

INTERNATIONAL STANDARD

IEC
60335-2-34

Fourth edition
2002-10

Household and similar electrical appliances – Safety –

Part 2-34: Particular requirements for motor-compressors

*Appareils électrodomestiques et analogues –
Sécurité –*

*Partie 2-34:
Règles particulières pour les motocompresseurs*



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-34: Particular requirements for motor-compressors

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

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

This fourth edition cancels and replaces the third edition published in 1999. It constitutes a technical revision.

The text of this part of IEC 60335 is based on the following documents:

FDIS	Report on voting
61C/214/FDIS	61C/217/RVD

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

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 fourth edition (2001) of that standard.

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

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

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

NOTE 2 The following numbering system is used:

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

NOTE 3 The following print types are used:

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

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

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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

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).

A bilingual version of this publication may be issued at a later date.

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.

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.

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.

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.

For **motor-compressors**, testing in accordance with this standard is an option and cannot be required as a precondition for testing the complete appliance, for example by reference in Clause 24 of a part 2 of IEC 60335. However, testing of the appliance should be reduced if an incorporated **motor-compressor** including its protection system or control system, if any, complies with this standard.

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

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

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

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

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-34: Particular requirements for motor-compressors

1 Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of sealed (hermetic and semi-hermetic type) **motor-compressors**, their protection and control systems, if any, which are intended for use in equipment for household and similar purposes and which conform with the standards applicable to such equipment. It applies to **motor-compressors** tested separately under the most severe conditions that may be expected to occur in normal use, their **rated voltage** being not more than 250 V for single-phase **motor-compressors** and 480 V for other **motor-compressors**.

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.

NOTE 102 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 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 103 Attention is drawn to the fact that

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

NOTE 104 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 105 This standard does not take into consideration failure of software. If the safety of the **motor-compressor** is dependent on the correct functioning of software, this hazard is addressed by the necessary software analysis. Requirements for this analysis are under consideration.

2 Normative references

This clause of Part 1 is applicable except as follows.

Modification:

Replace IEC 60252, AC Motor capacitors by IEC 60252-1, AC motor capacitors – Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation

3 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. 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. 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. This control carries **motor-compressor** current and is sensitive to one or both of the following:

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

NOTE 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 electronic protection system 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. 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** over-heat protection;
- **motor-compressor** failure to start protection;
- **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

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 equal to or less than $-35\text{ }^{\circ}\text{C}$ 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 equal to or greater than $+15\text{ }^{\circ}\text{C}$.

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.

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

5.7 Replacement:

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

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**.

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**.

6 Classification

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

6.101 Motor-compressors are classified as being tested with Annex AA or without 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 may 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 may be necessary.

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.

7.5 Not applicable.

7.7 Not applicable.

7.12 Not applicable, except 7.12.1 which is applicable.

7.13 Not applicable.

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 may be covered by Annex AA.

12 Void

13 Leakage current and electric strength at operating temperature

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

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

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

15.3 Addition:

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

16 Leakage current and electric strength

This clause of Part 1 is applicable.

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

18 Endurance

This clause of Part 1 is not applicable.

19 Abnormal operation

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

19.1 Modification:

Replace the test specification by the following:

Motor-compressors are submitted to the tests of 19.101, 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 Modification:

Replace the fifth paragraph of the test specification by the following:

For simulation of the fault conditions, a **motor-compressor** incorporating an **electronic circuit** is operated under the conditions specified in 19.101, 19.102 and 19.103 but supplied at **rated voltage**.

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.

Motor-compressors with a manually reset **motor-compressor protection system** are operated for 50 cycles of the **motor-compressor protection system**, the system being reset as quickly as possible after each operation.

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.

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 of this clause.

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 may 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 may be used for the test at the lowest voltage.

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

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

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

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

NOTE 3 This test may be performed on a separate sample.

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 the circuit shown in Figure 101 and 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 manually reset **motor-compressor protection system**, until the first operation of the **motor-compressor protection system**.

NOTE This test may 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, 19.102 and 19.103

- 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.

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 manually reset **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 may 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 three hours.

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 pressures expected in normal use.

Compliance is checked by the following tests.

*A **housing** which is exposed to high side pressure shall be subjected to a pressure equal to 3,5 times the saturated vapour pressure of the refrigerant at 70 °C or equal to 3,5 times the pressure at the critical temperature if this temperature is lower than 70 °C, the test pressure being rounded up to the next 0,5 MPa (5 bar).*

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

Saturated vapour pressure at 70 °C = 2,89 MPa (28,9 bar)

Test pressure = $3,5 \times 2,89$ 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).

NOTE 102 The test values for some refrigerants are given in Table 101.

Table 101 – High side test pressures

Refrigerant		Test pressure	
		MPa	(bar)
CCl ₂ F ₂	R-12	6,0	(60)
CF ₃ CH ₂ F	R-134a	6,5	(65)
CHCl ₂ F ₂	R-22	10,5	(105)
by weight 73,8 % R-12 + 26,2 % R-152a	R-500	10,0	(100)
by weight 48,8 % R-22 + 51,2 % R-115	R-502	10,5	(105)
by weight 44 % R-125 + 52 % R-152a + 4 % R-134a	R-404A	10,0	(100)
by weight 50 % R-125 + 50 % R-143a	R-507	11,0	(110)
by weight 25 % R-125 + 52 % R-134a + 23 % R-32	R-407C	10,5	(105)
by weight 50 % R-125 + 50 % R-32	R-410A	15,0	(150)

NOTE 103 The values given above may not be high enough for some applications.

A **housing** which is exposed only to low side pressure shall be subjected to a pressure equal to five times the saturated vapour pressure of the refrigerant at 20 °C or equal to 2,5 MPa (25 bar) whichever is the greater, the test pressure being rounded up to the next 0,2 MPa (2 bar).

NOTE 104 Example of test pressure calculation for R-22:

Saturated vapour pressure at 20 °C = 0,81 MPa (8,1 bar)

Test pressure = $5 \times 0,81$ 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).

NOTE 105 The test values for some refrigerants are given in Table 102.

Table 102 – Low side test pressures

Refrigerant		Test pressure MPa (bar)	
CCl ₂ F ₂	R-12	2,5	(25)
CF ₃ CH ₂ F	R-134a	2,5	(25)
CHCl ₂ F ₂	R-22	4,2	(42)
by weight 73,8 % R-12 + 26,2 % R-152a	R-500	2,9	(29)
by weight 48,8 % R-22 + 51,2 % R-115	R-502	4,5	(45)
by weight 44 % R-125 + 52 % R-152a + 4 % R-134a	R-404A	5,0	(50)
by weight 50 % R-125 + 50 % R-143a	R-507	5,5	(55)
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	7,0	(70)

NOTE 106 The values given above may not be high enough for some applications.

NOTE 107 Further information relating to refrigerant number designations may be obtained from ANSI/ASHRAE 34.

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

*For a **motor-compressor** employing a bypass valve which relieves high side pressure into the low side at a predetermined pressure differential, the test pressure is three times the pressure developed while the valve is discharging.*

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.*

*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 108 All pressures are gauge pressures.

22.9 Addition:

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

NOTE 101 Compliance with this requirement may be proven by an appropriate certificate provided by the manufacturer of the **motor-compressor**.

22.14 Not applicable.

22.21 Addition:

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

23 Internal wiring

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

23.8 Addition:

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

24 Components

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

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.

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 29.1.2, clearances less than those specified in Table 16 are not allowed for basic insulation and functional insulation inside the compressor housing.

29.1.1 Addition:

Clearances inside the compressor housing are reduced by 0,5 mm for rated impulse voltages of 2 500 V or more.

29.1.2 Addition:

Clearances inside the compressor 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.

29.2.2 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.

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.

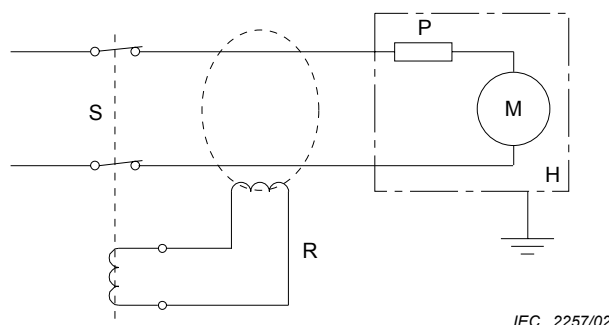
31 Resistance to rusting

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.

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IEC 2257/02

Key

S: supply

H: **housing**R: residual current device that can detect a.c. or a.c. with d.c. components,
max. $I_{\Delta n} = 30$ mA r.m.s. or d.c. max $I_{\Delta n} = 30$ mAP: **motor-compressor protection system** (external or internal)M: **motor-compressor**NOTE 1 The circuit must be modified for three-phase **motor-compressors**

NOTE 2 Care has to be taken to complete the earthing system to permit the correct operation of the residual current device.

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)

Aging test on motors

This annex of Part 1 is not applicable.

Annex D (normative)

Alternative requirements for protected motor units

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 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 at **rated voltage** and under the appropriate running overload conditions specified in Table AA.1 for a period of not less than 2 h.

NOTE 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.

NOTE 2 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 3 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 may be required, as the exact effect of the additional cooling means may not be able to be simulated.

NOTE 4 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 5 If the motor winding temperature of the **motor-compressor** does not exceed the maximum value specified in clause AA.3 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 60335-2-24, IEC 60335-2-40 and IEC 60335-2-75.