarily 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** with the locked-rotor, 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 them. In the **motor-compressor** originally tested, the **motor-compressor protection system** can be replaced 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, except as follows.

20.1 Not 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 normative Annex EE.

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) or an alternate test of 3,5 times the **maximum allowable pressure (PS)**.
- 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-290 (subcritical):

Saturated vapour pressure at 70 °C (gauge with respect to atmospheric pressure at STP) = 2,486 MPa (24,86 bar)

Test pressure = 3,5 × 2,486 MPa (24,86 bar)
 = 8,7 MPa (87 bar)
 = 9,0 MPa (90 bar) when rounded up to the next 0,5 MPa (5 bar).

- for **transcritical refrigeration systems**, the highest of
 - 3 times the **maximum allowable pressure (PS)**; 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 manufacturer.

Table 101 – Minimum high side test pressures

Refrigerant formulae	Refrigerant number	Test pressure	
		MPa (bar)	
Subcritical			
CF ₃ CH ₂ F	R-134a	7,5	(75)
CHClF ₂	R-22	10,5	(105)
CH ₂ F ₂	R-32	17,0	(170)
CH ₃ CH ₂ CH ₃	R-290	9,0	(90)
CF ₃ CF=CH ₂	R-1234yf	7,0	(70)
CF ₃ CH=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).			

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 the following but not less than 2,5 MPa (25 bar):

- for subcritical applications, other than those using R-744, 5 times the saturated vapour pressure of the refrigerant at 20 °C rounded up to the next 0,2 MPa (2 bar); or an alternate test of 3 times the **maximum allowable pressure (PS)**;
- 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) or an alternate test 3 times the **maximum allowable pressure (PS)**;
- for **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
 - 3 times the **maximum allowable pressure (PS)**; or
 - 5 times the saturated vapour pressure of the refrigerant at 20 °C rounded up to the next 0,2 MPa (2 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 manufacturer.

NOTE 102 Example of test pressure calculation for R-290 (subcritical):

Saturated vapour pressure at 20 °C (gauge with respect to atmospheric pressure at STP) = 0.736 MPa (7.36 bar)

Test pressure = 5×0.736 MPa (7,36 bar)

= 3,68 MPa (36,8 bar)

= 3,8 MPa (38 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)
<i>Subcritical</i>			
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)
<i>Transcritical</i>			
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).			

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.

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 shall 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.*

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 normative Annex BB or **motor-compressors** that do not use oil by test 16 in IEC 60851-4:2016 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 60851-4:2016, 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 normative Annex CC.*

Testing according to normative Annex BB and normative Annex CC may be conducted simultaneously in one vessel.

Testing according to normative Annex BB and normative Annex CC may be replaced by normative Annex FF.

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

Substituting another film-coated winding wire that is similar with respect to properties being considered, such as top and bottom insulation coats, temperature class and other similar characteristics (e.g. "ANSI designation") is possible without the need for additional tests.

Substituting an identical insulation system part from an alternate supplier is possible by subjecting the part to a series of short-term tests, such as infrared analysis, thermo gravimetric analysis, electric strength or similar tests.

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 can arc or spark during **normal operation** and abnormal operation shall comply with the requirements of IEC 60079-15:2017 or the requirements for level protection "dc" of IEC 60079-1:2014, as modified by normative 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 ≤ 600 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 ≤ 600 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.

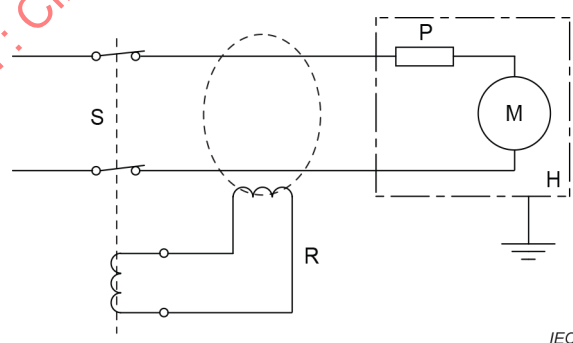
30.2.2 Not applicable.

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.

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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, IEC 60335-2-118.

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 shutdown.

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 2 h 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 2 h 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 $10 \text{ min} \pm 1,0 \text{ min}$ 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	SC R-744 LBP	–15	+5	+25
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
1	1,06 rated voltage	MLC	Defined by the manufacturer		
2	0,94 rated voltage	VLBP	–25	+55	+43
2	0,94 rated voltage	LBP	–15	+65	+43
2	0,94 rated voltage	SC R-744 LBP	–15	+5	+25
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
2	0,94 rated voltage	MLC	Defined by the manufacturer		

Condition for transcritical R744 (CO2) systems					
Test Number	Applied Voltage	Application category	Evaporation temperature °C	Discharge Pressure MPa	Return gas temperature °C
1	1,06 rated Voltage	TC R-744LBP	−15	7,5	+25
1	1,06 rated Voltage	TC R-744MBP	0	10,0	+25
1	1,06 rated Voltage	TC R-744HBP	+15	13,5	+25
1	1,06 rated Voltage	MLC	Defined by the manufacturer		
2	0,94 rated Voltage	TC R-744LBP	−15	7,5	+25
2	0,94 rated Voltage	TC R-744MBP	0	10,0	+25
2	0,94 rated Voltage	TC R-744HBP	+15	13,5	+25
2	0,94 rated Voltage	MLC	Defined by the manufacturer		
The application category abbreviations can be found in 3.1.102.					
Definition of maximum load condition (MLC) can be found in 3.1.103.					
NOTE For all tests, the motor-compressor ambient temperature is +43 °C.					

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, and the discharge pressure of the transcritical condition R744 system is $\pm 0,1$ MPa (1 bar).

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 steps in sequence until steady conditions are reached. Load increment follows the applicable steps as indicated in Table AA.2 except when the **maximum load conditions (MLC)** are declared by the manufacturer only voltage reduction starting from 94 % of rated voltage is required.

Procedure is continued until one of the following conditions occurs:

- **motor-compressor protection system** operates to disconnect the **motor-compressor** from the supply,
- **motor-compressor stalls** and steady conditions are reached.

NOTE For centrifugal **motor compressors**, aerodynamic surge, defined as the lowest flow condition at a compressor operating point, is equivalent to stall for the purpose of this test.

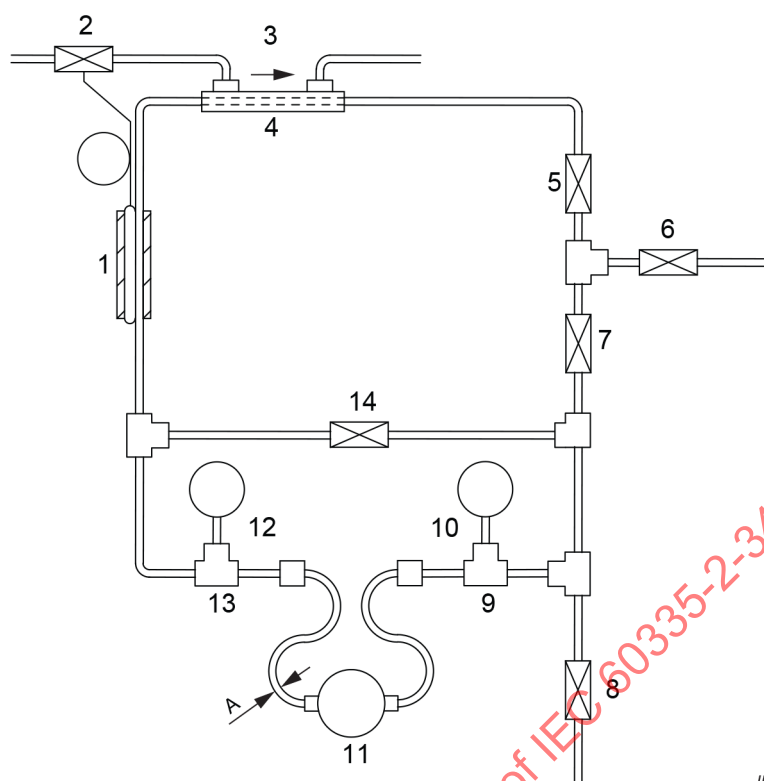
For a **motor-compressor** in which insulating materials were evaluated to Level 1 of Annex BB and Annex CC or Annex FF, the winding temperature at which one of the conditions occurred shall not exceed 150 °C for **motor-compressors** with cellulosic insulation or 160 °C for a **motor-compressor** with synthetic insulation. For a **motor-compressor** with synthetic insulating materials tested to Level 2 or 3 of Annex BB and Annex CC or Annex FF, the winding temperature shall not exceed 170 °C or 180 °C, respectively.

In addition, the maximum input current to the **motor-compressor** or the maximum input current to the electronic **control system**, if used, measured during any step of this clause testing, shall be recorded.

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

Step	Without electronic control system	With electronic control system	Procedure
<i>For motor-compressors for subcritical application categories other than R-744</i>			
1	A.	A.	Increase the condensing temperature to +70 °C
2	A.	A.	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
3	N.A.	A.	– VHBP up to +35 °C
			Increase the input voltage to the electronic control system in steps of approximately 6 % of the rated voltage , up to 1,12 times the rated voltage
4	A.	A.	Starting from rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
<i>For R-744 motor-compressors for subcritical application categories (SC R-744LBP)</i>			
1	A.	A.	Increase the condensing temperature to +10 °C
2	A.	A.	Increase the evaporating temperature in steps of approximately 5 K up to 0 °C
3	N.A.	A.	Increase the input voltage to the electronic control system in steps of approximately 6 % of the rated voltage , up to 1,12 times the rated voltage
4	A.	A.	Starting from rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
<i>For R-744 motor-compressors for transcritical application categories</i>			
1	A.	A.	Increase the discharge pressure in steps of approximately 0,05 MPa up to the values indicated in Table AA.1 increased by 1 MPa
2	A.	A.	Increase the evaporating temperature in steps of approximately 5 K for
			– TC R-744LBP up to 0 °C
			– TC R-744MBP up to +10 °C
3	N.A.	A.	– TC R-744HBP up to +20 °C
			Increase the input voltage to the electronic control system in steps of approximately 6 % of the rated voltage , up to 1,12 times the rated voltage
4	A.	A.	Starting from rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
<i>For motor-compressors when maximum load conditions (MLC) are declared by the manufacturer</i>			
1	A.	A.	Starting from 94 % of rated voltage , decrease the input voltage to the motor-compressor or to the electronic control system in steps of approximately 5 % of the rated voltage at a rate of approximately 2 V/min
NOTE A: Applicable; N.A: Not applicable.			



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 return gas temperature measuring point 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 to 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:

Film-coated winding wire shall be prepared in accordance with IEC 60851-5:2008, 4.4.1 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.

Winding wire insulation shall be described in the test report with the temperature limits and minimum thickness.

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.

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

BB.5 The set of six samples 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 13,33 Pa (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 (10 bar) and 2,4 MPa (24 bar) for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa (73 bar).

BB.9 The samples shall be tested as detailed in Table BB.1 using one of the following methods:

- a) The total heating time shall be divided into five equal heating periods. Each heating period is followed by a period in which heating is not to be applied. The period without heating shall be at a temperature of $25\text{ °C} \pm 5\text{ °C}$ for not less than 48 h; or
- b) Heating shall be applied continuously for the entire total heating time.

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
Level 1		
140	1 440	288
145	1 018	204
150	720	144
155	509	102
Level 2		
150	1 440	288
155	1 018	204
160	720	144
165	509	102
Level 3		
160	1 440	288
165	1 018	204
170	720	144
175	509	102

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.

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**.

All insulation components shall be described in the test report with the temperature limits and minimum thickness.

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 test 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 Void

CC.7 Void

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 13,33 Pa (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 (10 bar) and 2,4 MPa (24 bar) for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa (73 bar).

CC.12 The samples shall be tested as detailed in Table BB.1 using one of the following methods:

- a) the total heating time shall be divided into five equal heating periods. Each heating period is followed by a period in which heating is not to be applied. The period without heating shall be at a temperature of 25 °C ± 5 °C for not less than 48 h; or
- b) heating shall be applied continuously for the entire total heating time.

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

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

- a) void;
- b) 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: $(55 \pm 0,5)$ % hydrogen/air at atmospheric pressure; or

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

Annex EE (normative)

Fatigue test

EE.1 If subjected to the test specified in this annex, the **housing** shall not rupture, burst, or leak.

The pressures referenced in this annex shall be the specified percentage of the hydrostatic test pressures defined in 22.7.

EE.2 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 Clause EE.1 and maintained for 1 minute.

A **motor-compressor** employing a gasket or seal shall comply with Clause EE.2 and EE.3 even though visible leakage occurs at the gasket or seal. If visible leakage occurs, leakage shall not occur at or below 40 % of the test pressure required by Clause EE.1.

EE.3 Fatigue cycle test is as follows.

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.2.

The test pressure for the first cycle shall be 30 % of the test pressure defined in Clause EE.1.

The test pressure within each sample, for the remainder of the test cycles, shall be raised to not less than 26 % of the test pressure for low side defined by Clause EE.1 and lowered to not more than 6 % of the test pressure defined by Clause EE.1 for high side parts and not more than 0.1 MPa (1 bar) for low side parts, 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.

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

EE.4 Following the specified number of test cycles, the test pressure shall be increased to 45 % of the test pressure defined in Clause EE.1 and maintained for 1 minute without rupture, burst, or leak.

Annex FF (normative)

Motorette or coilette compatibility test

NOTE 1 Parts and materials that are not fabricated as part of the **motorette** or **coilette** but which are used inside a **motor-compressor housing** such as electrical insulating materials, tubing, wiring leads, terminal blocks and tie cords are evaluated using the method of Annex FF but can be included within the same test vessel(s) along with the **motorettes** or **coillettes** being tested according to this annex.

NOTE 2 Actual **motor-compressor** motors with windings arranged to allow the turn-to-turn tests can be substituted for this testing in place of **motorettes** or **coillettes**.

FF.1 Motorettes or coillettes shall be used for this test and be assembled with components representing the materials and parts used on the actual **motor-compressor**. Their construction shall be as follows:

- a) If **motorettes** are used, they shall be uniformly constructed but can vary slightly from the following description: The component parts of a **motorette** are as shown in Figure FF.1. Figure FF.3 shows a typical completely assembled **motorette**. A **motorette** 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 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 having minimum 15 tight turns each, insulated from ground by slot insulation, insulated from each other by phase insulation and held in place with slot wedges. The coils are each wound with two parallel wires so that conductor-to-conductor electrical tests can be made.
- b) If **coillettes** are used, they are not necessarily consistent in their construction but are typically described as follows: The component parts of a **coilette** are as shown in Figure FF.2. Figure FF.4 shows a typical completely assembled **coilette** consisting of a rigid supporting metal frame bolted together, made from an inner and outer plate fabricated from steel sheets approximately 1,5 mm thick. The assembled slot portion shall contain two coils having minimum 15 tight turns each, insulated from ground by slot cells, insulated from each other by phase insulation if used in the motor application, and held in place with slot wedges. Each coil shall be wound with two parallel wires so that turn-to-turn tests can be made.

All insulation components shall be described in the test report with the temperature limits and minimum thickness.

The components shown on Figure FF.1, Figure FF.2 and Figure FF.3 shall be disposed after the test is finished and shall not be used for any further test.

NOTE The **motorette** or **coilette** samples can be tested with or without the film-coating (varnish).

FF.2 Six samples of **motorettes** or **coillettes** shall be maintained in the as-received condition (no exposure to refrigerant and oil). Another six samples shall be prepared for the refrigerant and oil exposure testing.

FF.3 To establish uniformity, the six as-received samples of **motorettes** or **coillettes** shall be subjected to the electric strength test using the method of 16.3 except that the applied voltage shall be that specified for basic insulation at not less than 125 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** or **coilette** winding and insulation are intended to be used, but not less than 500 V. 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** or **coilette** coil. No breakdown shall occur on any of the samples.

The leakage test in 16.2 is not be conducted.

FF.4 The six **motorette** or **coilette** samples prepared for the refrigerant and oil exposure testing, along with any additional motor non-metallic materials, 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 13,33 Pa (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.

FF.5 The oil shall be added within each test vessel so that all samples will remain partially or fully immersed in the refrigerant-oil-mixture throughout the duration of the test, including during the no heat period, if any.

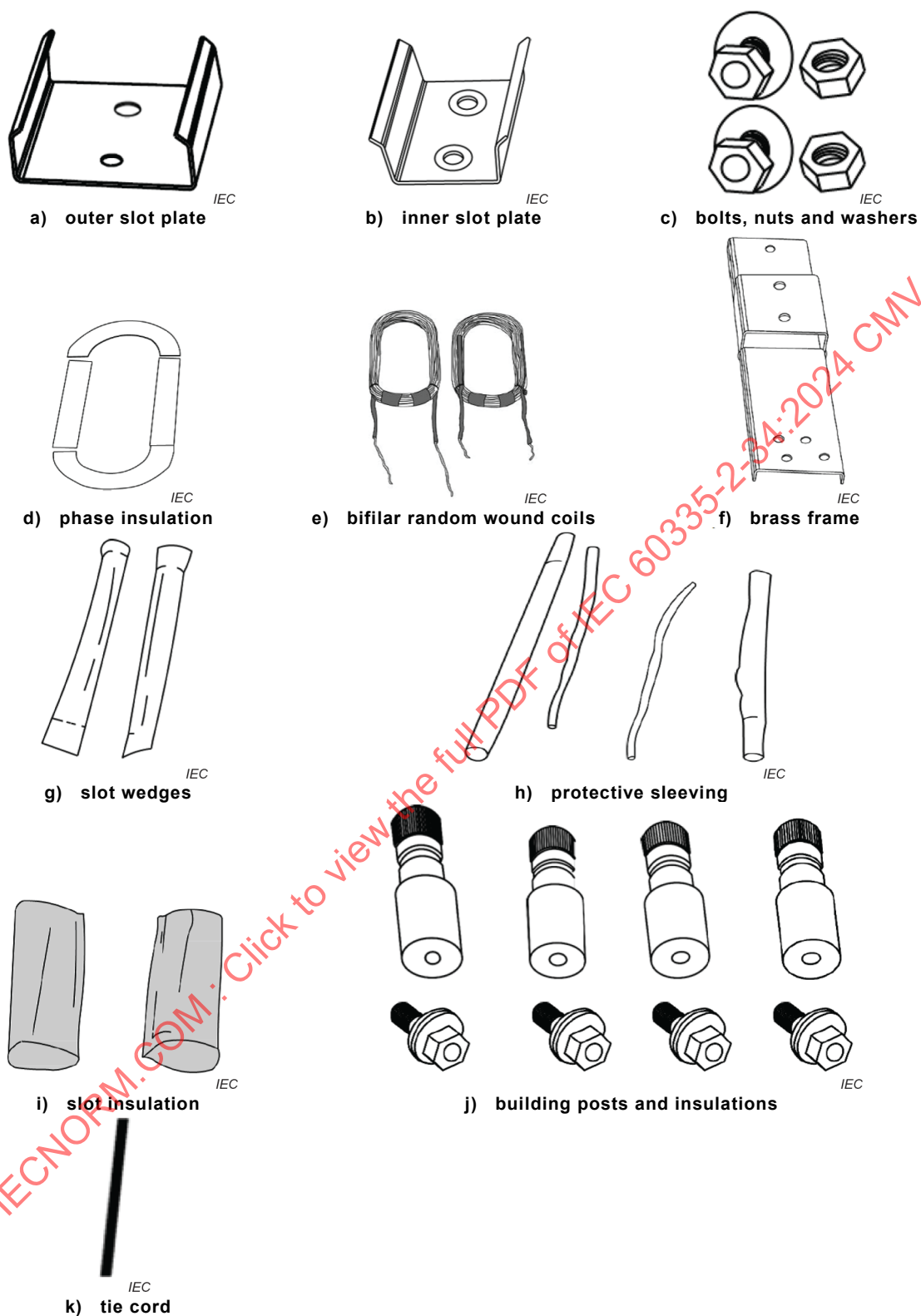
FF.6 Each test vessel shall then be re-sealed, evacuated and heated in accordance with Clause FF.4.

FF.7 For a single component refrigerant, each test vessel shall then be charged with the refrigerant vapor in a manner which does not permit air to be introduced into the test vessel. The pressure of the refrigerant vapor shall be any convenient pressure between 1,0 MPa (10 bar) and 2,4 MPa (24 bar) for any refrigerant other than transcritical R-744, which shall be at a pressure of not less than 7,3 MPa (73 bar). For refrigerant blends, the test vessels shall be charged in a similar manner except that liquid refrigerant shall be used to prevent fractionation.

FF.8 The samples shall be tested as detailed in Table BB.1 using one of the following methods:

- a) The total heating time shall be divided into five equal heating periods. Each heating period is followed by a period in which heating is not to be applied. The period without heating shall be at a temperature of 25 °C ± 5 °C for not less than 48 h; or,
- b) Heating shall be applied continuously for the entire total heating time.

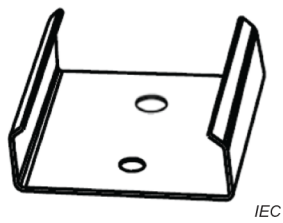
FF.9 Immediately after being exposed to the refrigerant and oil, the six samples of **motorettes** or **coilettes** shall be subjected to the electric strength test specified in Clause FF.3 except that the applied voltage shall be that specified for basic insulation at not less than 100 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** or **coilette** winding and insulation are intended to be used. 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** or **coilette** coil. Not less than five of the six samples shall withstand the application of the electric voltage without breakdown.

**Key**

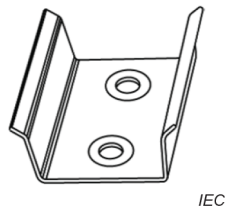
- A outer slot plate
- B inner slot plate
- C bolts, nuts and washers
- D phase insulation
- E bifilar random wound coils

- F brass frame
- G slot wedges
- H protective sleeving
- I slot insulation
- J building posts and insulations
- K tie cord

Figure FF.1 – Motorette components



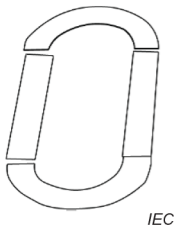
a) outer slot plate



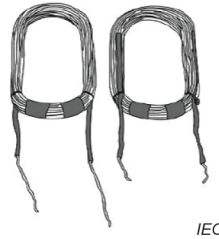
b) inner slot plate



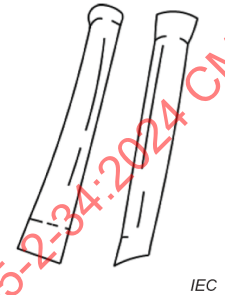
c) bolt, nut and washer



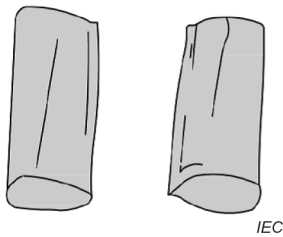
d) phase insulation



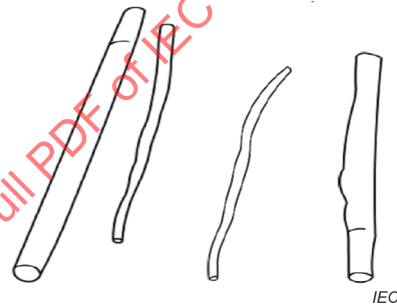
e) bifilar random wound coils



f) slot wedges



g) slot insulation



h) protective sleeving



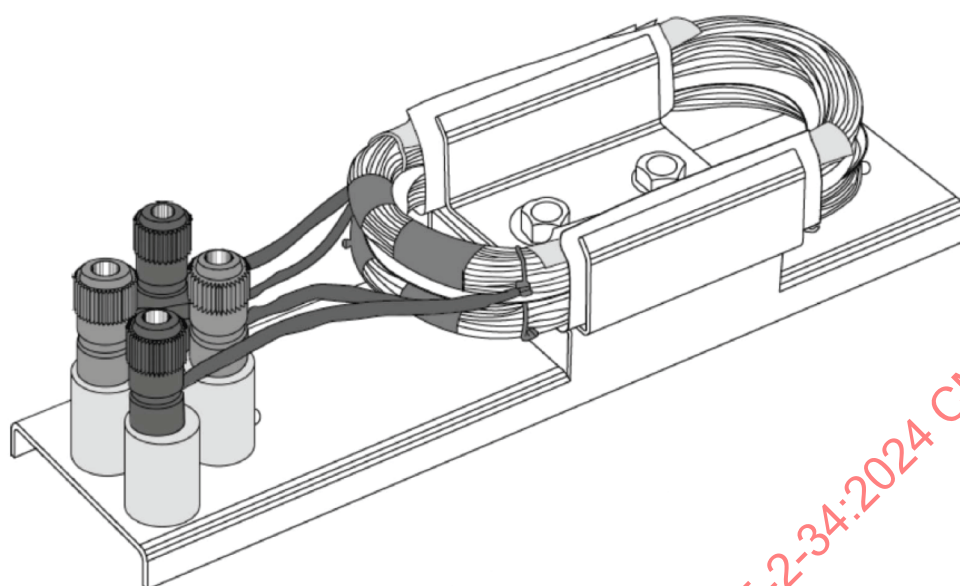
i) tie cord

Key

- A outer slot plate
- B inner slot plate
- C bolt, nut and washer
- D phase insulation
- E bifilar random wound coils

- F slot wedges
- G slot insulation
- H protective sleeving
- J tie cord

Figure FF.2 – Coillette components



IEC

Figure FF.3 – Completely assembled motorette



IEC

Figure FF.4 – Completely assembled coilette

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)

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

APPAREILS ÉLECTRODOMESTIQUES ET ANALOGUES – SÉCURITÉ –

Partie 2-34: Exigences particulières pour les motocompresseurs

AVANT-PROPOS

- 1) La Commission Électrotechnique 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. À 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.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
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- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 9) L'IEC attire l'attention sur le fait que la mise en application du présent document peut entraîner l'utilisation d'un ou de plusieurs brevets. L'IEC ne prend pas position quant à la preuve, à la validité et à l'applicabilité de tout droit de brevet revendiqué à cet égard. À la date de publication du présent document, l'IEC n'avait pas reçu notification qu'un ou plusieurs brevets pouvaient être nécessaires à sa mise en application. Toutefois, il y a lieu d'avertir les responsables de la mise en application du présent document que des informations plus récentes sont susceptibles de figurer dans la base de données de brevets, disponible à l'adresse <https://patents.iec.ch>. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

L'IEC 60335-2-34 a été établie par le sous-comité 61B: Sécurité des appareils de réfrigération à usage domestique et commercial, du comité d'études 61 de l'IEC: Sécurité des appareils électrodomestiques et analogues. Il s'agit d'une Norme internationale.

Cette septième édition annule et remplace la sixième édition parue en 2021. Cette édition constitue une révision technique.

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

- a) le texte a été aligné sur l'IEC 60335-1:2020;
- b) la valeur assignée de 600 V a été ajoutée au domaine d'application (Article 1);
- c) la définition de la pression nominale a été remplacée par la pression maximale admissible (3.1.101, 7.102, 22.7);
- d) les conditions de charge maximale (MLC, *Maximum Load Conditions*) déclarées par le fabricant ont été introduites (3.1.103, 5.6, 7.12, Annexe AA);
- e) les catégories de contre-pression transcritique (R-744) ont été introduites (3.1.102, Tableau AA.1, Tableau AA.2);
- f) une nouvelle définition de la coquette a été introduite (3.8.103);
- g) une nouvelle définition du clapet de dérivation a été introduite (3.8.104);
- h) l'évaluation des motocompresseurs utilisant un dispositif de commande a été clarifiée (6.101, 6.103, 6.104, 19.1);
- i) la modification de l'essai de rigidité diélectrique a été ajoutée (16.2);
- j) la référence à l'essai d'endurance a été supprimée (Article 18);
- k) la conformité des essais de pression a été mise à jour (22.7, Annexe EE);
- l) la référence à la motorette a été transférée de l'Annexe BB à la nouvelle Annexe FF;
- m) l'annexe relative aux matériaux isolants et parties isolantes a été mise à jour et l'assouplissement concernant les cordons d'attache a été supprimé (Annexe CC);
- n) une nouvelle annexe relative aux motorettes ou coquettes a été introduite (Annexe FF).

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

Projet	Rapport de vote
61C/924/FDIS	61C/926/RVD

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

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

La version française de cette norme n'a pas été soumise au vote.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 60335, publiées sous le titre général *Appareils électrodomestiques et analogues – Sécurité*, se trouve 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 sauf si cette édition l'exclut. Dans ce cas, la dernière édition qui n'exclut pas la présente partie 2 est utilisée. Elle a été établie sur la base de la sixième édition (2020) 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 particulières 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.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

NOTE 4 L'attention des Comités nationaux est attirée sur le fait que les fabricants d'appareils et les organismes d'essai peuvent avoir besoin d'une période transitoire après la publication d'une nouvelle publication IEC, ou d'une publication amendée ou révisée, pour fabriquer des produits conformes aux nouvelles exigences et pour adapter leurs équipements aux nouveaux essais ou aux essais révisés.

Le comité recommande que le contenu de cette publication soit adopté pour application nationale (obligatoire) 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 (États-Unis).
- 22.7: Des pressions d'essai différentes sont utilisées (Japon, États-Unis).

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de ce document indique qu'il 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 admis par hypothèse, en établissant la présente Norme internationale, que l'exécution de ses dispositions était confiée à des personnes expérimentées et ayant une qualification appropriée.

Les documents de recommandations concernant l'application des exigences de sécurité pour les appareils peuvent être consultés dans les documents de support du CE 61, accessibles sur le site web de l'IEC à l'adresse:

<https://www.iec.ch/tc61/supportingdocuments>

Cette information est donnée à l'intention des utilisateurs de la présente Norme internationale et ne constitue nullement un remplacement du texte normatif de la présente norme.

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.

La présente 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 d'installation nationales 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 s'applique, l'influence d'une fonction sur les autres fonctions est prise en compte.

Lorsqu'une partie 2 ne comporte pas d'exigences complémentaires pour couvrir les dangers 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.

La présente 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 publications horizontales, les publications fondamentales de sécurité et les publications groupées de sécurité couvrant un danger ne s'appliquent pas, parce qu'elles ont été prises en considération lorsque les exigences générales et particulières ont été étudiées pour la série de normes IEC 60335.

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 la présente norme peut être examiné et soumis aux essais 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 présente norme.

NOTE 3 Les normes traitant des aspects non relatifs à la sécurité des appareils électrodomestiques sont:

- les normes IEC publiées par le comité d'études 59 concernant les méthodes de mesure de l'aptitude à la fonction;
- les normes CISPR 11 et CISPR 14-1, ainsi que les normes applicables de la série IEC 61000-3 concernant les émissions électromagnétiques;
- la norme CISPR 14-2 concernant l'immunité électromagnétique;
- les normes IEC publiées par le comité d'études 111 concernant l'environnement.

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 est possible 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 le produit final 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 **motocompresseurs** multiphasés à courant continu de 600 V.

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 à tambour (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 incorporé(e) ou à distance (IEC 60335-2-89);
- les appareils de réfrigération destinés au mesurage, à la régulation et à un usage en laboratoire (IEC 61010-2-011);
- les fabriques de crème glacée à usage professionnel (IEC 60335-2-118);
- les systèmes et pompes à chaleur à usage professionnel (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 n'est pas 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 le produit 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;
- pour les **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), 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.

2 Références normatives

L'article de la Partie 1 s'applique, avec l'exception suivante.

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/AMD2:2019¹

ISO 817:2014, *Fluides frigorigènes – Désignation et classification de sûreté*

ISO 817:2014/AMD1:2017

ISO 817:2014/AMD2:2021

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 s'applique, avec les exceptions suivantes.

3.1 Définitions relatives aux caractéristiques physiques

3.1.101

pression maximale admissible

PS

pression maximale pour laquelle le **motocompresseur** est conçu, spécifiée par le fabricant, compte tenu des conditions prévues d'utilisation finale de l'appareil

¹ Il existe une version consolidée de ce document, qui comprend l'IEC 60851-5:2008, l'IEC 60851-5:2008/AMD1:2011 et l'IEC 60851-5:2008/AMD2:2019.

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 $+15\text{ °C}$;
- très haute contre-pression (VHBP, *Very High Back Pressure*): température d'évaporation maximale de $+30\text{ °C}$;
- basse contre-pression R-744 sous-critique (SC R-744LBP): température d'évaporation maximale de -15 °C ;
- basse contre-pression transcritique (TC R-744LBP): température d'évaporation maximale de -15 °C ;
- moyenne contre-pression transcritique (TC R-744MBP): température d'évaporation maximale de 0 °C ;
- haute contre-pression transcritique (TC R-744HBP): température d'évaporation maximale de $+15\text{ °C}$;
- **condition de charge maximale (MLC)** déclarée par le fabricant.

3.1.103

condition de charge maximale

MLC

conditions maximales d'application dans lesquelles le fonctionnement du **motocompresseur** est admis, déclarées par le fabricant

Note 1 à l'article: L'abréviation "MLC" est dérivée du terme anglais développé correspondant "maximum load condition".

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 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

Note 1 à l'article: Tous les tubes de raccordement au **motocompresseur** (par exemple: tube de traitement, tube à décharge, tube d'aspiration) font partie du **boîtier**.

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: Le **dispositif de protection du motocompresseur** 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: Le **dispositif de protection du motocompresseur** 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 pré réglée 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

Note 1 à l'article: L'expression "à fils jetés" est utilisée pour décrire un enroulement de moteur dans lequel des conducteurs isolés ronds occupent des positions aléatoires dans une encoche.

3.8.103**coilette**

disposition modifiée d'une **motorette** qui ressemble à un moteur partiellement assemblé

Note 1 à l'article: Une **coilette** est une **motorette** sans cadre.

3.8.104**clapet de dérivation**

dispositif qui relâche la pression du côté haute pression vers le côté basse pression, à une pression différentielle prédéterminée

4 Exigences générales

L'article de la Partie 1 s'applique.

5 Conditions générales d'essais

L'article de la Partie 1 s'applique, 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** vide sont exigés.*

*Pour l'essai de l'Annexe EE normative, trois échantillons du **boîtier** vide sont exigés.*

5.6 Addition:

Les **motocompresseurs** à vitesse variable doivent fonctionner à la vitesse maximale, sauf spécification contraire dans les **conditions de charge maximale (MLC)** déclarées.

5.7 Remplacement:

Les essais sont effectués à une température ambiante de $20\text{ °C} \pm 5\text{ °C}$, sauf spécification contraire dans la présente norme.

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, un ou plusieurs échantillons (en fonctionnement et rotor bloqué) doivent être fournis et, si nécessaire, ils doivent être chargés d'huile 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.

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'un des marquages suivants:
 - 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 normative;
- une indication qui précise si un **câble d'alimentation** peut être raccordé directement aux bornes du **motocompresseur**.

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 normative et à l'Article 19. Si plusieurs **dispositifs de protection** sont déclarés, chacun doit être soumis à l'essai séparément.

6 Classification

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

6.101 Les motocompresseurs sont classés comme ayant été soumis aux essais avec ou sans l'Annexe AA normative.

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 Les **motocompresseurs** peuvent dans les deux cas 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 sur leurs bornes peuvent également être utilisés sans que le **câble d'alimentation** soit directement raccordé sur 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 vérification est effectuée par examen et par les essais appropriés.

6.103 Les **motocompresseurs** sont classés comme ayant été protégés ou non par le **dispositif de protection du motocompresseur**.

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

6.104 Le fabricant du **motocompresseur** doit déclarer les moyens 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 vérification est effectuée par examen ou par les essais appropriés.

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 vérification est effectuée par examen et par les essais appropriés.

6.106 Le fabricant doit déclarer tout matériau de substitution utilisé dans l'Annexe BB normative, l'Annexe CC normative ou l'Annexe FF normative comme ayant été préalablement soumis aux essais.

La vérification est effectuée par examen.

7 Marquage et instructions

L'article de la Partie 1 s'applique, 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 Ne s'applique pas.

7.6 *Addition:*



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

Mise en garde: risque d'incendie/matière inflammable

7.7 Ne s'applique pas.

7.12 Ne s'applique pas, à l'exception du 7.12.1, qui s'applique.

Addition:

- Lorsque la **condition de charge maximale (MLC)** est déclarée par le fabricant, les conditions de fonctionnement doivent être incluses dans les instructions du fabricant pour les fluides frigorigènes utilisés.

NOTE 1 Exemples de conditions de fonctionnement:

- température d'évaporation maximale;
- température de condensation maximale;
- pression de décharge maximale pour un système transcritique;
- température de retour des gaz maximale;
- température ambiante maximale;
- vitesse maximale de l'onduleur, le cas échéant.

7.13 Ne s'applique pas.

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 vérification est effectuée par examen.

7.102 La **pression maximale admissible (PS)** du côté basse pression et du côté haute pression doit être indiquée dans les instructions du fabricant.

8 Protection contre l'accès aux parties actives

L'article de la Partie 1 s'applique.

9 Démarrage des appareils à moteur

L'article de la Partie 1 ne s'applique pas.

10 Puissance et courant

L'article de la Partie 1 ne s'applique pas.

11 Échauffements

L'article de la Partie 1 est remplacé par l'Annexe AA normative. 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 le produit final conformément à la norme applicable à l'appareil concerné.

12 Charge des batteries à ions métalliques

L'article de la Partie 1 ne s'applique pas.

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

L'article de la Partie 1 ne s'applique pas, à l'exception du 13.3, comme cela est exigé au 19.104.

13.3 Addition:

Dans le Tableau 4, ajouter ce qui suit à 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 s'applique.

15 Résistance à l'humidité

L'article de la Partie 1 s'applique, avec l'exception suivante.

15.1 Modification:

Remplacer le troisième alinéa par:

*Après avoir essuyé soigneusement l'enveloppe externe pour éliminer toute trace d'eau, un examen doit montrer qu'il n'y a sur l'isolation aucune trace d'eau susceptible d'entraîner une réduction des **lignes de fuite** ou des **distances dans l'air** au-dessous des valeurs spécifiées à l'Article 29. Pour les appareils et parties d'appareils équipés de broches destinées à être introduites dans des socles de prises de courant, un examen doit montrer l'absence de pénétration d'eau dans l'enveloppe.*

16 Courant de fuite et rigidité diélectrique

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

16.2 Modification:

La première phrase "*Une tension d'essai en courant alternatif est appliquée entre les parties actives et:*" est remplacée par:

*Pour les **motocompresseurs** à courant alternatif uniquement ou à courant alternatif et courant continu, une tension d'essai en courant alternatif est appliquée. Pour les **motocompresseurs** à courant continu uniquement, une tension d'essai en courant continu est appliquée. La tension d'essai est appliquée entre les **parties actives** et:*

16.3 Addition:

Dans le Tableau 7, ajouter ce qui suit à 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 s'applique.

18 Endurance

L'article de la Partie 1 ne s'applique pas.

19 Fonctionnement anormal

L'article de la Partie 1 s'applique, avec les exceptions suivantes.

19.1 Modification:

Remplacer les modalités d'essais par le texte suivant:

*Si le **motocompresseur** est classé comme étant protégé par un **dispositif de protection du motocompresseur**, le **motocompresseur** et le **dispositif de protection du motocompresseur** doivent être 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 normative.*

*Si le **motocompresseur** est classé comme n'étant pas protégé par un **dispositif de protection du motocompresseur** et si un tel dispositif n'est ni incorporé ni associé au **motocompresseur** conformément au 6.103, le **motocompresseur** doit être soumis aux essais du 19.11, du 19.12, du 19.14, du 19.15, du 19.101, du 19.102 et du 19.103 dans le cadre des essais du produit final.*

*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 cela est décrit au 19.13. La conformité aux essais du 19.101, du 19.102 et du 19.103 est vérifiée comme cela est décrit au 19.104. La conformité aux essais de l'Annexe AA est vérifiée comme cela est décrit à l'Annexe AA.

19.2 à 19.10 Ne s'appliquent pas.

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 si 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 cela est indiqué de a) à g) au 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 pas non plus 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 si pendant les essais du 19.11.2 et du 19.11.3 un composant électrique a produit des étincelles ou des arcs, le composant doit être conforme au 24.101, 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 du Tableau AA.1. Tout contacteur ou contact de relais qui fonctionne dans les conditions du Tableau AA.1 est court-circuité.

Si un relais ou un contacteur comportant plus d'un contact est utilisé, tous les contacts sont court-circuités en même temps.

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.

L'essai n'est effectué que sur les **motocompresseurs** classés comme ayant été soumis à l'essai avec l'Annexe AA.

NOTE 101 Pour les **motocompresseurs** non classés comme ayant été soumis à l'essai avec l'Annexe AA, cet essai est réalisé sur le produit final.

NOTE 102 Si le **motocompresseur** a plusieurs modes de fonctionnement, les essais sont réalisés avec le **motocompresseur** fonctionnant dans chaque mode, s'il y a lieu.

19.101 Le motocompresseur avec le rotor bloqué et le dispositif de protection du motocompresseur, ainsi que tous leurs composants associés qui fonctionnent dans les conditions de rotor bloqué, sont raccordés au circuit indiqué à la Figure 101 et alimentés à la tension assignée spécifiée au 5.8.2.

NOTE 1 Les composants associés conformes aux exigences de l'Article 24 ne sont pas évalués par cet essai.

Pour les **motocompresseurs** équipés d'un **dispositif thermique de protection du motocompresseur sans réarmement automatique**, le **motocompresseur** est laissé en fonctionnement jusqu'à ce qu'un nombre de cycles de fonctionnement suffisant ait été effectué pour s'assurer qu'aucune reprise automatique continue ne se produise. Cependant, il convient que le nombre de cycles de fonctionnement ne soit pas inférieur à 3 et qu'ils soient exécutés aussi rapidement que possible, dans un délai minimal de 6 s.

Un temps d'interruption plus long est admis si le **dispositif de protection** ou le **dispositif de commande** met en œuvre un délai supérieur à 6 s.

Tous les composants électromécaniques du **dispositif de protection** doivent être soumis à l'essai individuellement pendant 50 cycles de fonctionnement au total avec le **motocompresseur** ou avec une charge supérieure ou égale au **motocompresseur** réel.

Pour les **motocompresseurs** équipés d'un **dispositif de protection du motocompresseur à réarmement automatique**, le **dispositif de protection du motocompresseur** est soumis à l'essai en fonctionnement continu pendant 15 jours consécutifs ou pendant au moins 2 000 cycles, si cette durée est plus longue.

Les **motocompresseurs** qui ne comportent pas de **dispositif de protection du motocompresseur** et qui sont uniquement protégés par l'impédance des enroulements sont raccordés au circuit indiqué à la Figure 101 et alimentés à la tension assignée. Si un **motocompresseur** est conçu pour fonctionner à plusieurs tensions assignées, il est soumis à l'essai à la tension la plus élevée.

À l'issue des 72 premières heures de l'essai à rotor bloqué, le **motocompresseur** est soumis à l'essai de rigidité diélectrique du 16.3.

Pour les **motocompresseurs** qui comportent un **dispositif de protection du motocompresseur à réarmement automatique**, si 2 000 cycles du dispositif de protection n'ont pas été accomplis à l'issue des 15 jours, l'essai peut être interrompu sous réserve que les conditions suivantes soient remplies:

- la température du **boîtier** est relevée au 12^e et au 15^e jour. Si, pendant ces 3 jours, la température n'a pas augmenté de plus de 5 K, l'essai peut être interrompu. Si la température a augmenté de plus de 5 K, l'essai doit être poursuivi jusqu'à ce que la température n'augmente pas de plus de 5 K pendant 3 jours consécutifs ou pendant au moins 2 000 cycles du **dispositif de protection du motocompresseur**, si cette durée est plus courte;
- les composants du circuit respectent les exigences de l'24 en utilisant au moins le courant et un facteur de puissance qui ne dépassent pas les valeurs mesurées lors de l'essai.

NOTE 2 Si une combinaison **motocompresseur/dispositif de protection du motocompresseur à réarmement automatique** donnée est destinée à être utilisée avec plusieurs fluides frigorigènes, un seul essai de 15 jours est exigé, le choix du fluide frigorigène étant laissé au fabricant du **motocompresseur**.

NOTE 3 Ces procédures d'essai peuvent être modifiées, en cas de besoin, pour l'évaluation des **dispositifs de protection du motocompresseur** dotés de caractéristiques spéciales ou uniques.