

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

NOTE 2 The following numbering system is used:

- subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;
- unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;
- additional annexes are lettered AA, BB, etc.

NOTE 3 The following print types are used:

- requirements: in roman type;
- *test specifications: in italic type;*
- notes: in small roman type.

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

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

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

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

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

The following differences exist in the countries indicated below.

- 7.1: The locked-rotor current marking is required for some motor-compressors (USA).
- 22.7: Different test pressures are used (Japan, USA).

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INTRODUCTION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-34: Particular requirements for motor-compressors

1 Scope

This clause of Part 1 is replaced by the following.

This part of IEC 60335 deals with the safety of sealed (hermetic and semi-hermetic type) **motor-compressors**, their protection and control systems, if any, which are intended for use in equipment for household and similar purposes and which conform with the standards applicable to such equipment. It applies to **motor-compressors** tested separately, under the most severe conditions that may be expected to occur in normal use, their **rated voltage** being not more than 250 V for single-phase **motor-compressors** and 600 V for other **motor-compressors**.

This standard also covers

- multi-speed **motor-compressors**, that are **motor-compressors**, the speed of which can be set to different values;
- variable capacity **motor-compressors** that are **motor-compressors** where the capacity of the compressor is controlled at fixed speeds.

NOTE 101 Examples of equipment which contain **motor-compressors** are

- ~~— refrigerators, food freezers and ice makers (IEC 60335-2-24);~~
- ~~— air-conditioners, electric heat pumps and dehumidifiers (IEC 60335-2-40);~~
- ~~— commercial dispensing appliances and vending machines (IEC 60335-2-75);~~
- ~~— factory-built assemblies for transferring heat in applications for refrigerating, air-conditioning or heating purposes or a combination of such purposes.~~
- tumble dryers (IEC 60335-2-11);
- refrigerating appliances, ice-cream appliances and ice-makers (IEC 60335-2-24);
- electrical heat pumps, air-conditioners and dehumidifiers (IEC 60335-2-40);
- commercial dispensing appliances and vending machines (IEC 60335-2-75);
- commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or compressor (IEC 60335-2-89);
- electrical equipment for measurement, control, and laboratory use (IEC 61010-2-011);
- professional ice-cream makers (IEC 60335-2-118);
- refrigerating systems and heat pumps (ISO 5149-2).

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

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

- the use of appliances by young children or infirm persons without supervision;
- playing with the appliances by young children.

NOTE 102 Attention is drawn to the fact that

- for **motor-compressors** intended to be used in appliances in vehicles or on board ships, additional requirements ~~may~~ could be necessary;
- in many countries, additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour and similar authorities.

~~NOTE 103~~ This standard does not apply to

- **motor-compressors** designed exclusively for industrial purposes;
- **motor-compressors** used in appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

NOTE ~~104~~103 If **motor-compressors** for refrigerant R-744 used in appliances with a **transcritical refrigeration system** are equipped with **pressure relief devices**, compliance with the requirements for these devices is checked during the tests on the final appliance.

2 Normative references

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

Addition:

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

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

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

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

IEC 60851-5:2008/AMD1:2011

IEC 60851-5:2008/AMD2:2019¹

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

ISO 817:2014/AMD1:2017

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

3 Terms and definitions

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

~~3.101~~

motor-compressor

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

~~Note 1 to entry: The housing may be permanently sealed, such as by welding or brazing (hermetic motor-compressor), or may be sealed by gasketed joints (semi-hermetic motor-compressor). A terminal box, a terminal box cover, and other electrical components or an electronic control system may be included.~~

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

Note 2 to entry: Hereafter, the term **motor-compressor** will be used to designate either a **hermetic motor-compressor** or **semi-hermetic motor-compressor**.

3.102

housing

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

3.103

thermal motor-protector

automatic control, built in or fitted on a **motor-compressor**, that is specifically intended to protect the **motor-compressor** against over-heating due to running overload and failure to start

Note 1 to entry: This control carries **motor-compressor** current and is sensitive to one or both of the following:

- **motor-compressor** temperature;
- **motor-compressor** current.

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

3.104

motor-compressor protection system

thermal motor-protector and associated components, if any, or **protective electronic circuit** fully or partly separate or integrated into the **motor-compressor control system** and which is specifically intended to protect the **motor-compressor** against over-heating due to running overload or failure to start

Note 1 to entry: The control carries **motor-compressor** current and is sensitive to one or both of the following:

- **motor-compressor** temperature;
- **motor-compressor** current.

3.105

motor-compressor control system

system comprising one or more electrical or **electronic components**, or **electronic circuits** that provides at least one of the following:

- **motor-compressor** starting control functions;
- **motor-compressor** cooling capacity control functions

3.106

starting relay

electrically operated control device intended for integration or incorporation into a **motor-compressor** and used within the **motor-compressor** circuit to control the starting of single-phase **motor-compressors**

3.107

application category

back pressure relative to the evaporation temperature range over which the **motor-compressor** operates

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

- low back pressure (LBP): denotes an evaporation temperature range from $-35\text{ }^{\circ}\text{C}$ to $-15\text{ }^{\circ}\text{C}$;
- medium back pressure (MBP): denotes an evaporation temperature range from $-20\text{ }^{\circ}\text{C}$ to $0\text{ }^{\circ}\text{C}$;
- high back pressure (HBP): denotes an evaporation temperature range from $-5\text{ }^{\circ}\text{C}$ to $+15\text{ }^{\circ}\text{C}$.

3.108

transcritical refrigeration system

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

3.109**design pressure**

~~gauge pressure that has been assigned to a transcritical refrigeration system~~

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

3.110**pressure relief device**

~~pressure sensing device, intended to reduce pressure automatically when pressures within the refrigeration system exceed the preset pressure of the device~~

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

3.111**two-stage motor-compressor**

~~motor-compressor comprising two compressors and one motor in a single housing~~

3.1 Definitions relating to physical characteristics**3.1.101****design pressure**

gauge pressure that has been assigned to a **transcritical refrigeration system**

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

3.1.102**application category**

back pressure relative to the evaporation temperature range over which the **motor-compressor** operates

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

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

3.5 Definitions relating to types of appliances**3.5.101****motor-compressor**

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

Note 1 to entry: The **housing** may be permanently sealed, such as by welding or brazing (**hermetic motor-compressor**), or may be sealed by gasketed joints (**semi-hermetic motor-compressor**). A terminal box, a terminal box cover, and other electrical components or an electronic control system may be included.

Note 2 to entry: Hereafter, the term **motor-compressor** will be used to designate either a **hermetic motor-compressor** or **semi-hermetic motor-compressor**.

3.5.102**two-stage motor-compressor**

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

3.6 Definitions relating to parts of an appliance

3.6.101

housing

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

3.6.102

starting relay

electrically operated control device intended for integration or incorporation into a **motor-compressor** and used within the **motor-compressor** circuit to control the starting of single-phase **motor-compressors**

3.7 Definitions relating to safety components

3.7.101

thermal motor-protector

automatic control, built-in or fitted on a **motor-compressor** that is specifically intended to protect the **motor-compressor** against over-heating due to running overload and failure to start

Note 1 to entry: This control carries **motor-compressor** current and is sensitive to one or both of the following:

- **motor-compressor** temperature;
- **motor-compressor** current.

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

3.7.102

motor-compressor protection system

thermal motor protector and associated components, if any, or **protective electronic circuit** fully or partly separate or integrated into the **motor-compressor control system** and which is specifically intended to protect the **motor-compressor** against over-heating due to running overload or failure to start

Note 1 to entry: The control carries **motor-compressor** current and is sensitive to one or both of the following:

- **motor-compressor** temperature;
- **motor-compressor** current.

3.7.103

motor-compressor control system

system comprising one or more electrical or **electronic components**, or **electronic circuits** that provides at least one of the following:

- **motor-compressor** starting control functions;
- **motor-compressor** cooling capacity control functions

3.7.104

pressure relief device

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

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

3.8 Definitions relating to miscellaneous matters

3.8.101

transcritical refrigeration system

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

3.8.102**motorette**

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

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

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

5.2 Addition:

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

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

5.6 Addition:

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

5.7 Replacement:

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

5.8.2 Addition:

Motor-compressors with **self-resetting motor-compressor protection systems**, and designed for more than one **rated voltage**, are subjected to the tests of 19.101 and 19.103 at the highest voltage.

5.10 Addition:

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

*The manufacturer or responsible agent shall provide the following information for each type of **motor-compressor** submitted for the tests:*

- type (synthetic or cellulosic) of winding insulation;
- refrigerant identification:
 - a) for a single component refrigerant, by at least one of the following:
 - chemical name;
 - chemical formula;
 - refrigerant number;
 - b) for a blended refrigerant, at least one of the following:
 - chemical name and nominal proportion of each of the components;

- *chemical formula and nominal proportion of each of the components;*
- *refrigerant number and nominal proportion of each of the components;*
- *refrigerant number of the refrigerant blend;*
- *types and quantity of oil to be used if the test samples which use oil are not already charged;*
- **application category** or application categories for motor-compressors classified as being tested with Annex AA;
- *whether a **supply cord** can be connected directly to terminals on the **motor-compressor**;*
- *for motor-compressors intended for appliances with a transcritical refrigeration system, the test pressure for the high pressure side if higher than the minimum test pressure.*

5.11 Replacement:

For **motor-compressors** which can be used in appliances where the **supply cord** is connected directly to terminals on the **motor-compressor**, the test sample shall be provided with a **supply cord**.

NOTE 101 Any additional samples required for testing need not be provided with a **supply cord**.

5.101 Motor-compressors, including those with crank-case heaters, are tested as **motor-operated appliances**.

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

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

6 Classification

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

6.101 Motor-compressors without an incorporated or associated **electronic circuit** are classified as being tested with Annex AA or without Annex AA.

Motor-compressors with an incorporated or associated **electronic circuit** are classified as being tested with Annex AA.

Motor-compressors can be classified as being tested with Annex AA only if the **motor-compressor** in combination with the **motor-compressor protection system** or **motor-compressor control system**, if any, can be configured to operate so as to deliver maximum cooling capacity, independently of any input sensors that are only provided as part of the final application.

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

~~Compliance is checked by~~

- ~~— the tests of this standard including the tests in Annex AA, for **motor-compressors** tested with Annex AA;~~
- ~~— the tests of this standard but not including the tests in Annex AA, for **motor-compressors** tested without Annex AA.~~

6.102 Motor compressors are classified as being

- intended for direct connection of the appliance **supply cord** to the **motor-compressor** terminals, or
- not intended for direct connection of the appliance **supply cord** to the **motor-compressor** terminals.

NOTE 1 **Motor-compressors** can in both cases be delivered with or without the external components necessary for connection of the **supply cord**.

NOTE 2 **Motor-compressors** intended for direct connection of the appliance **supply cord** to their terminals can also be used without the **supply cord** being connected directly to their terminals.

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

Compliance is checked by inspection and by the relevant tests.

6.103 Motor-compressors are classified as being protected by **protective electronic circuits** or not being protected by **protective electronic circuits**.

This does not preclude the **protective electronic circuits** being provided in the end product, in which case many of the tests of this standard shall be conducted on the end product.

Compliance is checked by inspection and by the relevant tests.

6.104 The **motor-compressor** manufacturer shall declare the means of motor protection, **thermal motor protector**, impedance protection, **protective electronic circuit**, or a combination of the above.

Compliance is checked by inspection and by the relevant tests

6.105 Motor-compressors using refrigerant R744 shall be classified as used in a **transcritical refrigeration system** or in a ~~non-transcritical~~ **subcritical refrigeration system**.

Compliance is checked by inspection and by the relevant tests

7 Marking and instructions

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

7.1 Modification:

The **rated power input** or **rated current** need not be marked.

Addition:

Motor-compressors suitable for use with a flammable refrigerant shall be marked with ~~symbol~~ **Warning sign ISO 7010 W021 (2011-05)**.

7.5 Not applicable.

7.6 Addition:



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

Warning; Risk of fire / Flammable material

7.7 Not applicable.

7.12 Not applicable, except 7.12.1, which is applicable.

7.13 Not applicable.

7.14 *Addition:*

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

7.101 Refrigerants that can be used with the **motor-compressor** shall be listed in the instructions.

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of Part 1 is applicable.

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is not applicable.

11 Heating

~~This clause of Part 1 is not applicable.~~

~~NOTE 101—For **motor-compressors**, this clause of Part 1 can be covered by Annex AA.~~

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

12 Void

13 Leakage current and electric strength at operating temperature

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

13.3 *Addition:*

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

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

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

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

15.3 Addition:

~~NOTE 101—Motor-compressors with glass-insulated terminals and without any external control devices, protectors or other components need not be tested.~~

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

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.3 Addition:

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

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

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is ~~not~~ applicable, except as follows.

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

19 Abnormal operation

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

19.1 Modification:

Replace the test specification by the following:

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

Motor-compressors incorporating **electronic circuits** are also subjected to the tests of 19.11 and 19.12.

Only one abnormal condition is simulated each time.

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

19.2 to 19.10 Not applicable.

19.11.2 Addition:

For simulation of the fault conditions, a **motor-compressor** with its incorporated or associated **electronic circuit** is connected to the substitute refrigeration circuit of Figure AA.1 and operated under the conditions given in ~~Clause AA.5~~ Annex AA. The conditions applied are the step prior to that which caused the **protective device** to operate or the motor-compressor to stall during the tests of ~~Clause AA.5~~ Table AA.2.

19.11.3 Replacement:

If the **motor-compressor** is classified as being protected by a **protective electronic circuit** and if this **protective electronic circuit** operates to ensure compliance with Clause 19 and Annex AA, the tests of 19.101, 19.102, 19.103 and Annex AA are repeated with a single fault simulated, as indicated in a) to g) of 19.11.2.

However, the test of Annex AA is not repeated if during the test of Annex AA, for **motor-compressors** classified as being tested with Annex AA, the **motor-compressor protection system** did not operate. The test of Annex AA is also not repeated on **motor-compressors** that are classified as being tested without Annex AA.

19.11.4 Addition:

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

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

19.13 Addition:

If the **motor-compressor** is intended to use flammable refrigerants, and if during the tests of 19.11.2 and 19.11.3 any electrical component produced sparks or arcs, this shall be reported unless the component was an **intentionally weak part** or a **non-self-resetting protective device**.

19.14 Replacement:

Motor-compressors are operated under the conditions of ~~Clause~~ Table AA.1. Any contactor or relay contact that operates under the conditions of ~~Clause~~ Table AA.1 is short-circuited.

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

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

If more than one relay or contactor operates ~~in Clause~~ under the conditions of Table AA.1, each such relay or contactor is short-circuited in turn.

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

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

NOTE 1101 For **motor-compressors** not classified as being tested with Annex AA, this test will be performed on the final product.

NOTE 2102 If the **motor-compressor** has several modes of operation, the tests are carried out with the **motor-compressor** operating in each mode, if necessary.

19.101 The **motor-compressor** and **motor-compressor protection system**, together with all their associated components which operate under locked-rotor conditions, are connected in the circuit shown in Figure 101 and supplied with **rated voltage** as specified in 5.8.2.

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

For **motor-compressors** with a **non-self-resetting thermal motor-compressor protection system**, the **motor-compressor** is operated until a sufficient number of operations have been made to ensure that continuous automatic recycling does not occur. The number of operations should, however, not be less than three and should be performed as rapidly as possible with a minimum delay of 6 s.

A longer off time is permitted if a delay feature longer than 6 s is part of the **protection system** or **control system**.

All 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 continuously for a period of 15 days or for at least 2 000 cycles, whichever is the longer.

Motor-compressors without a **motor-compressor protection system** and only protected by the impedance of the windings are connected in the circuit shown in Figure 101 and supplied with rated voltage. If a **motor-compressor** is designed for more than one rated voltage, it is tested at the highest voltage.

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

For **motor-compressors** with a **self-resetting motor-compressor protection system**, if 2 000 cycles of the protection system have not been performed by the end of the 15-day period, the test may be terminated provided the following conditions are met:

- the **housing** temperature is recorded on the 12th and 15th days. If, during this three day period, the temperature has not increased by more than 5 K, the test can be terminated. If the temperature has increased by more than 5 K, the test is to be continued until the temperature has not increased by more than 5 K over a period of three consecutive days or for at least 2 000 cycles of the **motor-compressor protection system**, whichever occurs first;
- the components in the circuit comply with the requirements of Clause 24 using at least the current and a power factor not exceeding that measured during the test.

NOTE 2 If a given **motor-compressor**, **self-resetting motor-compressor protection system** combination is intended for use with more than one refrigerant, only one 15 day test is required, the choice of the refrigerant being made by the **motor-compressor** manufacturer.

NOTE 3 These test procedures can be modified, if necessary, to evaluate **motor-compressor protection systems** which incorporate special or unique features.

Motor-compressors with a self-resetting motor-compressor protection system and designed for more than one rated voltage are also tested at the lowest voltage for 3 h.

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

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

*If the **motor-compressor** is designed for more than one rated voltage, the test is performed at all rated voltages.*

*If the **motor-compressor** is designed for a voltage range, the test is performed at the upper and lower voltage limit.*

Motor-compressors without a motor-compressor protection system are left energized as described above for 15 days. The **housing** temperature is recorded on the 12th and 15th days. If during these three days, the temperature has not increased by more than 5 K, the test can be terminated.

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

- ~~— with start and run capacitors open-circuited one at a time;~~
- ~~— with start and run capacitors short-circuited one at a time, unless they have been tested and shown to comply with the requirements for protection class P2 capacitors of IEC 60252-1.~~
- with motor starting capacitors and motor running capacitors open-circuited one at a time;
- with motor starting capacitors and motor running capacitors short-circuited one at a time, unless they have been tested and shown to comply with the requirements for protection class S2 capacitors of IEC 60252-1.

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

NOTE 2 For **motor-compressors** with a **self-resetting motor-compressor protection system** and which are designed for more than one **rated voltage**, it is not necessary to repeat the test at the lowest voltage.

NOTE 3 This test can be performed on separate samples.

19.103 Three-phase **motor-compressors** and the **motor-compressor protection systems**, together with all their associated components which operate under locked-rotor conditions, are connected in a circuit similar to that shown in Figure 101, the circuit being appropriately modified for three-phase **motor-compressors**. They are supplied with **rated voltage** but with one phase to the **motor-compressor** disconnected during the following periods:

- for **motor-compressors** with a **self-resetting motor-compressor protection system**, for 3 h;
- for **motor-compressors** with a **non-self-resetting motor-compressor protection system**, until the first operation of the **motor-compressor protection system**.

- for **motor-compressors** without a **motor-compressor protection system**, for 3 h.

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

19.104 During the tests of 19.101, 19.102 and 19.103,

- the **motor-compressor protection system** shall be able to operate;
- the temperature of the **housing** and the temperature of the accessible surfaces of associated components shall not exceed 150 °C;
- the residual current device shown in Figure 101 shall not operate;
- the **motor-compressor**, its associated **starting relay** and **motor-compressor protection system** shall not emit flames, sparks or molten metal.

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

- enclosures shall not have deformed to such an extent as to impair compliance with Clause 29;
- the **motor-compressor protection system** shall be able to operate;
- the **motor-compressor** shall withstand
 - the leakage current test as specified in 16.2, the test voltage being applied between the windings and the **housing**;
 - the electric strength test of 13.3 of Part 1.

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

- enclosures shall not have deformed to such an extent as to impair compliance with Clause 29;
- the **motor-compressor** shall withstand
 - the leakage current test as specified in 16.2, the test voltage being applied between the windings and the **housing**;
 - the electric strength test of 13.3 of Part 1;
- the **motor-compressor protection system** shall be able to operate or it shall remain permanently open-circuited.

If the **motor-compressor protection system** remains permanently open-circuited, the test of 19.102 with start and run capacitors short-circuited shall be repeated on three additional samples and all three additional samples shall remain permanently open-circuited at the conclusion of the test.

NOTE The test can be repeated on three new **motor-compressors** or by replacing, in the **motor-compressor** originally tested, the **motor-compressor protection system** with one of the same type.

19.105 Three-phase **motor-compressors** shall be adequately protected against primary single-phase failure.

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

Compliance is checked by the following test.

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

The test is continued for the following periods:

- 24 h, for **motor-compressors** with a **self-resetting motor-compressor protection system**;
- until the first operation of the protective system, for motor-compressors with a **non-self-resetting motor-compressor protection system**.

Motor-compressors designed for more than one **rated voltage** are tested at each voltage.

However, **motor-compressors** with a **self-resetting motor-compressor protection system** and designed for more than one **rated voltage** are tested at the highest voltage for 24 h and at the lowest voltage for 3 h.

NOTE 2 Separate samples can be used in testing **motor-compressors** designed for more than one **rated voltage**, at each of their **rated voltages**.

During the test,

- the temperature of the **housing** and the temperature of the accessible surfaces of associated components shall not exceed 150 °C;
- the **motor-compressor** windings shall not be damaged;
- the **motor-compressor** and **motor-compressor protection system** shall not emit flames, sparks or molten metal.

NOTE 3 **Motor-compressor** windings are considered damaged if the windings open circuit or if the **motor-compressor** does not comply with the electric strength tests specifications. **Motor-compressors** with a **self-resetting motor-compressor protection system** are also considered damaged if there is a change in the relative distribution of currents during the test, or if currents measured at the conclusion of the test vary by more than 5 % from currents measured 3 h after the start of the test or on the first closure of the protective system following these 3 h.

Immediately following this test, the **motor-compressor** shall withstand the electric strength test of 16.3.

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

- an overcurrent device, protecting each phase of its supply and which is provided with the **motor-compressor** or the rating of which is specified by the **motor-compressor** manufacturer;
- a **motor-compressor protection system**, responsive to motor current, installed symmetrically at the centre point of a star-connected **motor-compressor** and which simultaneously opens at least two windings;
- a **motor-compressor protection system**, located in each winding of the **motor-compressor**, which activates pilot duty contacts controlling the supply to the coil of the **motor-compressor** supply contactor and which is responsive to at least one of the following:
 - **motor-compressor** current,
 - **motor-compressor** temperature.

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable.

22 Construction

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

22.2 Not applicable.

22.5 Not applicable.

22.7 *Replacement:*

Housings shall withstand the pressure expected in normal use.

Compliance is checked by the following tests or the test in Subclause 18.101 for refrigerants with minimum high side test pressure 10 MPa.

A **housing** which is exposed to high side pressure, including those in a **motor-compressor** incorporating a bypass valve, shall be subjected to a pressure equal to:

- for subcritical refrigeration systems, other than those using R-744, 3,5 times the saturated vapour pressure of the refrigerant at 70 °C, the test pressure being rounded up to the next 0,5 MPa (5 bar).
- for R-744 subcritical refrigeration systems, 3,5 times the saturated vapour pressure of the refrigerant at 27 °C, rounded up to the next 0,5 MPa (5 bar).

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

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

Test pressure = 3,5 × 2,89 MPa (28,9 bar)
 = 10,1 MPa (101 bar)
 = 10,5 MPa (105 bar) when rounded up to the next 0,5 MPa (5 bar).

- for **transcritical refrigeration systems**, the highest of
 - 3 times the **design pressure**; or
 - the test pressure declared by the manufacturer; or
 - the test pressure specified in Table 101.

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

Table 101 – Minimum high side test pressures

Refrigerant formulae	Refrigerant number	Test pressure MPa (bar)
Subcritical		
CCl₂F₂	R-12	6,5 (65)
CF₃CH₂F	R-134a	7,5 (75)
CHClF₂	R-22	10,5 (105)
CH₂F₂	R-32	17,0 (170)
CH₃CH₂CH₃	R-290	9,0 (90)
CF₃CF=CH₂	R-1234yf	7,0 (70)
CF₃CH=CHF	R-1234ze	5,5 (55)
CH(CH₃)₃	R-600a	3,5 (35)
CO₂	R-744	23,5 (235)
by weight 73,8 % R-12 + 26,2 % R-152a	R-500	7,5 (75)
by weight 48,8 % R-22 + 51,2 % R-115	R-502	11,0 (110)
by weight 44 % R-125 + 52 % R-143a + 4 % R-134a	R-404A	12,5 (125)
by weight 50 % R-125 + 50 % R-143a	R-507A	12,5 (125)
by weight 25 % R-125 + 52 % R-134a + 23 % R-32	R-407C	11 (110)
by weight 50 % R-125 + 50 % R-32	R-410A	16,5 (165)
Transcritical		
CO₂	R-744	42 (420)
NOTE The refrigerant test pressure data is based on NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1.		

Refrigerant formulae	Refrigerant number	Test pressure MPa (bar)	
<i>Subcritical</i>			
$\text{CF}_3\text{CH}_2\text{F}$	R-134a	7,5	(75)
CHClF_2	R-22	10,5	(105)
CH_2F_2	R-32	17,0	(170)
$\text{CH}_3\text{CH}_2\text{CH}_3$	R-290	9,0	(90)
$\text{CF}_3\text{CF}=\text{CH}_2$	R-1234yf	7,0	(70)
$\text{CF}_3\text{CH}=\text{CHF}$	R-1234ze	5,5	(55)
$\text{CH}(\text{CH}_3)_3$	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)
<i>Transcritical</i>			
CO_2	R-744	42	(420)
NOTE The refrigerant test pressure data is based on NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1.			

In subcritical applications, a housing which is exposed only to low side pressure, including those in a **motor-compressor** incorporating a bypass valve, shall be subjected to a test pressure equal to

- for subcritical applications, other than those using R-744, the higher of
 - 5 times the saturated vapour pressure of the refrigerant at 20 °C rounded up to the next 0,2 MPa (2 bar); or
 - 2,5 MPa (25 bar);
- for subcritical applications using R-744, 5 times the saturated vapour pressure of the refrigerant at –6,5 °C rounded up to the next 0,2 MPa (2 bar).

In **transcritical refrigeration systems**, a **housing** which is exposed only to low side pressure shall be subjected to a test pressure that is equal to the highest of

- 5 times the **design pressure**; or
- 5 times the saturated vapour pressure of the refrigerant at 20 °C rounded up to the next 0,2 MPa (2 bar); or
- 2,5 MPa (25 bar); or
- the test pressure specified in Table 102.

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

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

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

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

= 4,05 MPa (40,5 bar)

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

Table 102 – Minimum low side test pressures

Refrigerant formulae	Refrigerant number	Test pressure MPa (bar)
Subcritical		
CCl_2F_2	R-12	2,5 (24)
$\text{CF}_3\text{CH}_2\text{F}$	R-134a	2,5 (24)
CHClF_2	R-22	4,2 (42)
CH_2F_2	R-32	7,0 (70)
$\text{CH}_3\text{CH}_2\text{CH}_3$	R-290	3,8 (38)
$\text{CF}_3\text{CF}=\text{CH}_2$	R-1234yf	2,6 (26)
$\text{CF}_3\text{CH}=\text{CHF}$	R-1234ze	2,5 (18)
$\text{CH}(\text{CH}_3)_3$	R-600a	2,5 (25)
CO_2	R-744	14,2 (142)
by weight 73,8 % R-12 + 26,2 % R-152a	R-500	3,0 (30)
by weight 48,8 % R-22 + 51,2 % R-115	R-502	4,6 (46)
by weight 44 % R-125 + 52 % R-143a + 4 % R-134a	R-404A	5,0 (50)
by weight 50 % R-125 + 50 % R-143a	R-507A	5,2 (52)
by weight 25 % R-125 + 52 % R-134a + 23 % R-32	R-407C	4,0 (40)
by weight 50 % R-125 + 50 % R-32	R-410A	6,8 (68)
Transcritical		
CO_2	R-744	28,2 (282)
NOTE The refrigerant test pressure data is based on NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1.		

Refrigerant formulae	Refrigerant number	Test pressure	
		MPa	(bar)
<i>Subcritical</i>			
$\text{CF}_3\text{CH}_2\text{F}$	R-134a	2,5	(25)
CHClF_2	R-22	4,2	(42)
CH_2F_2	R-32	7,0	(70)
$\text{CH}_3\text{CH}_2\text{CH}_3$	R-290	3,8	(38)
$\text{CF}_3\text{CF}=\text{CH}_2$	R-1234yf	2,6	(26)
$\text{CF}_3\text{CH}=\text{CHF}$	R-1234ze	2,5	(25)
$\text{CH}(\text{CH}_3)_3$	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 ~~leakage~~ leak occurs, the test has to be repeated on a sample specially prepared by the manufacturer to avoid leakage at the gasket.

For a **semi-hermetic motor-compressor** employing a bypass valve which relieves high side pressure into the low side at a predetermined pressure differential, the **housing** shall be capable of withstanding the required test pressure even though leakage occurs at gaskets.

NOTE 104 All pressures are gauge pressures.

22.9 Addition:

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

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

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

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

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

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

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

22.14 Not applicable.

22.21 Addition:

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

The requirement shall only be applied to external parts of the **motor-compressor**.

22.101 Where a **motor-compressor** used in a **transcritical refrigeration system** includes a **pressure relief device** in the high side or discharge piping of the **motor-compressor**, there shall be no other shut off devices or system components except piping located between the **motor-compressor** and **pressure relief device** which could introduce a pressure drop.

NOTE The required **pressure relief device** ~~could~~ can be installed by either the **motor-compressor** manufacturer or the appliance manufacturer.

Compliance is checked by inspection.

23 Internal wiring

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

23.8 Addition:

~~NOTE 101—This does not apply to wiring inside the **housing**.~~

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

24 Components

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

24.1.4 Addition:

- | | |
|--|---------|
| – starting relay | 100 000 |
| – self-resetting thermal motor-protectors for motor-compressors* | 2 000 |
| – non-self resetting thermal motor-protectors for motor-compressors | 50 |

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

24.101 In **motor-compressors** that employ flammable refrigerants, components that may arc or spark during **normal operation** of the end product shall comply with the requirements of IEC 60079-15 or the requirements for level protection “dc” of IEC 60079-1, as modified by Annex DD, for group IIA gases or the refrigerant used. This requirement is not applicable to components within the **housing**.

Compliance is checked by inspection and the appropriate tests of IEC 60079-15 and IEC 60079-1.

25 Supply connection and external flexible cords

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

25.1 Addition:

- a set of terminals allowing the connection of a **supply cord**.

25.7 Not applicable.

26 Terminals for external conductors

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

27 Provision for earthing

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

27.1 Addition:

An earthing terminal is required only if the **motor-compressor** is classified in accordance with 6.102 as being intended for direct connection of the appliance **supply cord** to the **motor-compressor** terminals.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

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

29.1 Addition:

Except as specified in 29.1.1 and 29.1.4, **clearances** less than those specified in Table 16 are not allowed for **basic insulation** and **functional insulation** inside the **housing**.

For a **rated voltage** $> 300\text{ V}$ and $\leq 346\text{ V}$, 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** $> 300\text{ V}$ and $\leq 346\text{ V}$, the minimum thickness for accessible parts of **reinforced insulation** consisting of a single layer is for

- overvoltage category I: 0,6 mm;
- overvoltage category II: 1,2 mm;
- overvoltage category III: 1,5 mm.

NOTE 101—For multi-phase appliances, the line to neutral or line to earth voltage is used for **rated voltage**.

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

30 Resistance to heat and fire

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

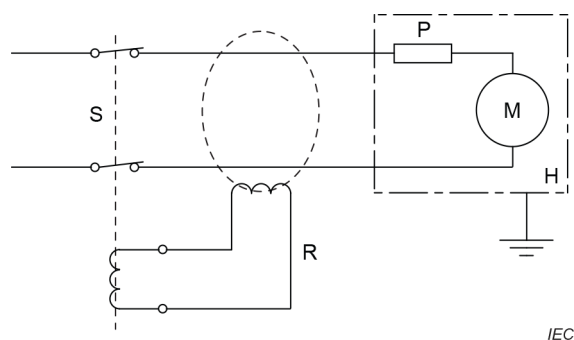
30.2.2 Not applicable.

31 Resistance to rusting

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

32 Radiation, toxicity and similar hazards

This clause of Part 1 is not applicable.



Key

S supply

H **housing**

R residual current device that can detect AC or AC with DC components, max. $I_{\Delta n} = 30 \text{ mA RMS or DC max.}$
 $I_{\Delta n} = 30 \text{ mA}$

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

Annexes

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

Annex C (normative)

Ageing test on motors

This annex of Part 1 is not applicable.

Annex D (normative)

Thermal motor protectors

This annex of Part 1 is not applicable.

Annex AA (normative)

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

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

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

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

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

~~—under the conditions specified in Table AA.1 but at rated voltage; or~~

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

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

~~If the motor-compressor protection system or motor-compressor control system contains an electronic circuit the tests in Clauses AA.4 and AA.5 are to be conducted, otherwise, the tests in Clauses AA.2 and AA.3 are to be conducted. If two stage motor-compressors are to be tested in accordance with Clauses AA.2 and AA.3, they have to be tested under the most onerous conditions of operation.~~

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

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

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

NOTE 5—As the motor-compressor protection system is the motor temperature limiting device, measuring the motor temperature at the ultimate trip point is all that is required to establish the maximum motor winding temperature.

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

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

~~AA.2 The motor-compressor including the motor-compressor protection system or motor-compressor control system, if any, is connected to the substitute refrigeration circuit of Figure AA.1 and operated under the appropriate conditions given in Table AA.1 for tests 1 and 2. However, for R-744 refrigerant intended for use in a transcritical refrigeration system, for all tests the maximum operating discharge pressure is 12 MPa and the return gas temperature is $+25^{\circ}\text{C}$. The tests are continued until steady conditions are reached. If the motor-compressor cooling capacity is variable, the tests are carried out at maximum and minimum cooling conditions.~~

NOTE 1—Special arrangements for the ~~motor-compressor control system~~ can be needed in order to obtain the maximum value of the cooling capacity.

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

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

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

NOTE For R-744 refrigerant intended for use in a non-transcritical refrigeration system, for all tests the evaporation temperature is –15 °C, the condensation temperature is +20 °C, the motor compressor ambient temperature is +43 °C and the return gas temperature is +2 °C.

~~NOTE 3—The tolerances on the temperatures in Table AA.1 are ± 2 K for the **motor-compressor** ambient temperature, condensation and return gas temperatures, and ± 1 K for the evaporation temperature.~~

~~NOTE 4—For some **motor-compressors**, an injection cooler or an oil cooler and air flow over the **motor-compressor** can be required as recommended by the **motor-compressor** manufacturer.~~

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

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

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

~~During tests 1 and 2,~~

- ~~— the temperature rises are measured and shall not exceed the values given in the Table 3 of Part 1 reduced by 7 K ;~~
- ~~— the **motor-compressor protection system** shall not operate to disconnect the **motor-compressor** from the supply;~~
- ~~— the temperature of the housing and the temperature of the accessible surfaces of associated components shall not exceed 150°C .~~

~~NOTE 8—The requirements in Table 3, regarding winding temperatures of the different insulation classes are not applicable to the windings of **motor-compressors**.~~

~~**AA.3—Immediately after the tests of Clause AA.2, the **motor-compressor** including the **motor-compressor protection system** or **motor-compressor control system**, if any, is operated under the appropriate conditions given in Table AA.1 for test 3 so as to cause the **motor-compressor protection system** to operate or to reach steady conditions with the **motor-compressor** in the stalled or running condition.**~~

~~During test 3, if the **motor-compressor protection system** does not operate, the voltage is reduced in steps of $4\% \pm 1\%$ of the rated voltage, at a rate of approximately 2 V/min , until steady conditions are reached at each step. This procedure is continued until one of the following conditions occurs:~~

- ~~— the **motor-compressor protection system** operates;~~
- ~~— the **motor-compressor** stalls and steady conditions are reached.~~

~~NOTE 1—If the cooling capacity is influenced by the adjustment of the voltage, the **motor-compressor control system** is not adjusted during the test in an attempt to maintain the cooling capacity as it was when the test was started.~~

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

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

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

~~AA.4 The motor-compressor including the motor-compressor protection system and motor-compressor control system, if any, is connected to the substitute refrigeration circuit of Figure AA.1 and operated under the appropriate conditions given in Table AA.2. However, for R-744 refrigerant intended for use in a transcritical refrigeration system, for all tests the operating discharge pressure is 12 MPa and for test 4 the return gas temperature is +25 °C. The tests are continued until steady conditions are reached.~~

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

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

~~During tests 4 and 5,~~

- ~~— the temperature rises of the motor-compressor control system and the motor-compressor protection system containing electronic components are measured and shall not exceed the values given in the Table 3 of Part 1, reduced by 7 K;~~
- ~~— the protective device shall not operate to disconnect the motor-compressor from the supply;~~
- ~~— the temperature of the housing and the temperature of the accessible surfaces of associated components shall not exceed 150 °C.~~

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

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

NOTE 3—For some motor-compressors, an injection cooler or an oil cooler and air flow over the motor-compressor may be required as recommended by the motor-compressor manufacturer.

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

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

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

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

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

- ~~— a protective device operates to disconnect the motor-compressor from the supply;~~
- ~~— the motor-compressor stalls and steady conditions are reached.~~

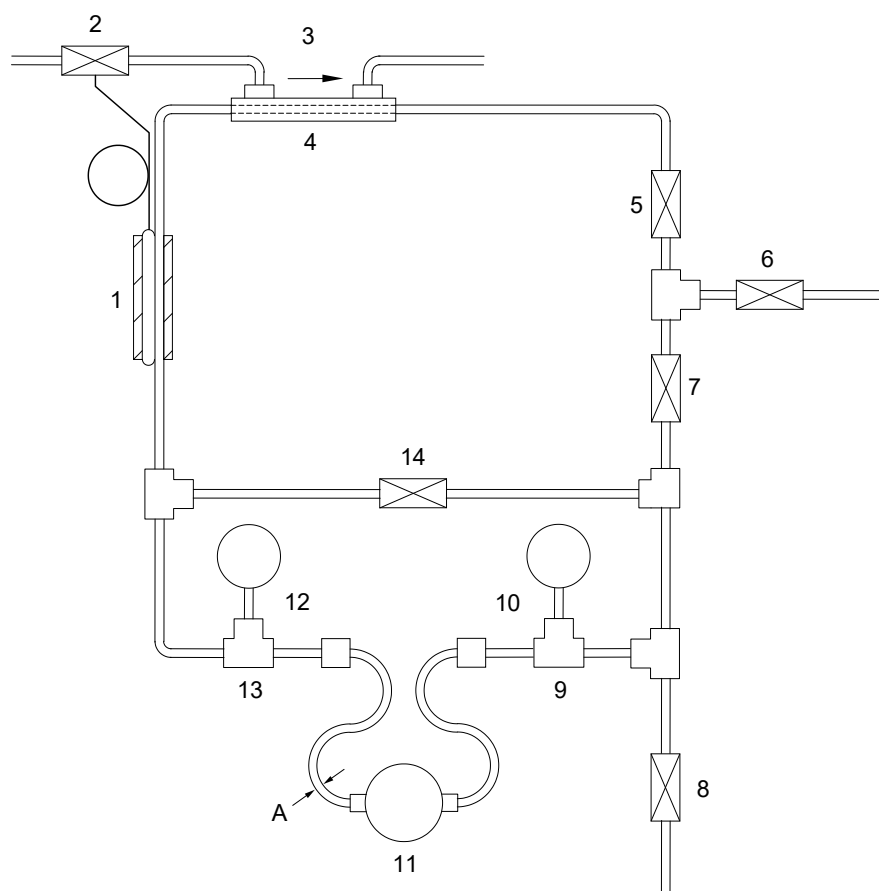
~~In neither of these conditions shall the motor-compressor winding temperature exceed 160 °C for motor-compressors with synthetic insulation and 150 °C for motor-compressors with cellulosic insulation.~~

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

Step	Procedure
1a	For other than R-744 transcritical refrigeration systems, increase the condensing temperature to 70 °C
1b	For R-744 transcritical refrigeration systems, increase the discharge pressure in steps of approximately 0,05 MPa up to a discharge pressure of 13 MPa
2	Increase the evaporating temperature in steps of approximately 5 K for a — LBP application category: up to 0 °C — MBP application category: up to +10 °C — HBP application category: up to +20 °C
3	Increase the input voltage to the inverter in steps of approximately 6 % of the input voltage to the inverter at rated voltage, up to 1,12 times the input voltage to the inverter at rated voltage
4	Starting from rated voltage, decrease the input voltage to the inverter in steps of approximately 5 % of the input voltage to the inverter at rated voltage

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

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



IEC 842/12

Key

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

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

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

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

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

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

Figure AA.1 — Substitute refrigeration circuit

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

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

As the motor-compressor protection system is the motor temperature limiting device, measuring the motor temperature at the ultimate trip point is all that is required to establish the maximum motor winding temperature.

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

NOTE 1 A motor-compressor/motor compressor protection system combination complying with the requirements in Annex AA is considered as complying with the motor winding temperature requirements in related standards, such as IEC 60335-2-11, IEC 60335-2-24, IEC 60335-2-40, IEC 60335-2-75 and IEC 60335-2-89.

NOTE 2 The evaporation and condensation temperatures relate to the corresponding saturated vapour pressures of the refrigerant in use, and are measured by means of the pressure gauges as "suction" and "discharge" respectively in Figure AA.1.

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

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

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

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

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

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

If the motor-compressor is of the single-phase type with an internally mounted protective device, the combined resistance of the main winding and start winding, in series, shall be measured. If the motor-compressor is of the three-phase type with an internally mounted protective device, the trip point of the protected device shall first be established. The test shall then be reconducted and the resistance of the entire winding shall be measured after shut-down, just prior to the protective device activating.

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

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

Before testing in accordance with Clause AA.3 is started, it shall be verified that the **motor-compressor** is in working order by applying the test of 16.3 and then by operating it in the substitute refrigeration circuit of Figure AA.1 under the conditions specified in Table AA.1 but at **rated voltage** for a period of not less than 2 h.

During this two hour period, the maximum value of the current averaged over any 5 min period shall be recorded beginning not more than 60 s following the start of the two hours period. The interval between current measurements shall not exceed 30 s. The starting current is considered to be excluded if the first current measurement is made approximately 1 min after starting.

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

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

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

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

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

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

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

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

The application category abbreviations can be found in 3.1.102.

The tolerances on the temperatures in Table AA.1 are $\pm 2 \text{ K}$ for the **motor-compressor** ambient temperature, condensation and return gas temperatures, and $\pm 1 \text{ K}$ for the evaporation temperature.

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

- the temperature rises of the **motor-compressor control system** and the **motor-compressor protection** system including those containing **electronic components** are measured and shall not exceed the values given in the Table 3 of Part 1, reduced to