

# INTERNATIONAL STANDARD



**Household and similar electrical appliances – Safety –  
Part 2-104: Particular requirements for appliances to recover and/or recycle  
refrigerant from air conditioning and refrigeration equipment**



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# INTERNATIONAL STANDARD



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**Household and similar electrical appliances – Safety –  
Part 2-104: Particular requirements for appliances to recover and/or recycle  
refrigerant from air conditioning and refrigeration equipment**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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### HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

#### **Part 2-104: Particular requirements for appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment**

#### FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60335-2-104:2003. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

IEC 60335-2-104 has been prepared by subcommittee 61D: Appliances for air-conditioning for household and similar purposes, of IEC technical committee 61: Safety of household and similar electrical appliances. It is an International Standard.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

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

- a) Clause 1 – The scope has been edited to reflect that "appliance" in this document means recovery and/or recycle equipment to recover and/or recycle refrigerant from air-conditioning and refrigeration equipment.
- b) Clause 2 – Normative references were added.
- c) Clause 3 – Some definitions were deleted, some were added.
- d) Subclause 7.1 – Some markings were deleted, some were added.
- e) Subclause 7.6 – Symbols were added for "read operator's manual", "operator's manual; operating instructions" including coloring are placed in visible location; maximum allowable pressure markings following X MPa.
- f) Subclause 19.11.4 was modified.
- g) Subclause 21.1 was modified.
- h) Subclause 21.2 was modified.
- i) Subclause 22.102 was modified.
- j) Subclause 22.104.1.1 was modified.
- k) Subclause 22.104.5 was modified.
- l) Subclause 22.104.10 was modified.
- m) Subclause 22.104.11 was modified.
- n) Subclause 22.105.1 was modified.
- o) Subclause 22.107 was modified.
- p) Subclause 30.2 was moved to Clause 29.
- q) Annex AA was deleted and replaced with Annex AA.
- r) Annex BB was deleted and replaced with former IEC 60335-2-104 Annex CC (normative) Compatibility requirements following addition to Annex BB.
- s) Annex DD was deleted and replaced with Annex CC.
- t) New Annex DD was added.
- u) New Annex EE was added.

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

| Draft        | Report on voting |
|--------------|------------------|
| 61D/472/FDIS | 61D/474/RVD      |

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

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

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available

at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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

This part 2 is to be used in conjunction with the fifth edition of IEC 60335-1:2010 and its amendments.

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 appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment.

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

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

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

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

The following differences exist in the countries indicated below:

- 6.1: Class 01 appliances are allowed (Japan).
- 11.8: The temperature of the wooden walls in the test casing is limited to 85 °C (Sweden).

**IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

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

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.

## HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

### Part 2-104: Particular requirements for appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment

#### 1 Scope

This clause of Part 1 is replaced by the following:

This part of IEC 60335 deals with the safety of electrical ~~appliances~~ **recovery** and/or **recycle** equipment to recover and/or **recycle refrigerant** from air conditioning and refrigeration equipment. This applies to air-conditioning, heat-pumps and refrigeration equipment incorporating open drive or motor **compressors**, their maximum **rated voltages** being not more than ~~250~~ 300 V for single phase appliances and 600 V for all other ~~appliances~~ equipment.

Appliances not intended for normal household use but which nevertheless may be a source of danger to the public, such as appliances intended to be used by service personnel in shops, in light industry and on farms, are within the scope of this standard.

The appliances referenced above may consist of one or more factory made assemblies. If provided in more than one assembly, the separate assemblies are to be used together, and the requirements are based on the use of matched assemblies.

~~NOTE 101—A definition of “sealed motor **compressor**” is given in IEC 60335-2-34.~~

~~NOTE 102—Requirements for refrigeration safety are covered by ISO 5149.~~

~~NOTE 103—For appliances using flammable refrigerants, additional requirements are under consideration.~~

~~NOTE 104—Attention is drawn to the fact that~~

- ~~— for appliances intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary;~~
- ~~— for appliances subjected to pressure, 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, national water supply authorities and similar authorities.~~

~~NOTE 105—This standard does not apply to~~

- ~~— appliances designed exclusively for industrial processing;~~
- ~~— 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 101 In this document, the term appliance is to denote **recovery** equipment.

#### 2 Normative references

This clause of Part 1 is applicable except as follows.

*Replacement:*

IEC 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

*Addition:*

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

IEC 60079-15:2010<sup>1</sup>, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

IEC 600320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60335-2-34:~~2002~~2012, *Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors*

IEC 60335-2-40:2018, *Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

IEC 62640:2011, *Residual current devices with or without overcurrent protection for socket-outlets for household and similar uses*  
IEC 62640:2011/AMD1:2015

~~ISO 5149:1993, Mechanical Refrigerating systems used for cooling and heating – Safety requirements~~

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

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

ASTM D4728-17, *Standard Test Method for Random Vibration Testing of Shipping Containers*

SAE J2210 HFC-134a (R-134a), *Recovery/Recycling Equipment for Mobile Air-Conditioning Systems*

SAE J2843 R-1234yf [HFO-1234yf], *Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems*

SAE J3030, *Automotive Refrigerant Recovery/Recycling/Recharging Equipment Intended for use with Both R-1234yf and R-134a*

### 3 Terms and definitions

This clause of part 1 is applicable except as follows.

#### 3.1.6

**rated current** ~~Addition:~~

Note 101 to entry: If the appliance comprises electrical accessories, including fans, the **rated current** is based upon the total maximum electrical power input with all accessories energized, when operating continuously under the appropriate environmental conditions.

<sup>1</sup> Withdrawn.

*Replacement:*

### 3.1.9

#### **normal operation**

conditions that apply when the appliance is mounted as in normal use and is operating under the most severe operating conditions specified by the manufacturer

### 3.101

#### **compressor**

~~a refrigerant open drive or motor compressor with the suction side (low pressure side) intended to be connected to a system from which the refrigerant is being removed. The discharge side is connected to the refrigerant recovery tank~~

open drive **compressor** or motor-**compressor** (hermetically sealed) with the suction side (low pressure side) which is intended to be temporarily connected to the appliance's low pressure side to remove refrigerant

### 3.102

#### ~~temperature limiting device~~

~~a control that serves to prevent excessive temperature~~

### 3.1032

#### **pressure-limiting device**

mechanism that automatically responds to a predetermined pressure by stopping the operation of the pressure-imposing element

### 3.104

#### ~~pressure-relief device~~

~~pressure-actuated valve or rupture member which functions to relieve excessive pressure automatically~~

~~NOTE—A rupture member is a device that will rupture at a predetermined pressure.~~

### 3.105

#### ~~service garage~~

~~location where vehicle testing, diagnostic and repair work is performed~~

### 3.1064

#### **recovery**

pumping out (removal) of **refrigerant** from air conditioning or refrigeration equipment

### 3.1075

#### **recycle**

pumping out (removal) and cleaning of **refrigerant** from air conditioning or refrigeration equipment

### 3.106

#### **refrigerant**

substance that is classified by ISO 817 as A1, A2L, A2, A3 or B1

### 3.107

#### **flammable refrigerant**

substance that is classified by ISO 817 as A2L, A2, or A3

### 3.108

#### **recovery cylinder**

receptacle used for recovered **refrigerant**

### 3.109

#### scale

weighing device which is capable of measuring recovered **refrigerant**

## 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.

*Replacement:*

**5.7** The tests and test conditions of Clause 10 and Clause 11 are carried out under conditions as in 11.4 or under the most severe operating conditions within the operating temperature range specified by the manufacturer.

## 6 Classification

This clause of Part 1 is applicable except as follows.

*Modification:*

**6.1** Appliances shall be of one of the following classes with respect to protection against electric shock:

**class I, class II or class III.**

*Compliance is checked by inspection and by the relevant tests.*

**6.2** *Addition:*

Appliances shall be classified according to degree of protection against harmful ingress of water in accordance with IEC 60529:

- appliances or parts of appliances intended for outdoor use shall be at least IPX4;
- appliances intended only for indoor use may be IPX0.

## 7 Marking and instructions

This clause of Part 1 is applicable except as follows.

**7.1** *Modification:*

*Replace the second dash by:*

- symbol for nature of supply including number of phases, unless for single phase operation;

*Replace the third dash by:*

- **rated current** in amperes;

*Addition:*

- **rated frequency**;
- IP rating;
- maximum high and low side pressure;
- each applicable **refrigerant** for which the appliance is rated;
- for ~~a single component~~ each **refrigerant**, one of the following:
  - the chemical name;
  - ~~the chemical formula~~;
  - the **refrigerant** number (R designation) per ISO 817;
- ~~for a blended refrigerant, one of the following:~~
  - ~~the chemical name of each of the components~~;
  - ~~the chemical formula for each of the components~~;
  - ~~the refrigerant numbers of each of the components~~;
  - ~~the refrigerant number of the refrigerant blend~~;
- ~~permissible excessive operating pressure for the storage tank;~~
- ~~for the refrigerant circuit, should the permissible excessive operating pressure for the suction and discharge side differ, a separate indication is required;~~
- ~~appliances intended for use in **service garages** shall be marked: "This appliance should be used in locations with mechanical ventilation that provides at least four air changes per hour or the appliance should be used at least 0,5 m above the floor;~~
- ~~marked to indicate that it should not be used in the vicinity of spilled or open containers of flammable liquid.~~
- the **recovery cylinder** shall meet the pressure of the **refrigerant** being recovered. Maximum allowable pressure for the **refrigerant** circuit; if the permissible excessive operating pressure for the suction and discharge side differ, a separate indication is required;
- **appliances** (**recovery** equipment) intended for use in service garages or other environments where flammable gases may be present shall be marked: "This appliance should be used in locations with mechanical ventilation that provides at least four air changes per hour;
- **recovery** equipment intended for use in service garages that are covered by SAE J standards covering **recovery** equipment for flammable equipment shall be exempt from this marking and fall under the appropriate SAE or VDA standard.

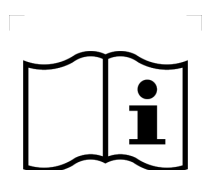
For **flammable refrigerants**, any tubing or other devices through which the **refrigerant** is intended to be serviced shall be painted or colored red. This color shall be present at all places where service puncturing, or otherwise creating an opening in the **refrigerant** circuit might be expected. In the case of a process tube on a **compressor**, the color mark shall extend at least 25 mm from the **compressor**.

**7.6** *Addition:*

Markings shall include the symbols for "read operator's manual", "operator's manual; operating instructions" (symbol ISO 7000-0790 (2004-01)) including colour, and be placed on the **recovery** equipment in a location visible to the persons required to know the information. The perpendicular height of the symbol shall be at least 10 mm.

The maximum allowable pressures shall be marked with symbol ISO 7000-1701 (2004-01) followed by the text "(X) MPa".

If the **recovery** equipment is certified for use with **flammable refrigerant**, the **flammable refrigerant** symbol shall be used per ISO 7010-W021 (2011-05) and the perpendicular height of the triangle shall be at least 30 mm.



[symbol ISO 7000-1641  
(2004-01)]

operator's manual; operating  
instructions



[symbol ISO 7000-1701  
(2004-01)]

pressure

(X) MPa



[symbol ISO 7010-W021  
(2011-05)]

warning; flammable material

#### 7.15 Addition:

A marking may be located on a panel that can be removed for installation or service, providing that the panel shall be in place for the **normal operation** of the appliance.

**7.101** A marking shall be provided for a replaceable fuse or a replaceable overload **protective device** provided as a part of a product. It shall be visible when the cover or door of the compartment is open. This marking shall specify

- the rating of the fuse in amperes, the type and voltage rating, or
- the manufacturer and model designation of the replaceable overload **protective device**.

## 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 applicable.

## 11 Heating

This clause of Part 1 is replaced by the following.

**11.1** Appliances and their surroundings shall not attain excessive temperatures in normal use.

*Compliance is checked by determining the temperatures of the various parts under the conditions specified in 11.2 to 11.7. Nevertheless, if the temperature of the motor winding exceeds the value specified in ~~Table 3~~ Table 1 or if there is a doubt with regard to the classification of the insulation system employed in a motor, compliance is checked by the tests of Annex C.*

**11.2** The appliance is installed in a test room in accordance with the manufacturer's installation instructions. In particular

- **clearances** to adjacent surfaces specified by the manufacturer shall be maintained;
- adjustable limit controls are set at the maximum cut-out setting and the minimum differential permitted by the control adjusting means.

**11.3** *Temperatures are determined by means of fine-wire thermocouples so chosen and positioned that they have the minimum effect on the temperature of the part under test.*

NOTE 101 Thermocouples having wires with a diameter not exceeding 0,3 mm are considered to be fine-wire thermocouples.

*The temperature of motor windings or of coils may be measured by the change-in-resistance method.*

*Thermocouples used for determining the temperatures of the surface of walls, ceiling and floor are embedded in the surface or attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick, which are flush with the surface.*

*So far as is possible, the appliance is positioned so that parts likely to attain the highest temperatures touch the disks.*

*In determining the temperatures of handles, knobs, grips and the like, consideration is given to all parts which are gripped in normal use and, if of insulating material, to parts in contact with hot metal.*

*The temperature of electrical insulation, other than that of windings, is determined on the surface of the insulation, at places where failure could cause a short circuit, contact between **live parts** and accessible metal parts, bridging of insulation or reduction of **creepage distances** or **clearances** below the values specified in 29.1.*

**11.4** Appliance is operated at normal operating voltage in a test room maintained at 43 °C or at the maximum temperature specified by the manufacturer if higher, until temperatures reach stabilisation.

**11.5** Appliances of the water-cooled type shall be operated with the water flow maintained at the most severe condition as specified by the manufacturer.

**11.6** All appliances are operated continuously until steady state conditions are obtained. All appliances shall ~~function to meet the criteria in Annex AA, which specifies minimum criteria for the refrigerants, so they can be reused~~ be operated according to the conditions in Annex AA.

**11.7** During the test, the temperatures and pressures are monitored continuously and shall not exceed the values shown in ~~Table 3~~ Table 1. **Protective devices** shall not operate and sealing compound shall not flow out. Pressures are recorded and used in Clause 21.

**Table 3 1 – Temperature limits**

| Part                                                                                                                                          | Temperature<br>°C |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <i>Windings of sealed motor-compressors</i> <sup>a</sup>                                                                                      |                   |
| – with synthetic insulation                                                                                                                   | 140               |
| – with other insulation                                                                                                                       | 130               |
| <i>External enclosures of sealed motor-compressors or of any other motor</i>                                                                  | 150               |
| <i>Windings</i> <sup>b</sup> if the winding insulation is (other than motor-compressors):                                                     |                   |
| – of class A material <sup>c</sup>                                                                                                            | 100 (90)          |
| – of class E material <sup>c</sup>                                                                                                            | 115 (105)         |
| – of class B material <sup>c</sup>                                                                                                            | 120 (110)         |
| – of class F material <sup>c</sup>                                                                                                            | 140               |
| – of class H material <sup>c</sup>                                                                                                            | 165               |
| – of class 200                                                                                                                                | 185               |
| – of class 220                                                                                                                                | 205               |
| – of class 250                                                                                                                                | 235               |
| <i>Terminals, including earthing terminals, for external conductors of stationary appliances, unless they are provided with a supply cord</i> | 85                |
| <i>Ambient of switches, and thermostats and temperature limiters</i> <sup>d</sup>                                                             |                   |
| – without T marking                                                                                                                           | 55                |
| – with T marking                                                                                                                              | T                 |
| <i>Rubber or polyvinyl chloride insulation of internal and external wiring, including supply cords:</i>                                       |                   |
| – without temperature rating <sup>e</sup>                                                                                                     | 75                |
| – with temperature rating (T)                                                                                                                 | T                 |
| <i>Cord sheaths used as supplementary insulation</i>                                                                                          | 60                |
| <i>Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:</i>                         |                   |
| – when used as a <b>supplementary insulation</b> or <b>reinforced insulation</b>                                                              | 65                |
| – in other cases                                                                                                                              | 75                |
| <i>Lampholders B22, E26 and E27:</i>                                                                                                          |                   |
| – metal or ceramic type                                                                                                                       | 185               |
| – insulated type, other than ceramic                                                                                                          | 145               |
| – with T-marking                                                                                                                              | T                 |
| <i>Lampholders E14 and B15:</i>                                                                                                               |                   |
| – metal or ceramic type                                                                                                                       | 155               |
| – insulated type, other than ceramic                                                                                                          | 115               |
| – with T-marking                                                                                                                              | T                 |

| Part                                                                                                                                                                                                   | Temperature<br>°C |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Material used as insulation other than that specified for wires and windings:                                                                                                                          |                   |
| – impregnated or varnished textile, paper or press board                                                                                                                                               | 95                |
| – laminated bonded with:                                                                                                                                                                               |                   |
| • melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins                                                                                                                                 | 110               |
| • urea-formaldehyde resin                                                                                                                                                                              | 90                |
| – printed circuit boards bonded with epoxy resin                                                                                                                                                       | 145               |
| – moulding of:                                                                                                                                                                                         |                   |
| • phenol-formaldehyde with cellulose fillers                                                                                                                                                           | 110               |
| • phenol-formaldehyde with mineral fillers                                                                                                                                                             | 90                |
| • melamine-formaldehyde                                                                                                                                                                                | 110               |
| • urea-formaldehyde                                                                                                                                                                                    | 90                |
| – polyester with glass-fibre reinforcement                                                                                                                                                             | 135               |
| – silicone rubber                                                                                                                                                                                      | 170               |
| – polytetrafluoroethylene                                                                                                                                                                              | 290               |
| – pure mica and tightly sintered ceramic material, when such materials are used as <b>supplementary insulation</b> or <b>reinforced insulation</b>                                                     | 425               |
| – thermoplastic material <sup>f</sup>                                                                                                                                                                  | -                 |
| Wood, in general <sup>g</sup>                                                                                                                                                                          | 90                |
| Wooden walls of the test casing                                                                                                                                                                        | 90                |
| Outer surface of capacitors <sup>h</sup>                                                                                                                                                               |                   |
| – with marking of maximum operating temperature (T) <sup>i</sup>                                                                                                                                       | T                 |
| – without marking of maximum operating temperature:                                                                                                                                                    |                   |
| • small ceramic capacitors for radio and television interference suppression                                                                                                                           | 75                |
| • capacitors complying with IEC 60384-14 or 14.2 of IEC 60065:2014                                                                                                                                     | 75                |
| • other capacitors                                                                                                                                                                                     | 60                |
| External enclosure of appliances without supplementary heater                                                                                                                                          | 85                |
| Handles, knobs, grips and the like and all parts which are gripped in normal use:                                                                                                                      |                   |
| – of metal                                                                                                                                                                                             | 60                |
| – of porcelain or vitreous material                                                                                                                                                                    | 70                |
| – of moulded material, rubber or wood                                                                                                                                                                  | 85                |
| Parts in contact with oil having a flash-point of t °C                                                                                                                                                 | t-25              |
| Any point where the insulation of wires can come into contact with parts of a terminal block or compartment for fixed wiring of a <b>stationary appliance</b> not provided with a <b>supply cord</b> : |                   |
| – if the instructions require the use of supply wires with a temperature rating (T)                                                                                                                    | T                 |
| – in other cases <sup>e</sup>                                                                                                                                                                          | 75                |

- <sup>a</sup> Not required for motor-**compressors** that comply with IEC 60335-2-34.
- <sup>b</sup> The temperatures within parentheses apply when thermocouples are used. The figures without parentheses apply when the resistance method is used.
- <sup>c</sup> The classification is in accordance with IEC 60085.
- Examples of class A material are:
- impregnated cotton, silk, artificial silk and paper,
  - enamels based on oleo or polyamide resins.
- Examples of class B materials are:
- glass fibre, melamine-formaldehyde and phenol-formaldehyde resins.
- Examples of class E materials are:
- mouldings with cellulose fillers, cotton fabric laminates and paper laminates, materials bonded with melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins;
  - cross-linked polyester resins, cellulose triacetate films, polyethylene terephthalate films;
  - varnished polyethylene terephthalate textile bonded with oil-modified alkyd resin varnish;
  - enamels based on polyvinyl formalin, polyurethane or epoxy resins.
- For totally enclosed motors, the temperature limits for Class A, Class E and Class B materials may be increased by 5 °C (5 K).
- A totally enclosed motor is a motor so constructed that the circulation of the air between the inside and the outside of the case is prevented, but which is not necessarily sufficiently enclosed to be called airtight.
- <sup>d</sup> T means the maximum operating temperature. The ambient **temperature** of switches and **thermostats** is the temperature of the air at the hottest point at a distance of 5 mm from the surface of the switch and **thermostat** concerned. For the purpose of this test, switches and **thermostats** marked with the individual ratings may be considered as having no marking for the maximum operating temperature, if this is requested by the manufacturer of the appliance.
- <sup>e</sup> This limit applies to cables, cords and wires complying with the relevant IEC standards; for others, it may be different.
- <sup>f</sup> There is no specific limit for thermoplastic material, which ~~must~~ **shall** withstand the tests of 30.1 or 30.2 of Part 1, for which purpose the temperature shall be measured.
- <sup>g</sup> The limit specified concerns the deterioration of wood and it does not take into account the deterioration of surface finishes.
- <sup>h</sup> There is no limit for the temperature rise of capacitors which are short-circuited in 19.7.
- <sup>i</sup> Temperature marking for capacitors mounted on printed circuit boards may be given in the technical sheet.
- If these or other materials are used, they shall not be subjected to temperatures in excess of the thermal capabilities as determined by aging tests made on the materials themselves.

NOTE 101 The value of the temperature of a winding is calculated from the formula:

$$T = \frac{R_2}{R_1} (k + T_1) - k$$

where

T is the temperature of the copper winding at the end of the test;

R<sub>1</sub> is the resistance at the beginning of the test;

R<sub>2</sub> is the resistance at the end of the test;

T<sub>1</sub> is the ambient temperature at the beginning of the test;

k is equal to 234,5 for copper windings and 225 for aluminium windings.

At the beginning of the test, the windings ~~shall be~~ **are** at ambient temperature.

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

## 12 Void

## 13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

### 13.2 Modification:

For **permanently connected** stationary **class I**-~~appliances~~ **recovery equipment**, the leakage current shall not exceed 2 mA per kilowatt at **rated power input** with a maximum value of 10 mA for appliances accessible to the general public, and a maximum value of 30 mA for appliances not accessible to the general public.

## 14 Transient overvoltages

This clause of Part 1 is applicable.

## 15 Moisture resistance

This clause of Part 1 is replaced by the following.

**15.1** Electrical components of appliances shall be protected against the ingress of water which may be present in the appliance.

*Compliance is checked by the tests of 15.2, followed immediately by the spillage test of 15.3, and this is followed by the tests of 11.6 and the tests of Clause 16.*

Following these tests, an inspection is made within the enclosures. The water which may have entered the enclosure shall not have reduced the creepage distances and clearances below the minimum values specified in Clause 29.

NOTE 101 Appliances designed to be installed completely inside a building and which have no outdoor parts are not subjected to the test of 15.2.

The motor-**compressor** is not operated during the tests of 15.2 and 15.3.

**15.2** *Appliances other than IPX0 are subjected to the tests of IEC 60529:1989 as follows:*

- *IPX1 appliances as described in 14.2.1;*
- *IPX2 appliances as described in 14.2.2;*
- *IPX3 appliances as described in 14.2.3;*
- *IPX4 appliances as described in 14.2.4;*
- *IPX5 appliances as described in 14.2.5;*
- *IPX6 appliances as described in 14.2.6;*
- *IPX7 appliances as described in 14.2.7.*

*For this test, the appliance is immersed in water containing 1 % NaCl by weight.*

**15.3** *The appliance is installed according to the manufacturer's installation instructions, but not operated. Covers which provide access for manual operation of electrical controls are set in the open position, unless such covers are of the self-closing type. A solution of 0,25 l of water containing 2,5 g of ordinary table salt is poured onto the unit in a manner most likely to cause entrance of the water into or on electrical controls or uninsulated **live parts**. After the spillage is completed, the appliance shall withstand the tests of Clause 16. The spillage test is not applicable to units if the minimum dimension of a horizontal or near horizontal top surface of the cabinet is 75 mm or less.*

## 16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

### 16.2 Modification:

*For **permanently connected** stationary **class I appliances**, the leakage current shall not exceed 2 mA per kilowatt of **rated power input**, with a maximum value of 10 mA for appliances accessible to the general public and a maximum value of 30 mA for appliances not accessible to the general public.*

## 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 replaced by the following.

**19.1** Appliances shall be so constructed that the risk of fire, or of mechanical damage impairing safety or protection against electric shock, as a result of abnormal or careless operation is obviated, as far as practicable. Failure of the transfer medium flow, or of any control devices, shall not result in a hazard.

**Electronic circuits** shall be designed and applied so that a fault condition will not render the appliance unsafe with regard to electric shock, fire hazard, mechanical hazard or dangerous malfunction.

Appliances are subjected to the tests specified in 19.2 to 19.6.

*Appliances incorporating **electronic circuits** are also subjected to the tests of 19.7 and 19.8 as applicable.*

During and after the tests the appliance shall comply with the requirement of 19.9.

**19.2** *The motors, other than motor-**compressors**, are mounted on a support of wood or similar material. The motor rotors are locked; fan blades and brackets are not removed.*

*The motors are supplied at the **rated voltage** of the appliance, or at the upper limit of the **rated voltage range**, in a circuit as shown in Figure 101.*

Under these conditions, the assembly is operated for 15 days (360 h) or until a protection device permanently opens the circuit, whichever is the shorter period.

During the test, the ambient temperature is maintained at  $23\text{ °C} \pm 5\text{ °C}$ .

If the temperature of the motor windings does not exceed  $90\text{ °C}$  when steady conditions are established, the test is considered to be ended.

During the test, the temperature of the enclosure shall not exceed  $150\text{ °C}$  and the temperature of the windings shall not exceed the values shown in ~~Table 8~~ Table 2.

**Table-8 2 – Maximum winding temperature**

| Type of appliance                                                                              | Class of insulating material and limiting temperature<br>°C |     |     |     |     |     |     |     |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|
|                                                                                                | A                                                           | E   | B   | F   | H   | 200 | 220 | 250 |
| – If impedance protected                                                                       | 150                                                         | 165 | 175 | 190 | 210 | 230 | 250 | 280 |
| – If protected by <b>protective devices</b> which operate during the first hour, maximum value | 200                                                         | 215 | 225 | 240 | 260 | 280 | 300 | 330 |
| – After first hour, maximum value                                                              | 175                                                         | 190 | 200 | 215 | 235 | 255 | 275 | 305 |
| – After first hour, arithmetic average                                                         | 150                                                         | 165 | 175 | 190 | 210 | 230 | 250 | 280 |

Three days (72 h) after the beginning of the test, the motor shall withstand an electric strength test as specified in 16.3.

During the test, a 30 mA residual current device shall not open.

At the end of the test, the leakage current between the windings and the enclosure is measured and shall not exceed 2mA, the motor being supplied at twice the **rated voltage**.

**19.3** If the motor-**compressor** has not been type-tested against the requirements of IEC 60335-2-34, a sample shall be provided with the rotor locked and being filled with oil and **refrigerant** as intended.

The sample shall then be subjected to the locked rotor test specified in 19.101, 19.102 and 19.103 of IEC 60335-2-34:2012 and shall comply with the requirements of this subclause.

**19.4** Appliances incorporating three-phase motors are operated under the conditions of Clause 11 at **rated voltage** or at the upper limit of the **rated voltage range** with one phase disconnected, until steady conditions are obtained or the **protective device** operates.

This test is not applicable to three-phase motor-**compressors** complying with IEC 60335-2-34.

**19.5** The ~~appliance~~ **recovery equipment** is operated under conditions in Clause 11 and at **rated voltage**, with any form of operation, or any ~~defect~~ **fault condition** which may be expected during normal use. Only one fault condition is reproduced at a time, the tests being made consecutively. **Temperatures and pressures are recorded at each of the fault conditions and used in Clause 21.**

Examples of fault conditions include the following:

- *condensing fan motor failure;*
- *the programme controller, if any, stopping in any position;*
- *disconnection and reconnection of one or more phases of the supply;*
- *open-circuiting or short-circuiting of components.*

*In general, tests are limited to those cases which may be expected to give the most unfavourable results.*

*Locking in the "on" position of the main contacts of a contact intended for switching on and off the heating element(s) in normal use is considered to be a fault condition, unless the appliance is provided with at least two sets of contacts connected in series. This condition is, for example, achieved by providing two contactors operating independently of each other or by providing one contactor having two independent armatures operating two independent sets of main contacts.*

**19.6** Compliance for **electronic circuits** is checked by evaluation of the fault conditions specified in 19.6.2 for all circuits or parts of circuits, unless they comply with the conditions specified in 19.6.1.

*If the safety of the appliance under any of the fault conditions depends on the operating of a miniature fuse-link complying with IEC 60127, the test of 19.7 is made.*

*During and after each test, the temperature of the windings shall not exceed the values specified in Table-6 2 and the appliance shall comply with the conditions specified in 19.10. In particular, **live parts** shall not be accessible ~~to the test finger or the test pin~~, as specified in 8.1.4. Any current flowing through protective impedance shall not exceed the limits specified in 8.1.4.*

*If a conductor of a printed circuit becomes open-circuited, the appliance is considered to have withstood the particular test, provided all three of the following conditions are met:*

- the material of the printed circuit board withstands the burning test of ~~20.1 of~~ IEC 60065:2014 Subclause 20.2;
- any loosened conductor does not reduce the **creepage distances** or **clearances** between **live parts** and accessible metal parts below the values specified in Clause 29;
- the appliance withstands the tests of 19.7 6.2 with the open-circuited conductor bridged.

NOTE 101 Unless it is necessary to replace components after any of the tests, the electric strength test of 19.9 need only be carried out after the final test on the **electronic circuit**.

NOTE 102 In general, examination of the appliance and its circuit diagram will reveal the fault conditions which have to be simulated, so that testing can be limited to those cases which ~~may~~ can be expected to give the most unfavourable results.

NOTE 103 In general, the tests take into account any failure which ~~may~~ can arise from perturbations on the mains supply. However, where more than one component ~~may~~ can be affected simultaneously, it ~~may~~ could be necessary to carry out additional tests, which are under consideration.

**19.6.1** Fault conditions a) to f) specified in 19.6.2 are not applied to circuits or parts of circuits where both of the following conditions are met:

- the **electronic circuit** is a low-power circuit as described below;
- the protection against electric shock, fire hazard, mechanical hazard or dangerous malfunction in other parts of the appliance does not rely on the correct functioning of the electronic circuit.

A low power circuit is determined as follows; an example is shown in Figure-9 6.

The appliance is supplied at **rated voltage** and a variable resistor adjusted to its maximum resistance is connected between the point to be investigated and the opposite pole of the supply source.

The resistance is then decreased until the power consumed by the resistor reaches a maximum. Points closest to the supply at which the maximum power delivered to this resistor does not exceed 15 W at the end of 5 s are called low-power points. The part of the circuit farther from the supply source than a low-power point is considered to be a low-power circuit.

NOTE 101 The measurements are made from only one pole of the supply source, preferably the one that gives the fewest low-power points.

NOTE 102 When determining the low-power points, it is ~~recommended~~ preferable to start with points close to the supply source.

NOTE 103 The power consumed by the variable resistor is measured by a wattmeter.

**19.6.2** The following fault conditions are considered and, if necessary, applied one at a time; consequential faults are taken into consideration:

- a) short circuit of **creepage distances** and **clearances** between **live parts** of different potential, if these distances are less than the values specified in 29.1, unless the relevant part is adequately encapsulated;
- b) open circuit at the terminals of any component;
- c) short-circuit of capacitors, unless they comply with IEC 60384-14 or 14.23 of IEC 60065:2014;
- d) short circuit of any two terminals of an **electronic component**, other than integrated circuits. This fault condition is not applied between the two circuits of an optocoupler.
- e) failure of triacs in the diode mode;
- f) failure of an integrated circuit. In this case, the possible hazardous situations of the appliance are assessed to ensure that safety does not rely on the correct functioning of such a component.

All possible output signals are considered under fault conditions within the integrated circuit. If it can be shown that a particular output signal is unlikely to occur, then the relevant fault is not considered.

NOTE 101 Components such as thyristors and triacs are not subjected to fault condition f).

NOTE 102 Microprocessors are tested as integrated circuits.

In addition, each low-power circuit is short-circuited by connecting the low-power point to the pole of the supply from which the measurements were made.

When any of the fault conditions are simulated, the duration of the test is

- as specified in 11.6 but only for one operating cycle and only if the fault cannot be recognized by the user, for example, change in temperature;
- as specified in 19.2, if the fault can be recognized by the user, for example, when the motor stops;
- until steady conditions are established, for circuits continuously connected to the supply main, for example, stand-by circuits.

In each case, the test is ended if interruption of the supply occurs within the appliance.

If the appliance incorporates an **electronic circuit**, which operates to ensure compliance with Clause 19, the relevant test is repeated with a single fault simulated, as indicated in items a) to f) above.

*Fault condition f) is applied to encapsulated and similar components if the circuit cannot be assessed by other methods.*

*Positive temperature coefficient resistors (PTCs), negative temperature coefficient resistors (NTCs) and voltage dependent resistors (VDRs) are not short-circuited if they are used within their manufacturer's declared specification.*

**19.7** *If, for any of the fault conditions specified in 19.6.2, the safety of the appliance depends on the operation of a miniature fuse-link complying with IEC 60127, the test is repeated but with the miniature fuse-link replaced by an ammeter.*

*If the current measured does not exceed 2,1 times the **rated current** of the fuse-link, the circuit is not considered to be adequately protected and the test is carried out with the fuse-link short-circuited.*

*If the current measured is at least 2,75 times the **rated current** of the fuse-link, the circuit is considered to be adequately protected.*

*If the current measured exceeds 2,1 times the **rated current** of the fuse-link but does not exceed 2,75 times the **rated current**, the fuse-link is short-circuited and the test is carried out*

- for quick acting fuse-links, for the relevant period or for 30 min, whichever is the shorter;*
- for time lag fuse-links, for the relevant period or for 2 min, whichever is the shorter.*

NOTE 101 In case of doubt, the maximum resistance of the fuse-link ~~has to be~~ is taken into account when determining the current.

NOTE 102 The verification whether the fuse-link acts as a **protective device** is based on the fusing characteristics specified in IEC 60127, which also gives the information necessary to calculate the maximum resistance of the fuse-link.

**19.8** *Appliances with **PTC heating elements** are supplied at **rated voltage** until steady conditions with regard to power input and temperature are established.*

*The voltage is then increased by 5 % and the appliance is operated until steady conditions are again established. This test is repeated until 1,5 times **rated voltage** is reached or until the heating element ruptures, whichever occurs first.*

**19.9** During the tests of 19.2 to 19.7 and 19.8 if appropriate, the appliance shall not emit flames or molten metal, or poisonous or ignitable gas in hazardous amounts. Enclosures shall not deform to such an extent as will impair compliance with this standard and temperatures shall not exceed the values shown in ~~Table 9~~ Table 3.

**Table 3– Maximum abnormal temperature**

| Parts                                                                                                                                                                                                                                                               | Temperature<br>°C                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Walls, ceiling and floor of the test casing                                                                                                                                                                                                                         | 175                                                                                            |
| Insulation of the supply cable                                                                                                                                                                                                                                      | 175                                                                                            |
| Supplementary insulation and reinforced insulation other than those of thermoplastic materials <sup>a</sup>                                                                                                                                                         | $[1,5 \times (T - 25)] + 25$<br>where $T$ is the value specified in <del>Table 3</del> Table 1 |
| <sup>a</sup> There is no specific limit for supplementary insulating and reinforced insulation of thermoplastic material, which <del>must</del> shall withstand the tests of 30.1 of Part 1, for which purpose the temperature <del>must</del> shall be determined. |                                                                                                |

After the tests, the insulation shall withstand the electric strength test as specified in 16.3, the test voltage however being

- 1 000 V for **basic insulation**;
- 2 750 V for **supplementary insulation**;
- 3 750 for **reinforced insulation**.

#### 19.11.4 Modification:

Add before the first paragraph:

The first paragraph of Part 1 is not applicable for stand-by mode if unintentional operation does not cause any hazards.

Replace the second paragraph by the following:

*Appliances incorporating a **protective electronic circuit** are subjected to the tests of 19.11.4.1 to 19.11.4.7. The tests are carried out after the **protective electronic circuit** has operated during the relevant tests of Clause 19, except 19.2, 19.6 and 19.11.3.*

*If the appliance incorporates more than one **protective electronic circuit**, each **protective electronic circuit** has to be tested individually with the appliance operated under **normal operation** at any temperature within the working range.*

*Components protected by a **protective electronic circuit** that have been previously tested and shown to comply with the requirements of 19.11.4 of its standard need not to be retested in the final application, if engineering judgement gives evidence that the test in the final application will not lead to a hazardous condition.*

NOTE 101 Components can be for example motor-**compressors**, fans and circulating pumps.

NOTE 102 Test results of 19.11.4.1, 19.11.4.2 and 19.11.4.3 can possibly be influenced by the wiring and the metal housing of the final application. Therefore, the best moment to perform these tests is once in the final application.

NOTE 103 Protective electronic circuit (PEC) operation is understood as the operation that stops the component(s) operation controlled by the PEC with the intention to prevent the hazardous situation.

*Add, after the last paragraph of the test specification, the following:*

*For these tests, it may be necessary to provide specially prepared component samples, e.g. **compressors** with locked rotor.*

## 20 Stability and mechanical hazards

This clause of Part 1 is applicable.

## 21 Mechanical strength

This clause of Part 1 is applicable except as follows.

*Addition:*

Safety requirements specified in ISO 5149-2 shall apply.

### 21.1 Addition:

Safety requirements specified in Annex CC shall apply. The pressure test in Annex CC applies to parts other than pressure vessels.

### 21.2 Addition:

Appliances using **flammable refrigerants** shall withstand the effects of vibration during transport.

The appliance is tested in its final packaging for transport and shall withstand a random vibration test according to ASTM D4728-17. Tests shall be run for a duration of 180 min.

*Compliance is checked by the following:*

- *the use of detection equipment having an equivalent sensitivity of 3 g/year of **refrigerant** shall reveal no leaks;*
- *the test may be carried out on the appliance charged with a **non-flammable refrigerant** or a non-hazardous gas;*
- *damage of parts other than the refrigerating circuit is allowed.*

**21.101** A **pressure-limiting device** designed to automatically stop the operation of the **compressor** shall be installed on all appliances.

**21.102** There shall be no shut-off valves between the **pressure-limiting device** and the pressure-imposing element of the **compressor**.

**21.103** All ~~refrigerating system~~ **recovery** equipment components shall withstand the maximum pressure expected in **normal operation**, abnormal operation and standstill.

*Compliance is checked by the following tests.*

*For all tests of Clause 21*

- *if the **refrigerant** is a blend, the **high-pressure side** (condensing pressure) is considered at the dew point condition;*
- *if the **refrigerant** is a blend, the **low-pressure side** (evaporating pressure) is considered at the boiling point condition.*

*The test value that is the maximum of a), b) or c) shall be used for the test of 21.104, respectively, for the high side and the low side components.*

a) Pressure test value determined under testing carried out in Clause 11.

A ~~refrigerating~~ **system** component that is exposed to pressure shall be subjected to measurement of the maximum pressure developed in the ~~refrigerating~~ **recovery system** when tested under the condition specified in Clause 11.

The pressure test value shall be at least three times the maximum pressure developed during operation under Clause 11.

b) Pressure test value determined under testing carried out in Clause 19.

A ~~refrigerating~~ **system** component that is exposed to pressure shall be subjected to measurement of the maximum pressure developed in the ~~refrigerating~~ **recovery system** when tested under the condition specified in Clause 19.

The pressure test value shall be at least three times the maximum pressure developed during abnormal operation (Clause 19).

c) Pressure test value determined under testing carried out under standstill conditions.

In order to determine the standstill pressure, the appliance shall be soaked in the highest operating temperature specified by the manufacturer for 1 h with power off.

A ~~refrigerating~~ **system** component which is exposed only to low side pressure shall be subjected to measurement of the maximum pressure developed in the ~~refrigerating~~ **recovery system** under the condition of standstill.

The pressure test value shall be at least three times the maximum pressure developed during standstill.

Exception: pressure gauges and control mechanisms need not be subjected to the test, provided they meet all applicable requirements for that component.

**21.104** The pressure test shall be carried out on three samples of each component. 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. The pressure is maintained for 1 min, during which time the sample shall not leak.

~~Where gaskets are employed for sealing parts under pressure, leakage at gaskets is acceptable, provided the leakage only occurs at a value greater than 120 % of the maximum allowable pressure and the test pressure is still reached for the specified time.~~

If gaskets are employed in components employing **non-flammable refrigerant**, leakage at gaskets is permitted, provided that such leakage occurs at a pressure greater than 65 % of the required pressure. The component shall not rupture at the required strength test pressure even though leakage occurs at gaskets or seals and the test pressure is still reached for the specified time.

**21.105** As an alternative to the pressure tests, the components shall be subjected to a burst test at 2,5 times the condensing (evaporating) pressure provided they comply with the fatigue test in 21.105.1 to 21.105.7

**21.105.1** Three samples of each **refrigerant**-containing part shall be tested at the cyclic pressure values specified in 21.105.6 and 21.105.7 for the number of cycles specified in 21.105.5 as described in 21.105.3 and 21.105.4.

**21.105.2** The samples shall be considered to comply with 21.106 at the completion of the test and if they do not rupture, burst, or leak.

**21.105.3** The test samples shall be filled with inert fluid and shall be connected to a pressure-driving source. ~~The fluid should completely fill the part, displacing all of the air.~~ The pressure shall be raised and lowered between the upper and lower cyclic values at a rate specified by the manufacturer. The pressure shall reach the specified upper and lower values during each

*cycle. The shape of the pressure cycle shall be such that the upper and lower pressure values shall be maintained for at least 0,1 s.*

NOTE For safety purposes, it is suggested that the inert fluid described in this subclause be a hydraulic fluid. ~~The fluid should completely fill the part, displacing all of the air.~~

*Material such as steel, copper, and aluminium have fatigue properties that are practically independent of temperature at the continuous operating temperatures normally encountered under the operating temperature conditions and internal system temperatures of the ~~appliance~~ **recovery unit**. If the continuous operating temperature is less than or equal to 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the component part or assembly shall be at least 20 °C. If the continuous operating temperature of the component exceeds 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the parts or assemblies that are at these temperatures, and subjected to the pressure, shall be at least 150 °C for copper or aluminium and 260 °C for steel. For other materials or higher temperatures, the effects of temperature on the material fatigue characteristics shall be evaluated by conducting the test at the higher temperatures and considering the material characteristics at the higher temperatures.*

**21.105.4** *The pressure for the first cycle shall be the maximum evaporating pressure for **low-pressure side** components or the maximum condensing pressure for the **high-pressure side** components.*

**21.105.5** *The total number of cycles shall be 250 000.*

**21.105.6** *The pressure for the test cycles shall be as follows.*

- a) *For components 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) *For components 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 between 0 MPa (0 bar) and the greater of 0,4 MPa (4,0 bar) or the saturated vapour pressure of the **refrigerant** at –13 °C.*

**21.105.7** *For the final test cycle, the test pressure shall be increased to two times the minimum upper pressure specified in 21.105.6.*

NOTE The objective is to avoid a test value that is a negative pressure but to require a lower pressure value of the saturated vapour pressure at –13 °C or 0,4MPa (4,0 bar), whichever is greater.

## 22 Construction

This clause of Part 1 is applicable except as follows.

### 22.6 Addition:

The electrical insulation shall not be affected by snow, which might enter the appliance.

NOTE 101 This requirement ~~may~~ can be met by the provision of suitable drain holes.

### 22.42 Modification:

*Replace the last paragraph by:*

*Resistors are checked by the test of 14.2 a) in IEC 60065:2014 and capacitors are checked by the tests for class Y capacitors in IEC 60384-14 appropriate to the rated voltage of the appliance.*

**22.101** ~~Appliances~~ **Recovery** units intended to be fixed shall be so designed that they can be securely fixed and maintained in position.

*Compliance is checked by inspection and in case of doubt, after installation of the appliance in accordance with the manufacturer's installation instructions.*

**22.102** The ~~refrigerant circuit of the~~ appliance (**recovery** equipment) shall be leak-tight and designed and operated in such a way as to minimize the risk of emission of **refrigerant** or oil into the environment.

- When changing replaceable core filter dryers in the ~~appliance~~ **recovery** unit, the section containing the filter should be isolated and the **refrigerant** shall be transferred into a suitable storage container prior to opening the filter shell.
- Any air introduced into the **refrigerant** circuit of the **recovery** ~~appliance~~ unit during the core change should be removed by evacuation and not by flushing out or purging with the **refrigerant**.
- ~~Care shall be taken that refrigerant contained in the hoses used for recovery will not be vented to the atmosphere.~~
- Service hoses shall be such that there is deminimus **refrigerant** loss during connection and disconnection.

**22.103** Requirements for use of **recovery** containers are as follows.

**22.103.1** The **refrigerant** shall only be transferred to a container suitable for the specific **refrigerant** being recovered.

**22.103.2** The container shall be prominently marked with the **refrigerant** type being recovered and appropriate markings per Clause 7.

**22.103.3** A disposable "single use" or "one time" container shall not be used, as there is the possibility of the remaining **refrigerant** content being discharged into the atmosphere when disposed.

**22.103.4** The **refrigerant** container shall not be overfilled. When a container is filled with **refrigerant**, the maximum charge shall always be observed, taking into account that possible **refrigerant**-oil mixtures may have a lower density than the pure **refrigerant**. The usable container capacity shall therefore be reduced for a **refrigerant**-oil mixture (approximately 80 % liquid by volume), controlled by mass.

NOTE Examples of overfill protection: float type protection, set to shut down equipment when 80 % fill level is reached, or **scale**/mass sensor type protection to accomplish same ~~may~~ can be employed.

**22.103.5** The allowable pressure rating of the container shall not be exceeded, even temporarily, during any operation.

**22.103.6** Different **refrigerants** shall not be mixed and shall be stored in different containers, as mixtures of **refrigerants** may ~~not be reclaimable~~ have different operating pressures, flammability levels and as such mixing these could hinder reclaimability or may cause an unknown safety hazard. An unknown **refrigerant** already in a container shall not be vented to the atmosphere, but shall be identified and reclaimed, or shall be disposed of properly.

**22.103.7** Transportable storage containers shall comply with the applicable transportation requirements for **flammable or non-flammable** liquid gas storage containers.

**22.103.8** If non-metallic components are employed for control of the container fill level, they shall comply with the requirements of Annex CC.

**22.104** Requirements for **refrigerant** hoses are as follows.

**22.104.1** Service hoses shall be provided with shut-off devices within 0,3 m of the open ends. These devices shall prevent **refrigerant** flow when the hose is not connected. Reinforced rubber and reinforced thermoplastic hoses supplied with the appliance shall be tested for the **refrigerant** employed in normal use.

**22.104.2** *The **refrigerant** exposure test is as follows. Three 0,50 m long hose assembly samples are required for this test. The inner surface of the hose assembly is to be exposed to a **refrigerant**/lubricant mixture for 30 days at a temperature of at least 10 °C above the maximum temperature measured during the test in Clause 11, but not less than (80 ± 2) °C. After exposure, one of the hose assemblies is to be subjected to the pull test as per 22.104.8. The remaining two assemblies shall withstand without failure the pressure indicated in 22.105.*

**22.104.3** *Each sample hose assembly subjected to the test in 22.104.2 shall not be filled more than 70 % full by volume with a liquid mixture of 95 % **refrigerant** and 5 % **refrigerant** lubricant at a temperature of 21 °C.*

**22.104.4** *Hydrostatic strength test. The hose assembly shall withstand, without failure, the pressure indicated in 22.105.*

**22.104.5** *Requirements for **flammable refrigerant** hoses are as follows.*

**22.104.5.1** *For appliances using **flammable refrigerants** which are supplied with the service hoses, the hoses shall be provided with grounding device, which can be either a separate cable or another mechanism which prevents static generation.*

**22.104.5.2** *Except for appliances which are certified for use with **A2L flammable refrigerants**, use service hoses which are under 3 meters in length.*

**22.104.5.3** *Thermal cycling test. The hose assembly is to be placed in an air circulating oven maintained at 80 °C for 23 h. The hose assembly is then removed and allowed to return to room temperature for 1 h. The hose is then placed in a cold chamber at –30 °C for 23 h and again allowed to return to room temperature for one hour. This cycle is to be repeated five times. Following this test, the hose shall withstand, without failure, the pressure indicated in the strength test per 22.105.*

**22.104.6** *Aging with oil test. Three hose assemblies shall be immersed in IRM903 oil at 80 °C for 168 h. Following this treatment, one of the hose assemblies is to be subjected to the pull test as per 22.104.8~~10~~. The remaining two assemblies shall withstand without failure the pressure indicated in 22.105.*

**NOTE** ~~This IRM903 oil is described in Annex DD.~~

**22.104.7** *Vibration test. The hose assembly shall be mounted to a vibration machine and connected to an airline maintained at ~~0,345 kPa~~ **MPa (3,45 bar)**. The amplitude of vibration shall be 3,2 mm and the frequency of vibration shall be 1 000 vibrations per minute. The test shall be conducted for 30 h with no leakage or failure.*

**22.104.8** Pull test. The hose assembly shall be mounted to a test apparatus having a crosshead speed of 0,025 m/min to determine the force necessary to separate the hose from the fitting or to pull the hose apart. Starting from zero, the force shall be gradually increased until the fitting separates and/or the hose pulls apart. The force shall not be less than 534 N for **non-flammable refrigerants** and 1 112 N for **flammable refrigerants**.

**22.104.9** Permeation tests. Hose and hose assemblies shall not permit permeation of **refrigerant** at a rate greater than 39,2 kg/m<sup>2</sup>/year for **non-flammable refrigerants** and 4,9 kg/m<sup>2</sup>/year for **flammable refrigerants** when tested at 49 °C ± 2 °C as specified in 22.104.9.1 to 22.104.9.7 while using **refrigerant** as per appliance marking.

**22.104.9.1** The apparatus required consists of canisters with internal volumes of 500 ml ± 25 ml and a 21 MPa minimum burst pressure with appropriate fittings to connect to the hose assemblies a detector, circulating air oven capable of maintaining uniform test temperatures throughout the test periods, and a weighing **scale** capable of mass measurements to 0,1 g accuracy.

**22.104.9.2** Four hose assemblies having a free hose length of 1 m are to be tested. Three of the hose assemblies shall be used for determining the loss of **refrigerant** and the fourth hose assembly shall be run as an empty plugged blank to be used as a means of determining the mass loss of the hose body alone.

**22.104.9.3** The free length of hose in each assembly is to be measured at zero gauge pressure to the nearest 1 mm. Each of the four hose assemblies is to be connected to a canister and the total mass of each unit including end plugs is obtained to the nearest 0,1 g.

**22.104.9.4** Three of the hose assemblies are to be loaded with 0,6 mg of liquid **refrigerant** per cubic millimeter of each unit's volume to a total variance of ± 5 g. The loaded hose assemblies are to be checked with a detector with a sensitivity of at least ~~11~~ 4 g per year to be sure they do not leak.

**22.104.9.5** The three loaded hose assemblies and one blank hose assembly are to be placed in the air oven for a period of 30 ± 5 min to remove the surface moisture. The hoses are not to be bent in a curve with a diameter smaller than 20 times the outside diameter of the hose, while in the oven. The loaded hose assemblies are to be checked for leakage and all the hose assemblies weighed not less than 15 min or more than 30 min after removal from the oven. The mass is to be obtained and recorded as the original mass.

**22.104.9.6** The hose assemblies are to be placed back in the air oven at the specified temperature for 24 h. At the end of the 24-hour period, the hose assemblies are to be removed, weighed in the same manner as previously specified, and returned to the oven. If a loss of 20 g or more occurs, discontinue the test, check for leaks and repeat the test procedure.

**22.104.9.7** The first 24-hour period is considered the preconditioning period. The mass loss during this period is to be disregarded in final calculations. The hose assemblies are again placed in the oven and are weighted as previously described. The 72-hour mass loss is to be calculated. The permeation rate is to be determined by subtracting the corresponding mass loss of the blank hose assembly from that of the loaded hose assemblies. The permeation rate is to be expressed in kg/m<sup>2</sup>/year. The rate of loss of **refrigerant** mass for the loaded hose assemblies is calculated as follows:

NOTE For clarification, the hose assembly samples needed are as follows: **refrigerant** exposure: 3; hydrostatic strength test: 1; thermal cycling: 1; oil aging test: 3; vibration test: 1; pull test: 1; and permeation test: 3, for a total of 14 hose assemblies.

$$R = \left[ \frac{(A - B)}{L_1} - \frac{(C - E)}{L_2} \right] \cdot \frac{K}{D}$$

where

- A* is the initial mass after preconditioning period of loaded hose assembly in grams;  
*B* is the final mass after 72-hour period of loaded hose assembly in grams;  
*C* is the initial mass after preconditioning period of blank hose assembly in grams;  
*D* is the nominal hose diameter in millimetres;  
*E* is the final mass after 72-hour period of the blank hose assembly t;

$K = 38,7$ ;

*R* is the rate of **refrigerant** loss, kg/m<sup>2</sup> (inner tube area of free hose length) per year (permeation);

*L*<sub>1</sub> is the free hose length (between hose fittings) of loaded hose assembly in meters;

*L*<sub>2</sub> is the free hose length of blank hose assembly in meters.

**22.105** Strength tests for pressure containing components are as follows:

~~22.105.1 High-side parts of the refrigerating system shall withstand the pressures expected in normal use.~~

*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 the saturated vapour pressure of the **refrigerant** at 27 °C, rounded up to the next 0,5 MPa (bar).*

Compliance is checked by the following tests:

A part which is exposed to high side pressure shall be subjected to a pressure as follows (see Table 4):

**Table 4 – High side pressure for strength tests**

| Refrigerant                                                                               |         | Pressure |        |
|-------------------------------------------------------------------------------------------|---------|----------|--------|
|                                                                                           |         | MPa      | (Bars) |
| CCl <sub>2</sub> F <sub>2</sub>                                                           | (R12)   | 6        | (60)   |
| CF <sub>3</sub> CH <sub>2</sub> F                                                         | (R134a) | 6,5      | (65)   |
| CHClF <sub>2</sub>                                                                        | (R22)   | 10,5     | (105)  |
| By weight 73,8 % CCl <sub>2</sub> F <sub>2</sub> + 26.2% CH <sub>3</sub> CHF <sub>2</sub> | (R500)  | 10       | (100)  |
| By weight 48,8 % CHClF <sub>2</sub> + 51.2% CCIF <sub>2</sub> CF <sub>3</sub>             | (R502)  | 10,5     | (105)  |

For other **refrigerants**, the test pressure is equal to 3,5 times the saturated vapor pressure of the **refrigerant** at 70 °C.

NOTE The values given above ~~may not~~ could need to be ~~high enough~~ increased for some applications.

**22.105.21** Low-side parts of the **refrigerant** circuit shall be subjected to a pressure as follows (see Table 5):

**Table 5 – Low side pressure for strength tests**

| Refrigerant                                                                |         | Pressure |        |
|----------------------------------------------------------------------------|---------|----------|--------|
|                                                                            |         | MPa      | (Bars) |
| $\text{CCl}_2\text{F}_2$                                                   | (R12)   | 2,5      | (25)   |
| $\text{CF}_3\text{CH}_2\text{F}$                                           | (R134a) | 3,0      | (30)   |
| $\text{CHClF}_2$                                                           | (R22)   | 4,0      | (40)   |
| By weight 73,8% $\text{CCL}_2\text{F}_2$ + 26,2% $\text{CH}_3\text{CHF}_2$ | (R500)  | 3,0      | (30)   |
| By weight 48,8% $\text{CHClF}_2$ + 51,2% $\text{CClF}_2\text{CF}_3$        | (R502)  | 4,5      | (45)   |

For other **refrigerants**, the test pressure is equal to 5 times the saturated vapor pressure of the **refrigerant** at ~~70~~ 20 °C.

NOTE The values given above ~~may not~~ could need to be ~~high enough~~ increased for some applications.

~~22.105.3 Two samples of each refrigerant-containing part are to be tested. The test medium is to be a non-hazardous liquid, such as water. The test samples are filled with the test medium so as to exclude air and to be connected to a hydraulic pump system. The pressure is raised gradually until the required pressure is reached. This pressure is to be maintained for 1 min, during which time the sample shall not burst or leak. If gaskets are employed in components employing refrigerant 12, 22, 500 or 502, leakage at gaskets is permitted, provided that such leakage occurs at a pressure greater than 40 % of the required pressure. The component shall not rupture at the required strength test pressure even though leakage occurs at gaskets or seals.~~

For other **refrigerants**, the test pressure is equal to 3,5 times the saturated vapor pressure of the **refrigerant** at 70 °C.

NOTE The values given above could need to be increased for some applications.

**22.106** The dial of a pressure gauge connected to the high side of the **refrigerant** system shall be graduated to no less than 1,2 times the marked factory leakage test pressure and no less than 1,2 times the marked design pressure of the high-side **refrigerant**-containing components.

~~22.107~~**22.106.1** The dial of a pressure gauge connected to the low side of the **refrigerant** system shall be graduated to no less than 1,2 times the marked factory leakage test pressure and no less than 1,2 times the marked design pressure of the low-side **refrigerant**-containing components, or 1,2 times the equalization pressure after shutdown.

**22.107** Appliances (**recovery** equipment) using **flammable refrigerants** shall be constructed so that any leaked **refrigerant** will not flow or stagnate so as to cause a fire or explosion hazard in areas within the appliance and connected ducts where electrical components, which could be a source of ignition and which could function under normal conditions or in the event of a leak, are fitted.

All **recovery** equipment electric components that could be a source of ignition and which could function under normal conditions or in the event of a leak shall comply with at least one of the following:

- shall be located in an enclosure which complies with Clause 20 of IEC 60079-15:2010 for restricted breathing enclosures suitable for use with group IIA gases or the **refrigerant** used;
- shall not be located in an area where a potentially flammable gas mixture will accumulate as demonstrated by the test of IEC 60335-2-40:2018, Annex FF.