भारतीय मानक
Indian Standard

IS/IEC 60335-2-34 : 2021

घरेलू एवं समान विद्युत उपस्कर — सुरक्षा

भाग 2-34 मोटर-संपीडकों की विशिष्ट अपेक्षाएं

Household and Similar Electrical Appliances — Safety

Part 2-34 Particular Requirements for Motor-compressors

ICS 97.040.30

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NATIONAL FOREWORD

This Indian Standard (Part 2/Sec 34) which is identical with IEC 60335-2-34 : 2021 'Household and similar electrical appliances — Safety — Part 2-34: Particular requirements for motor-compressors' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on recommendation of the Refrigeration and Air Conditioning Sectional Committee and approval of the Mechanical Engineering Division council.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminologies and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to the following International Standards, for which Indian Standards also exists. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with its degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60079-1 : 2014 Explosive atmospheres — Part 1: Equipment protection by flameproof enclosures "d"	IS/IEC 60079-1 : 2014 Explosive atmospheres: Part 1 Equipment protection by flameproof enclosures "d" (*first revision*)	Identical
IEC 60079-15 : 2017 Explosive atmospheres — Part 15: Equipment protection by type of protection "n"	IS/IEC 60079-15 : 2017 Explosive atmospheres: Part 15 Equipment protection by type of protection "n" (*second revision*)	Identical
IEC 60335-1 Household and similar electrical appliances — Safety — Part 1: General requirements	IS 302 (Part 1) : 2008 Safety of household and similar electrical appliances: Part 1 General requirements (*sixth revision*)	Not equivalent
IEC 60851-4 : 2016 Winding wires — Test methods — Part 4: Chemical properties	IS 13778 (Part 4) : 2018/IEC 60851-4 : 2016 Winding wires — Test methods: Part 4 Chemical properties (s*econd revision*)	Identical
IEC 60851-5 : 2008 Winding wires — Test methods — Part 5: Electrical properties IEC 60851-5 : 2008/AMD1 : 2011 IEC 60851-5 : 2008/AMD2 : 2019[1)]	IS 13778 (Part 5) : 2012/IEC 60851-5 : 2008 Winding wires — Test methods: Part 5 Electrical properties (*first revision*)	Identical to IEC 60851-5 : 2008
ISO 817 : 2014 Refrigerants — Designation and safety classification ISO 817 : 2014/AMD1 : 2017	IS 16656 : 2017/ISO 817 : 2014 Refrigerants — Designation and safety classification	Identical

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

(*Continued on third cover*)

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.

Indian Standard

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES — SAFETY

PART 2-34 PARTICULAR REQUIREMENTS FOR MOTOR-COMPRESSORS

1 Scope

This clause of Part 1 is replaced by the following.

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

This standard also covers

– multi-speed **motor-compressors**, that are **motor-compressors**, the speed of which can be set to different values;

– variable capacity **motor-compressors** that are **motor-compressors** where the capacity of the compressor is controlled at fixed speeds.

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

– tumble dryers (IEC 60335-2-11);

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

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

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

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

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

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

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

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

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

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

– playing with the appliances by young children.

NOTE 102 Attention is drawn to the fact that

– for **motor-compressors** intended to be used in appliances in vehicles or on board ships, additional requirements could be necessary;

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

This standard does not apply to

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

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

2 Normative references

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

Addition:

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

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

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

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

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

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

3 Terms and definitions

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

3.1 Definitions relating to physical characteristics

3.1.101
design pressure
gauge pressure that has been assigned to a **transcritical refrigeration system**

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

3.1.102
application category
back pressure relative to the evaporation temperature range over which the **motor-compressor** operates

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

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

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

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

3.5 Definitions relating to types of appliances

3.5.101
motor-compressor
appliance consisting of the mechanical mechanism of the compressor and the motor, both of which are enclosed in the same sealed **housing**, with no external shaft seals, and with the motor operating in a refrigerant atmosphere with or without oil

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

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

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

3.6 Definitions relating to parts of an appliance

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

3.6.102
starting relay
electrically operated control device intended for integration or incorporation into a **motor-compressor** and used within the **motor-compressor** circuit to control the starting of single-phase **motor-compressors**

3.7 Definitions relating to safety components

3.7.101
thermal motor-protector
automatic control, built-in or fitted on a **motor-compressor** that is specifically intended to protect the **motor-compressor** against over-heating due to running overload and failure to start

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

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

3.7.102
motor-compressor protection system
thermal motor protector and associated components, if any, or **protective electronic circuit** fully or partly separate or integrated into the **motor-compressor control system** and which is specifically intended to protect the **motor-compressor** against over-heating due to running overload or failure to start

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

– **motor-compressor** current.

3.7.103
motor-compressor control system
system comprising one or more electrical or **electronic components**, or **electronic circuits** that provides at least one of the following:

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

3 7.104
pressure relief device
pressure sensing device, intended to reduce pressure automatically when pressures within the refrigeration system exceed the preset pressure of the device

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

3.8 Definitions relating to miscellaneous matters

3.8.101
transcritical refrigeration system
refrigeration system where the pressure in the high pressure side is above the pressure where the vapour and liquid states of the refrigerant can coexist in thermodynamic equilibrium

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

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

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

5.2 *Addition:*

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

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

5.6 *Addition:*

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

5.7 *Replacement:*

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

5.8.2 *Addition*:

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

5.10 *Addition*:

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

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

– *type (synthetic or cellulosic) of winding insulation;*
– *refrigerant identification:*
  a) *for a single component refrigerant, by at least one of the following:*
    - *chemical name;*
    - *chemical formula;*
    - *refrigerant number;*
  b) *for a blended refrigerant, at least one of the following:*
    - *chemical name and nominal proportion of each of the components;*
    - *chemical formula and nominal proportion of each of the components;*
    - *refrigerant number and nominal proportion of each of the components;*
    - *refrigerant number of the refrigerant blend;*
– *types and quantity of oil to be used if the test samples which use oil are not already charged;*
– ***application category*** *or application categories for motor-compressors classified as being tested with Annex AA;*
– *whether a* ***supply cord*** *can be connected directly to terminals on the* ***motor-compressor****;*
– *for motor-compressors intended for appliances with a transcritical refrigeration system, the test pressure for the high pressure side if higher than the minimum test pressure.*

5.11 *Replacement*:

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

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

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

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

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

6 Classification

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

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

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

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

6.102 **Motor compressors** are classified as being

– intended for direct connection of the appliance **supply cord** to the **motor-compressor** terminals, or

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

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

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

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

Compliance is checked by inspection and by the relevant tests.

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

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

Compliance is checked by inspection and by the relevant tests.

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

Compliance is checked by inspection and by the relevant tests

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

Compliance is checked by inspection and by the relevant tests

7 Marking and instructions

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

7.1 *Modification:*

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

Addition:

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

7.5 Not applicable.

7.6 Addition:

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

Warning; Risk of fire / Flammable material

7.7 Not applicable.

7.12 Not applicable, except 7.12.1, which is applicable.

7.13 Not applicable.

7.14 *Addition:*

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

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

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of Part 1 is applicable.

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is not applicable.

11 Heating

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

12 Void

13 Leakage current and electric strength at operating temperature

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

13.3 *Addition:*

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

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

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

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

15.3 *Addition:*

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

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.3 *Addition:*

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

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

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

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

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

19 Abnormal operation

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

19.1 *Modification:*

Replace the test specification by the following:

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

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

Only one abnormal condition is simulated each time.

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

19.2 to **19.10** Not applicable.

19.11.2 *Addition*:

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

19.11.3 *Replacement:*

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

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

19.11.4 *Addition:*

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

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

19.13 *Addition:*

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

19.14 *Replacement:*

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

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

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

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

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

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

NOTE 101 For **motor-compressors** not classified as being tested with Annex AA, this test will be performed on the final product.

NOTE 102 If the **motor-compressor** has several modes of operation, the tests are carried out with the **motor-compressor** operating in each mode, if necessary.

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

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

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

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

*All electromechnical components of the **protection system** shall be tested individually for 50 operations in total with the **motor-compressor** or with a load corresponding to the actual **motor-compressor** or a higher load.*

*For **motor-compressors** with a **self-resetting motor-compressor protection system**, the **motor-compressor protection system** is allowed to cycle continuously for a period of 15 days or for at least 2 000 cycles, whichever is the longer.*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

– *with motor starting capacitors and motor running capacitors short-circuited one at a time, unless they have been tested and shown to comply with the requirements for protection class S2 capacitors of IEC 60252-1.*

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

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

NOTE 3 This test can be performed on separate samples.

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

– *for **motor-compressors** with a **self-resetting motor-compressor protection system**, for 3 h;*

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

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

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

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

– *the **motor-compressor protection system** shall be able to operate;*

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

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

– *the **motor-compressor**, its associated **starting relay** and **motor-compressor protection system** shall not emit flames, sparks or molten metal.*

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

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

– *the **motor-compressor protection system** shall be able to operate;*

– *the **motor-compressor** shall withstand*

  - *the leakage current test as specified in 16.2, the test voltage being applied between the windings and the **housing**;*
  - *the electric strength test of 13.3 of Part 1.*

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

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

– *the **motor-compressor** shall withstand*

  - *the leakage current test as specified in 16.2, the test voltage being applied between the windings and the **housing**;*
  - *the electric strength test of 13.3 of Part 1;*

– *the **motor-compressor protection system** shall be able to operate or it shall remain permanently open-circuited.*

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

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

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

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

Compliance is checked by the following test.

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

The test is continued for the following periods:

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

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

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

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

During the test,

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

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

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

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

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

- ***motor-compressor*** *current,*
- ***motor-compressor*** *temperature.*

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable.

22 Construction

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

22.2 Not applicable.

22.5 Not applicable.

22.7 *Replacement:*

Housings shall withstand the pressure expected in normal use.

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

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

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

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

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

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

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

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

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

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

Table 101 – Minimum high side test pressures

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

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

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

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

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

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

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

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

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

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

= 4,05 MPa (40,5 bar)

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

Table 102 – Minimum low side test pressures

Refrigerant formulae	*Refrigerant number*	*Test pressure*	
		MPa	*(bar)*
Subcritical			
CF_3CH_2F	*R-134a*	*2,5*	*(25)*
$CHClF_2$	*R-22*	*4,2*	*(42)*
CH_2F_2	*R-32*	*7,0*	*(70)*
$CH_3CH_2CH_3$	*R-290*	*3,8*	*(38)*
$CF_3CF=CH_2$	*R-1234yf*	*2,6*	*(26)*
$CF_3CH=CHF$	*R-1234ze*	*2,5*	*(25)*
$CH(CH_3)_3$	*R-600a*	*2,5*	*(25)*
CO_2	*R-744*	*14,2*	*(142)*
by weight 48,8 % R-22 + 51,2 % R-115	*R-502*	*4,6*	*(46)*
by weight 44 % R-125 + 52 % R-143a + 4 % R-134a	*R-404A*	*5,0*	*(50)*
by weight 50 % R-125 + 50 % R-143a	*R-507A*	*5,2*	*(52)*
by weight 25 % R-125 + 52 % R-134a + 23 % R-32	*R-407C*	*4,0*	*(40)*
by weight 50 % R-125 + 50 % R-32	*R-410A*	*6,8*	*(68)*
Transcritical			
CO_2	*R-744*	*28,2*	*(282)*
NOTE The refrigerant test pressure data is based on NIST Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 9.1.			

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

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

*For two stage **motor-compressors** with direct discharge from the second stage, the housing is considered to be exposed to low side pressure.*

*For two stage **motor-compressors** without direct discharge from the second stage, the **housing** is considered to be exposed to high side pressure.*

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

*Where gaskets are employed for sealing the **housing** of a **semi-hermetic motor-compressor**, leakage at gaskets is not considered as a failure, provided the leakage occurs at a pressure greater than 40 % of the required test pressure.*

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

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

NOTE 104 All pressures are gauge pressures.

22.9 *Addition:*

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

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

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

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

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

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

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

22.14 Not applicable.

22.21 *Addition:*

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

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

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

Compliance is checked by inspection.

23 Internal wiring

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

23.8 *Addition:*

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

24 Components

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

24.1.4 *Addition:*

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

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

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

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

25 Supply connection and external flexible cords

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

25.1 *Addition:*

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

25.7 Not applicable.

26 Terminals for external conductors

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

27 Provision for earthing

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

27.1 *Addition:*

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

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

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

29.1 *Addition:*

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

For a **rated voltage** > 300 V and ≤ 346 V, the rated impulse voltage is for

– overvoltage category I: 2 500 V;
– overvoltage category II: 4 000 V;
– overvoltage category III: 6 000 V.

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

29.1.1 *Addition:*

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

29.1.4 *Addition:*

Clearances inside the **housing** are reduced by 0,5 mm for rated impulse voltages of 2 500 V or more. Between winding wires and winding leads for motors or **thermal motor protectors**, no minimum **clearance** is specified.

29.2 *Addition:*

Pollution degree 1 applies inside the **housing**.

29.2.1 *Modification:*

Add the following to Note 2 in Table 17:

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

29.2.4 *Modification:*

Add the following to Note 2 in Table 18:

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

29.3.4 *Addition:*

*For a **rated voltage** > 300 V and ≤ 346 V, the minimum thickness for accessible parts of **reinforced insulation** consisting of a single layer is for*

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

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

30 Resistance to heat and fire

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

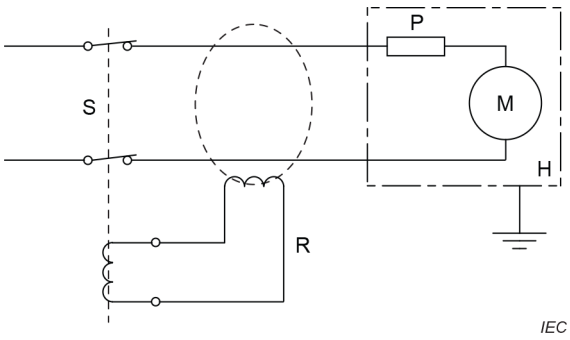
30.2.2 Not applicable.

31 Resistance to rusting

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

32 Radiation, toxicity and similar hazards

This clause of Part 1 is not applicable.



Key

S supply

H **housing**

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

P **motor-compressor protection system** (external or internal)

M **motor-compressor**

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

Annexes

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

Annex C
(normative)

Ageing test on motors

This annex of Part 1 is not applicable.

Annex D
(normative)

Thermal motor protectors

This annex of Part 1 is not applicable.

Annex AA
(normative)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The application category abbreviations can be found in 3.1.102.

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

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

– *the temperature rises of the **motor-compressor control system** and the **motor-compressor protection** system including those containing **electronic components** are measured and shall not exceed the values given in the Table 3 of Part 1, reduced by 7 K;*

– *the **motor-compressor protection system** shall not operate to disconnect the **motor-compressor** from the supply;*

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

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

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

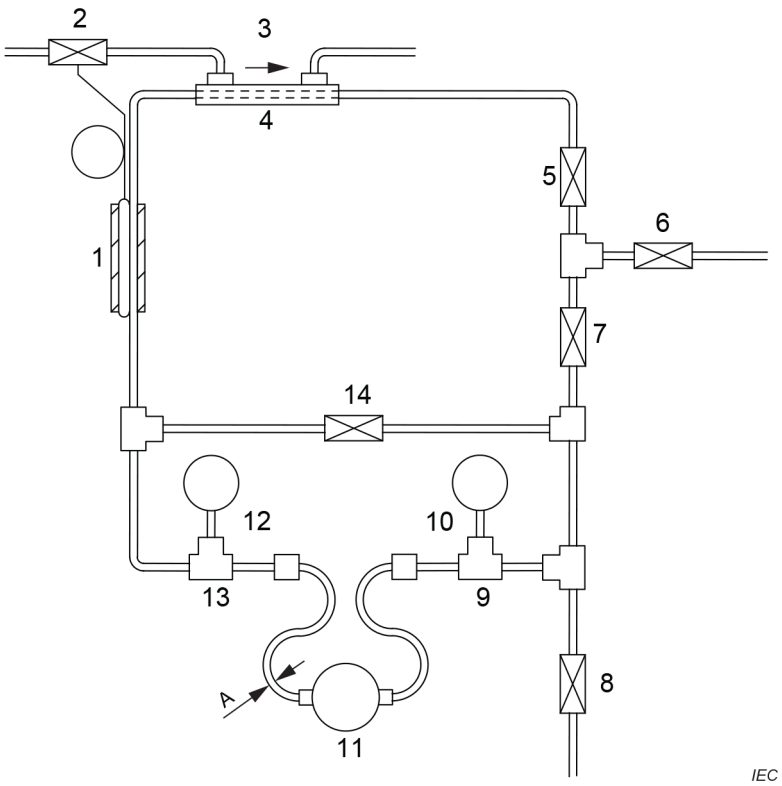
– *a **protective device** operates to disconnect the **motor compressor** from the supply*,

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

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

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

Step	Procedure
1a	*For other than R-744 subcritical **refrigeration systems** or **transcritical refrigeration systems**, increase the condensing temperature to +70 °C*
1b	*For R-744 subcritical **refrigeration systems** (**application category** SC R-744BP), increase the condensing temperature to +10 °C*
1c	*For R-744 **transcritical refrigeration systems**, increase the discharge pressure in steps of approximately 0,05 MPa up to a discharge pressure of 13 MPa*
2a	*For other than R-744 subcritical **refrigeration systems** increase the evaporating temperature in steps of approximately 5 K for* – *VLBP up to –15 °C* – *LBP up to 0 °C* – *MBP up to +10 °C* – *HBP up to +20 °C* – *VHBP up to +35 °C*
2b	*For R-744 subcritical **refrigeration systems** (**application category** SC R-744BP), increase the evaporating temperature in steps of approximately 5 K up to 0 °C*
3	*For inverter driven **motor-compressors**, increase the input voltage to the inverter in steps of approximately 6 % of the input voltage to the inverter at **rated voltage**, up to 1,12 times the input voltage to the inverter at **rated voltage***
4a	*Starting from **rated voltage**, decrease the input voltage to the **motor-compressor** in steps of approximately 5 % of the **rated voltage** at a rate of approximately 2 V/min*
4b	*For inverter driven **motor-compressors** starting from **rated voltage**, decrease the input voltage to the inverter in steps of approximately 5 % of the input voltage to the inverter at **rated voltage** at a rate of approximately 2 V/min*



Key

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

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

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

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

NOTE 2 For some **motor-compressors**, an additional means for reducing the motor temperature, such as an injection cooler or an oil cooler and air flow over the **motor-compressor**, can be required as recommended by the **motor-compressor** manufacturer. The heat removal will be done in conformity with the **motor-compressor** manufacturer's recommendations.

NOTE 3 In case an oil separator is required by the **motor-compressor** manufacturer, it can be incorporated in the substitute cooling system, as recommended by the **motor-compressor** manufacturer.

Figure AA.1 – Substitute refrigeration circuit

Annex BB
(normative)

Winding wire insulation compatibility tests

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

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

b) Other winding wires shall consist of either straight lengths of wire or **motorettes** (see Figure BB.1 and Figure BB.2).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

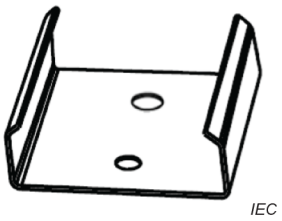
Table BB.1 – Time temperature heating cycles

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

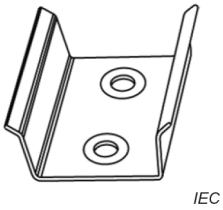
BB.11 Immediately after being exposed to the refrigerant and oil, the winding wire samples shall be subjected to the electric strength test of 16.3 except that the applied voltage shall be not less than 100 % of the maximum **working voltage** of the **motor-compressor** for which the winding wire is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

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

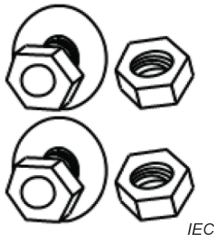
is that specified for basic insulation at 100 % of the maximum **working voltage** of the **motor-compressor** for which the **motorette** winding and insulation is intended to be used. The **motorettes** tested shall withstand the application of the test voltage specified without breakdown.



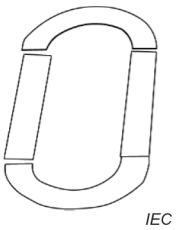
A outer slot plate



B inner slot plate

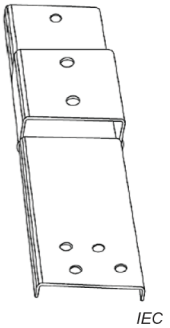


C bolts, nuts and washers

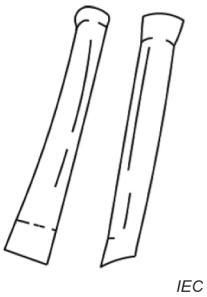


D phase insulation

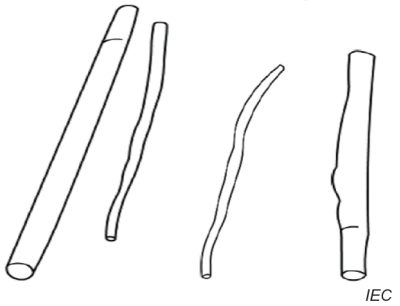
E bifilar random wound coils



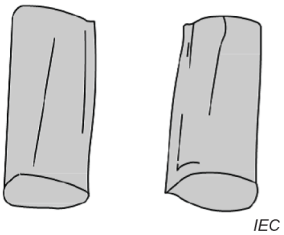
F brass frame



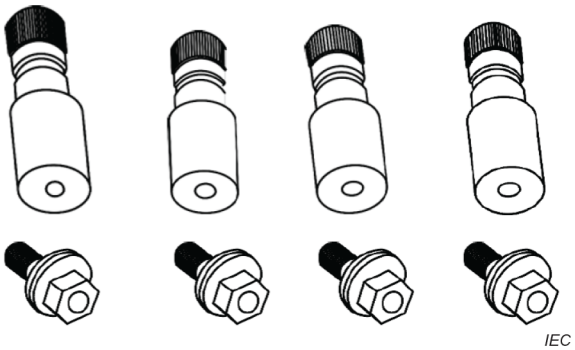
G slot wedges



H protective sleeving



I slot insulation



J building posts and insulations

Key

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

Figure BB.1 – Motorette components

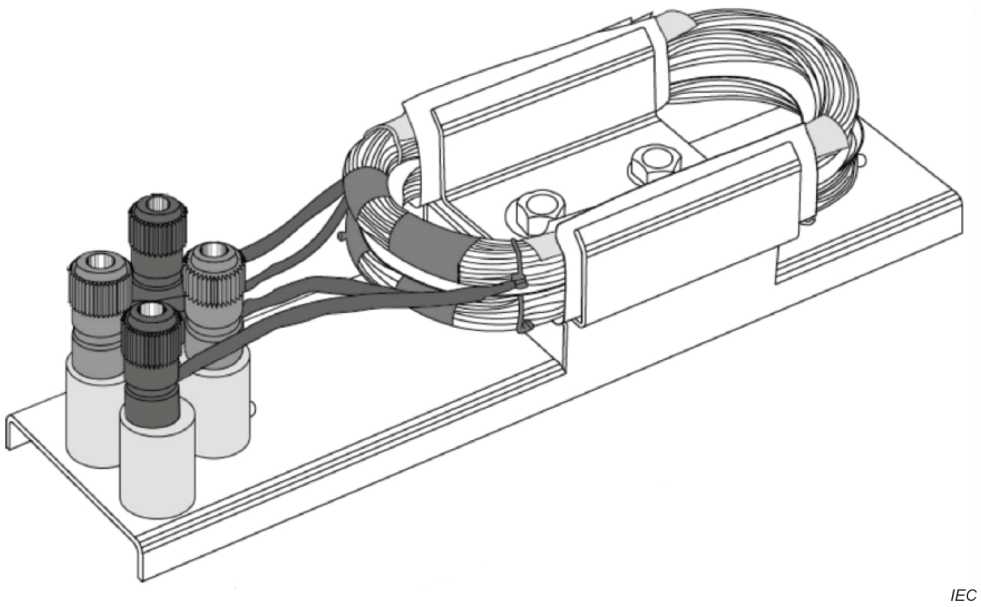


Figure BB.2 – Completely assembled motorette

Annex CC
(normative)

Tie cords and insulation compatibility tests

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

a) tie cords shall be at least 500 mm long and of the minimum nominal thickness intended for use on the **motor-compressor**;

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

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

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

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

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

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

CC.4 If the parts to be tested are:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table CC.1 – Time temperature heating cycles

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

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

a) tie cord samples shall be subjected to the breaking strength test in accordance with Clause CC.6. Not less than five of the six tie cord samples exposed to refrigerant and oil shall have a breaking strength of at least 50 % of the average as-received tie cord breaking strength;

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

Annex DD
(normative)

Non-sparking “n” electrical apparatus and test condition for “dc” devices

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

7 Requirements for non-incendive components

Clause 7 is applicable.

8 Requirements for hermetically sealed devices

Clause 8 is applicable.

9 Requirements for sealed devices

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

9.1 Non-metallic materials

Seals are tested using 11.2.

10 Requirements for restricted-breathing enclosures

Clause 10 is applicable.

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

15.5.3.1 General

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

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

Annex EE
(normative)

Fatigue test

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

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

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

EE.4 Fatigue cycle test is as follows.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

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

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

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

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

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

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

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

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

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

National Annex A

(*National Foreword*)

A-1 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 7010 : 2019 Graphical symbols — Safety colours and safety signs — Registered safety signs	IS 16451 : 2018/ISO 7010 : 2011 Graphical symbols — Safety colours and safety signs — Registered safety signs	Identical to ISO 7010 : 2011

The standard also makes a reference to BIS Certification marking of product. Details of which are given in National Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: MED 03 (17365).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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