IEC 60335-2-104

Edition 2.0 2021-05
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

IEC 60335-2-104:2021-05 RLV(en)

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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. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

This part 2 is to be used in conjunction with the 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[1], *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.

[1] 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~~

3.10~~3~~2
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~~

3.10~~6~~4
recovery
pumping out (removal) of **refrigerant** from air conditioning or refrigeration equipment

3.10~~7~~5
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.

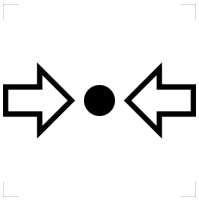
For **flammable refrigerants**, any tubing or other devices through which the **refrigerant** is intended to be serviced shall be painted or colored red. This color shall be present at all places where service puncturing, or otherwise creating an opening in the **refrigerant** circuit might be expected. 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
 (X) MPa	[symbol ISO 7000-1701 (2004-01)]	pressure
	[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 °C
*Windings of sealed motor-**compressors*** [a]	
– with synthetic insulation	*140*
– with other insulation	*130*
*External enclosures of sealed motor-**compressors** or of any other motor*	*150*
Windings [b] *if the winding insulation is (other than motor-**compressors**):*	
– of class A material [c]	*100 (90)*
– of class E material [c]	*115 (105)*
– of class B material [c]	*120 (110)*
– of class F material [c]	*140*
– of class H material [c]	*165*
– of class 200	*185*
– of class 220	*205*
– of class 250	*235*
*Terminals, including earthing terminals, for external conductors of **stationary appliances**, unless they are provided with a **supply cord***	*85*
*Ambient of switches, and **thermostats** and **temperature limiters*** [d]	
– without T marking	*55*
– with T marking	*T*
*Rubber or polyvinyl chloride insulation of internal and external wiring, including **supply cords**:*	
– without temperature rating [e]	*75*
– with temperature rating (T)	*T*
*Cord sheaths used as **supplementary insulation***	*60*
Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:	
*– when used as a **supplementary insulation** or **reinforced insulation***	*65*
– in other cases	*75*
Lampholders B22, E26 and E27:	
– metal or ceramic type	*185*
– insulated type, other than ceramic	*145*
– with T-marking	*T*
Lampholders E14 and B15:	
– metal or ceramic type	*155*
– insulated type, other than ceramic	*115*
– with T-marking	*T*

Part	Temperature °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 **supplementary insulation** or **reinforced insulation***	*425*
– thermoplastic material [f]	-
Wood, in general [g]	*90*
Wooden walls of the test casing	*90*
Outer surface of capacitors [h]	
– with marking of maximum operating temperature (T) [i]	*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 **stationary appliance** not provided with a **supply cord**:*	
– if the instructions require the use of supply wires with a temperature rating (T)	*T*
– in other cases [e]	*75*

[a] *Not required for motor-**compressors** that comply with IEC 60335-2-34.*

[b] *The temperatures within parentheses apply when thermocouples are used. The figures without parentheses apply when the resistance method is used.*

[c] *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.

[d] *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.*

[e] *This limit applies to cables, cords and wires complying with the relevant IEC standards; for others, it may be different.*

[f] *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.*

[g] *The limit specified concerns the deterioration of wood and it does not take into account the deterioration of surface finishes.*

[h] *There is no limit for the temperature rise of capacitors which are short-circuited in 19.7.*

[i] *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_1 is the resistance at the beginning of the test;

R_2 is the resistance at the end of the test;

T_1 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 IPXO 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 °C ± 5 °C.

If the temperature of the motor windings does not exceed 90 °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 °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*** °C							
	A	***E***	***B***	***F***	***H***	***200***	***220***	***250***
– *If impedance protected*	*150*	*165*	*175*	*190*	*210*	*230*	*250*	*280*
– *If protected by **protective devices** 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.~~2~~3 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 ~~9~~ 3– Maximum abnormal temperature

Parts	Temperature °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 [a]	$[1{,}5\times(T-25)]+25$ where T is the value specified in ~~Table 3~~ Table 1
[a] There is no specific limit for supplementary insulating and reinforced insulation of thermoplastic material, which ~~must~~ shall withstand the tests of 30.1 of Part 1, for which purpose the temperature ~~must~~ 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.~~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^2/year for non-**flammable refrigerants** and 4,9 kg/m^2/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^2/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^2 (inner tube area of free hose length) per year (permeation);

L_1 is the free hose length (between hose fittings) of loaded hose assembly in meters;

L_2 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_2F_2	*(R12)*	*6*	*(60)*
CF_3CH_2F	*(R134a)*	*6,5*	*(65)*
$CHClF_2$	*(R22)*	*10,5*	*(105)*
By weight 73,8 % CCL_2F_2 + 26.2% CH_3CHF_2	*(R500)*	*10*	*(100)*
By weight 48,8 % $CHClF_2$ + 51.2% $CClF_2CF_3$	*(R502)*	*10,5*	*(105)*

For other **refrigerant**s, 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.~~2~~1 *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)*
CCl_2F_2	*(R12)*	*2,5*	*(25)*
CF_3CH_2F	*(R134a)*	*3,0*	*(30)*
$CHClF_2$	*(R22)*	*4,0*	*(40)*
By weight 73,8% CCL_2F_2 + 26,2% CH_3CHF_2	*(R500)*	*3,0*	*(30)*
By weight 48,8% $CHClF_2$ + 51,2% $CClF_2CF_3$	*(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~~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.

- electrical components not 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 are not considered a potential ignition source;
- for **A2L refrigerants**, be located in an enclosure which is in compliance with IEC 60335-2-40:2018, Annex NN;
- components and apparatus complying with Clause 16 to 22 of IEC 60079-15:2010, for group IIA gases or the **refrigerant** used or an applicable standard that makes electrical components suitable for use in Zone 2, 1 or 0 as defined IEC 60079-14 are not considered as a source of ignition.

NOTE 1 The test current for a switching component is the **rated current** of the component or the actual load to be switched, whichever is greater.

NOTE 2 Potential ignition sources can be electrical components which produce sparks or arcs or hot surfaces under normal conditions. Examples are brush-type motors, light switches, relays, electric heaters, or UV lights.

For **A2L refrigerants**, electrical components in compliance with Annex JJ of IEC 60335-2-40:2018 are not considered a potential ignition source.

For **A2L refrigerants**, switching devices in compliance with all of the following are not considered a potential ignition source:

- the device is capable of 100 000 cycles per Clause 24;
- the switched electrical load (L_e) in kVA is less than or equal to:
  - $L_e = 5 \times (6{,}7/S_u)^4$ when breaking all phases;
  - $L_e = 2{,}5 \times (6{,}7/S_u)^4$ when breaking two legs of a three-phase load, or when breaking one or two legs of a single phase load

    where

    L_e is the switched inductive electrical load in kilovoltamperes (kVA),

    S_u is the burning velocity of a **refrigerant** in centimetres per second (cm/s).

Compliance is checked by measurement.

(d_q) in IEC 60335-2-40:2018 Annex JJ and the maximum allowable electrical load L_e according to the above shall take into consideration the effect of humidity on burn velocity (S_u).

- The burning velocity (S_u) shall be the highest value of
  - as specified in ISO 817; or
  - as measured in humid air at 27 °C ± 0,5 °C dew point at 0,1 013 MPa (1,013 bar) containing 21,0 % ± 0,1 % O2 excluding water vapour determined at the nominal composition as specified in ISO 817.

NOTE 3 The 27 °C dew point equates to an absolute humidity of 0,022 7 kg water vapour per 1 kg dry air.

This test can be done at the temperature higher than 27 °C. The required dew point is only for humidity.

The burning velocity (S_u) at 27 °C dew point may be determined by extrapolation of the measurement at 23 °C and 50 % relative humidity and the burning velocity (S_u) as provided by ISO 817. The extrapolation shall be based on the measured value increased by the measurement uncertainty to the burning velocity (S_u) at 23 °C and 50 % relative humidity. If the burning velocity (S_u) is not measurable at dry condition, the burning velocity shall be measured at 27 °C dew point.

Refrigerant pipes containing **A2L refrigerant** which connect **refrigerating system** components shall not be considered a source of leaked **refrigerant** for the purpose of

evaluating potential for fire or explosion hazard relative to potential ignition sources within the appliance if the piping within the area of the appliance to be evaluated complies with all of the following;

- no connecting joints;
- no bends with centreline bend radius less than 2,5 times the external pipe diameter;
- protected from potential damage during **normal operation**, service or maintenance.

22.108 Unless intended to be connected to a power supply separate from that supplying other loads, each receptacle intended for general use shall be rated at 15 A or 20 A, 125 V or 250 V. Each general or special use receptacle shall be of the grounding type and shall comply with the applicable requirements of IEC 60320.

22.108.1 Overcurrent protection shall be provided as part of the equipment for each receptacle included in the equipment unless:

a) the appliance coupler is intended to be connected to a power supply separate from that supplying the equipment;

b) the equipment can be connected to a branch circuit rated at not more than 15 A or 20 A in accordance with IEC 60320; or

c) the receptacle is intended for use only with specific accessories.

Socket-outlets connected to the line side of a unit disconnect shall have a separate disconnect.

When installed on equipment for outdoor use, in addition to complying with the rain test, the service socket-outlet shall comply with installation requirements in and insofar as they apply, including the following:

a) A 125 V or 250 V, single-phase, 15 A or 20 A receptacle intended for general use shall have a residual current operated circuit-breakers. The residual current operated circuit-breakers shall comply with IEC 62640.

b) Unless subjected to the rain test, 125 V or 250 V, single-phase, 15 A or 20 A socket-outlets installed in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug is inserted, and all 125 V or 250 V, single-phase, 15 A or 20 A non-locking socket-outlets shall be weather-resistant types.

23 Internal wiring

This clause of Part 1 is applicable.

24 Components

This clause of part 1 is applicable except as follows.

24.1 *Addition:*

Motor-**compressors** are not required to be separately tested according to IEC 60335-2-34, nor are they required to meet all requirements of IEC 60335-2-34 if they meet all requirements of this standard.

24.1.4 *Modification:*

– **self-resetting thermal cut-outs**	3 000
– **non-self-resetting thermal cut-outs**	300

Addition:

– **thermostats** which control the motor-**compressor**	100 000
– motor-**compressor** starting relays	100 000
– automatic thermal motor-protectors for motor-**compressors** of the hermetic and semi-hermetic type	min 2 000 (but not less than the number of operations during the locked rotor test)
– manual reset thermal motor-protectors for motor-**compressors** of the hermetic and semi-hermetic type	50
– other automatic thermal motor protectors	2 000
– other manual reset thermal motor protectors	30

24.101 Thermal control devices incorporating replaceable parts shall be marked in such a way that the replaceable parts can be identified.

The replacement part shall be marked accordingly.

Compliance is checked by inspection of the marking.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.7 *Addition:*

Supply cords of parts of ~~**appliances**~~ **recovery** units for outdoor use shall not be lighter than polychloroprene sheathed flexible cord (code designation 60245 IEC 57).

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable.

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 for parts related to motor-**compressors**. For these parts, IEC 60335-2-34 applies.

Addition:

NOTE 101 Parts located in an airflow are considered to be subjected to extra-severe duty conditions, unless these parts are enclosed or located so that pollution is unlikely to occur, in which case they are considered to be subjected to severe duty conditions.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2.2 Not applicable

~~**30.3** *Addition:*~~

~~NOTE Parts located in an airflow are considered to be subjected to extra-severe duty conditions, unless these parts are enclosed or located so that pollution is unlikely to occur, in which case they are considered to be subjected to severe duty conditions.~~

31 Resistance to rusting

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is checked by the following test.

All grease is removed from representative samples of the parts to be tested by immersion in an appropriate solution.

These samples are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of 20 °C ± 5 °C.

Without drying, after shaking off any drops, the samples are placed for 10 min in a box containing air saturated with moisture at a temperature of 20 °C ± 5 °C.

After the samples have been dried for 10 min in a heating cabinet at a temperature of 100 °C ± 5 °C, their surfaces shall show no signs of rust.

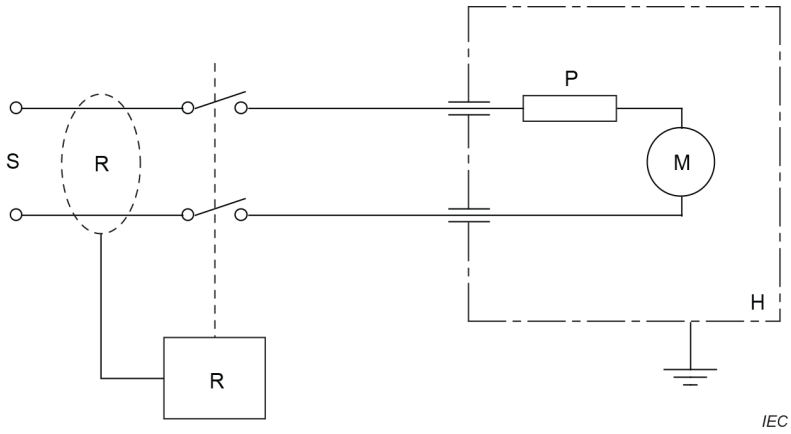
NOTE ~~*When using the liquids specified for the test, adequate precautions must*~~ *Care should be taken to prevent inhalation of* ~~*their*~~ *vapours during testing.*

Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

For small helical springs and the like, and for parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is not applicable.



Key

S supply

H motor housing

R residual current device ($I_{\Delta n}$ = 30 mA) (RCCB or RCBO)

P **protective device** (external or internal)

M motor

~~NOTE 1~~ Care has to be taken to complete the earthing system to permit the correct operation of the RCCB/RCBO.

NOTE ~~2~~ Revise as needed for three-phase test.

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

Annexes

The annexes of part 1 are applicable except as follows.

~~Annex AA~~
~~(normative)~~

~~Vacuum levels~~

~~AA.1 Introduction~~

~~**AA.1.1** Refrigerant recovery only equipment and refrigerant recovery/recycling equipment not intended for use in a **service garage** shall achieve the following vacuum levels when tested in accordance with Clauses AA.2 to AA.4.~~

~~a) Equipment intended for servicing air-conditioning and refrigeration systems containing less than 90,7 kg of high-pressure refrigerant: >6,88 kPa absolute.~~

~~b) Equipment intended for servicing air-conditioning and refrigeration systems containing more than 90,7 kg of high-pressure refrigerant: >5,155 kPa absolute.~~

~~c) Equipment intended for servicing air-conditioning and refrigeration systems containing low-pressure refrigerant: >0,338 kPa absolute.~~

~~**AA.1.2** Refrigerant recovery only equipment and refrigerant recovery/recycling equipment not intended for use in a **service garage** and designed to recover 2,27 kg or less of refrigerant shall comply with the following requirements when tested in accordance with Clause AA.5.~~

~~The equipment shall recover 90 % of the refrigerant from the test stand when the test stand **compressor** is operating and 80 % of the refrigerant when the **compressor** of the test stand is not operating, when tested in accordance with Clause AA.5.~~

~~NOTE As an alternative, the equipment shall achieve a 8,95 kPa absolute vacuum~~

~~AA.2 Test apparatus~~

~~AA.2.1 General recommendations~~

~~The recommended test apparatus is described in the following paragraphs. If alternate test apparatus are employed, the user shall be able to demonstrate that they produce results equivalent to the specified referee apparatus.~~

~~AA.2.2 Self-contained equipment test apparatus~~

~~The apparatus, shown in Figure AA.1, shall consist of the following.~~

~~AA.2.2.1 Mixing chamber~~

~~A mixing chamber consisting of a tank with a conical-shaped bottom, a bottom port and piping for delivering refrigerant to the equipment, various ports and valves for adding refrigerant to the chamber and stirring means for mixing.~~

~~**AA.2.2.2 Filling storage cylinder**~~

~~The storage cylinder to be filled by the refrigerant transferred shall be cleaned and at the pressure of the recovered refrigerant at the beginning of the test. It will not be filled over 80 %, by volume.~~

~~**AA.2.2.3 Vapour feed**~~

~~Vapour refrigerant feed consisting of evaporator, control valves and piping to create a 3,0 °C superheat condition at an evaporating temperature of (21 ± 2) °C.~~

~~**AA.2.2.4 Alternative vapour feed**~~

~~An alternative method for vapour feed shall be to pass the refrigerant through a boiler and then through an automatic pressure-regulating valve set at different saturation pressures, moving from saturated pressure at 24 °C to final pressure of recovery.~~

~~**AA.2.2.5 Liquid feed**~~

~~Liquid refrigerant feed consisting of control valves, sampling port and piping.~~

~~**AA.2.2.6 Instrumentation**~~

~~Instrumentation capable of measuring weight, temperature, pressure and refrigerant loss, as required.~~

~~**AA.2.3 Size**~~

~~The size of the mixing chamber shall be a minimum of 0,09 m^3. The bottom port and the refrigerant feed shall depend on the size of the equipment. Typically, the mixing valves and piping shall be 9,5 mm. For large equipment to be used on chillers, the minimum inside diameter of ports, valves and piping shall be the smaller of the manufacturer's recommendation or 37 mm.~~

~~AA.3 Contamination testing~~

~~**AA.3.1 General testing requirements**~~

~~**AA.3.1.1 Temperatures**~~

~~Testing shall be conducted at an ambient temperature of (40 ± 1) °C. The evaporator conditions of AA.2.2.3 shall be maintained as long as liquid refrigerant remains in the mixing chamber.~~

~~**AA.3.1.2 Refrigerants**~~

~~The equipment shall be tested for all designated refrigerants. All tests in Clause AA.3 shall be completed for each refrigerant before starting tests with the next refrigerant.~~

~~**AA.3.1.3 Selected tests**~~

~~Tests shall be as appropriate for the equipment type and ratings parameters selected.~~

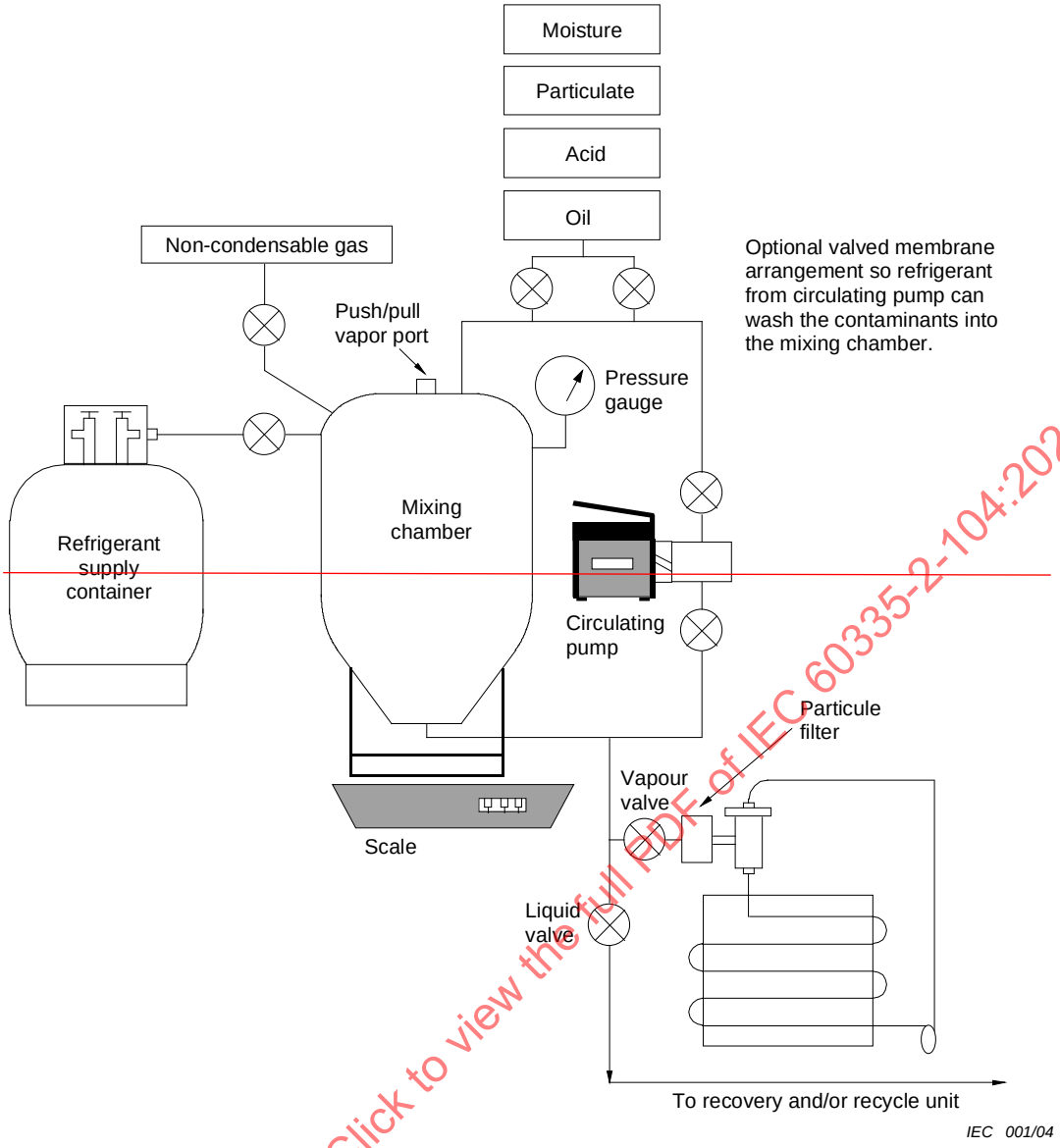


Figure AA.1 – Test apparatus for self-contained equipment

AA.4 Equipment preparation and operation.

AA.4.1 General

The equipment shall be prepared and operated per the operating instructions.

AA.4.2 Test batch

The test batch consisting of a t sample (see AA.4.2.1) of the test refrigerant shall be prepared and thoroughly mixed. Continued mixing or stirring shall be required during the test while liquid refrigerant remains in the mixing chamber. The mixing chamber shall be filled to 80 % level by volume.

AA.4.2.1 Contaminated refrigerants

The standard contaminated refrigerant sample shall have the characteristics specified in table AA.1, except as provided for in AA.4.2.2

AA.4.2.2 Recovery only testing

Recovery equipment not rated for any specific contaminant shall be tested with new or reclaimed refrigerant.

AA.4.3 Recovery tests (recovery and recovery/recycle equipment)

AA.4.3.1 If the equipment is intended for liquid recovery operations, connect the equipment inlet to the liquid valve of the test apparatus and process all liquid refrigerant from the mixing chamber. Continue with the recovery operation until the vapour is removed to the point where equipment shuts down by automatic means or is manually shut off per the unit operating instructions

AA.4.3.2 If the equipment is intended for vapour recovery only operations, connect the equipment inlet to the vapour valve of the test apparatus and repeat the procedures in AA.4.3.1.

AA.4.3.3 *Final recovery vacuum*. At the end of the first test batch for each refrigerant, the liquid valve and vapour valve of the apparatus shall be closed. After waiting 1 min, the mixing chamber pressure shall be recorded to determine the final vacuum level.

Table AA.1 – Standard contaminated refrigerant samples

	Refrigerant type							
Contaminants	**R11**	**R12**	**R13**	**R22**	**R113**	**R114**	**R123**	**R134a**
Moisture content: ppm by weight of pure refrigerant	100	80	30	200	100	85	200	200
Particulate content: ppm by weight of pure refrigerant[a]	80	80	N/A	80	80	80	80	80
Acid content: ppm by weight of pure refrigerant[b]	500	100	N/A	500	400	200	500	100
Oil content: % by weight of pure refrigerant	20	5	N/A	5	20	20	20	5
Viscosity / Type[c]	300/ MO	150/ MO	N/A	300/ MO	300/ MO	300/ MO	300/ MO	150/ POE
Non-condensable gasses (air content): % by volume	N/A	3	3	3	N/A	3	N/A	3

[a] Particulate content shall consist of inert materials and shall comply with requirements of Annex BB.

[b] Acid consists of 60 % oleic acid and 40 % hydrochloric acid on a total number basis.

[c] POE = polyoester, AB = alkylbenzene, MO = mineral oil.

N/A = Not available.

Table AA.1 – *(continued)*

	Refrigerant type							
Contaminants	**R500**	**R502**	**R503**	**R401A**	**R401B**	**R401C**	**R402A**	**R402B**
Moisture content: ppm by weight of pure refrigerant	200	200	30	200	200	200	200	200
Particulate content: ppm by weight of pure refrigerant[a]	80	80	N/A	80	80	80	80	80
Acid content: ppm by weight of pure refrigerant[b]	100	100	N/A	200	200	200	200	200
Oil content: % by weight of pure refrigerant.	5	5	N/A	5	5	5	5	5
Viscosity / Type[c]	150/ MO	150/ MO	N/A	150/ AB	150/ AB	150/ AB	150/ AB	150/ AB
Non-condensable gasses (Air content): % by volume	3	3	3	3	3	3	3	3

[a] Particulate content shall consist of inert materials and shall comply with requirements of Annex BB

[b] Acid consists of 60 % oleic acid and 40 % hydrochloric acid on a total number basis.

[c] POE = Polyoester, AB = Alkylbenzene, MO = Mineral oil.

N/A = Not available.

Table AA.1 – (continued)

	Refrigerant type							
Contaminants	**R404A**	**R406A**	**R407A**	**R407B**	**R407C**	**R407D**	**R408A**	**R409A**
Moisture content: ppm by weight of pure refrigerant	200	200	200	200	200	200	200	200
Particulate content: ppm by weight of pure refrigerant[a]	80	80	80	80	80	80	80	80
Acid content: ppm by weight of pure refrigerant[b]	500	200	500	500	500	500	200	200
Oil content: % by weight of pure refrigerant.	5	5	5	5	5	5	5	5
Viscosity / Type[c]	150/ POE	150/ MO	150/ POE	150/ POE	150/ POE	150/ POE	150/ MO	150/ MO
Non-condensable gasses (air content): % by volume	3	3	3	3	3	3	3	3

[a] Particulate content shall consist of inert materials and shall comply with requirements of Annex BB.

[b] Acid consists of 60 % oleic acid and 40 % hydrochloric acid on a total number basis.

[c] POE = Polyoester, AB = Alkylbenzene, MO = Mineral oil.

Table AA.1 – (*continued*)

	Refrigerant type							
Contaminants	**R410A**	**R411A**	**R411B**	**R412A**	**R23**	**R507**	**R508A**	**R508B**
Moisture content: ppm by weight of pure refrigerant	200	200	200	200	30	200	20	20
Particulate content: ppm by weight of pure refrigerant[a]	80	80	80	80	N/A	80	N/A	N/A
Acid content: ppm by weight of pure refrigerant[b]	500	200	200	200	N/A	100	N/A	N/A
Oil content: % by weight of pure refrigerant.	5	5	5	5	N/A	5	N/A	N/A
Viscosity / Type[c]	150/ POE	150/ MO	150/ MO	150/ AB	N/A	150/ POE	N/A	N/A
Non-condensable gasses (air content): % by volume	3	3	3	3	3	3	3	3

[a] Particulate content shall consist of inert materials and shall comply with requirements of Annex BB.

[b] Acid consists of 60 % oleic acid and 40 % hydrochloric acid on a total number basis.

[c] POE = Polyoester, AB = Alkylbenzene, MO = Mineral oil.

N/A = Not available.

Table AA.1 – (*continued*)

	Refrigerant type							
Contaminants	**R509**							
Moisture content: ppm by weight of pure refrigerant	100							
Particulate content: ppm by weight of pure refrigerant[a]	80							
Acid content: ppm by weight of pure refrigerant[b]	100							
Oil content: % by weight of pure refrigerant.	5							
Viscosity / Type[c]	150/ MO							
Non-condensable gasses (air content): % by volume	3							

[a] Particulate content shall consist of inert materials and shall comply with requirements of Annex BB

[b] Acid consists of 60 % oleic acid and 40 % hydrochloric acid on a total number basis.

[c] POE = Polyoester, AB = Alkylbenzene, MO = Mineral oil.

AA.5 Test procedure for refrigerant recovery only equipment and refrigerant recovery/recycling equipment not intended for use in a service garage and designed to recover 2,3 kg or less of refrigerant

AA.5.1 Refrigerant recovery only equipment and refrigerant recovery/recycling equipment not intended for use in a **service garage** and designed to recover 2,3 kg or less of refrigerant shall comply with the following requirements.

AA.5.2 The test stand refrigeration system required for this procedure is constructed with standard equipment utilized in currently produced household refrigerator and freezer products. The procedure also accounts for **compressor** oils that might be added to or removed from the test stand **compressor** or any **compressor** used in the recovery system.

AA.5.3 Test stand

Test stands are constructed in accordance with the following requirements:

- evaporator: 7,94 mm outside diameter with 0,49 L volume;
- condenser: 6,35 mm outside diameter with 0,33 L volume;
- suction line capillary heat exchanger: appropriate for **compressor** used;.
- a 234.48-278.45w (800-950 Btu/h) high side case (rotary) **compressor**; or (depending on the test scenario)
- a 234.48-278.45w (800-9500 Btu/h) low side case (reciprocating) **compressor**.

AA.5.4 Test conditions

Tests are to be conducted at (24 ± 1) °C. Separate tests are conducted on both high side case **compressor** stands and low side case **compressor** stands. Separate tests are also conducted with the test stand **compressor** running during the recovery operation, and without the test stand **compressor** running during the recovery operation, to calculate the system's recovery efficiency under either condition.

AA.5.5 A series of five recovery operations are to be performed for each **compressor** scenario and a recovery efficiency is calculated based on the total quantity of refrigerant captured during all five recoveries. Alternatively, at the request of the recovery system's vendor, a recovery efficiency is to be calculated for each recovery event. In this case, a statistically significant number of recovery operations are to be performed.

AA.5.6 Determination of what is a statistically significant number of recoveries is to be calculated as set out below. These individual recovery efficiencies are then averaged.

AA.5.6.1 There are four **compressor** scenarios to be tested. These are a high side case **compressor** in working condition; a high side case **compressor** in non-working condition; a low side case **compressor** in working condition; and a low side case **compressor** in non-working condition. Recovery efficiencies calculated for the two working **compressor** scenarios are to be averaged to report a working **compressor** performance. The two non-working **compressor** efficiencies are also to be averaged to report a non-working **compressor** performance.

AA.5.6.2 The following are definitions of symbols used in the test procedure.

Test stand:

- "TSO" means an original test stand weight.
- "TSC" means a charged test stand weight.

Shipping containers:

- "SCO" means the original or empty weight of shipping container(s).
- "SCF" means the final or full weight of shipping container(s).

Recover/transfer system:

- "RSO" means the original weight of a recovery/transfer system.
- "RSF" means the final weight of a recovery/transfer system.
- "OL" means the net amount of oil added/removed from the recovery device and/or transfer device between the beginning and end of the test for one compressor scenario.
- Weighing is to be conducted with precision and an accuracy of ±1,0 g.

AA.5.7 Test procedure

AA.5.7.1 Evacuate the test stand to 20 microns vacuum (pressure measured at a vacuum pump) for 12 h.

AA.5.7.2 Weigh the test stand (TSO).

AA.5.7.3 If this is the first recovery operation being performed for a **compressor** scenario (or if a recovery efficiency is to be calculated for each recovery event), then weigh all devices used in the recovery system to deliver recovered refrigerant to a container suitable for shipment or delivery to a refrigerant reclaimer. Weigh only devices that can retain refrigerant in a manner that it will ultimately be transferred to a shipping container without significant release to the atmosphere (RSO).

AA.5.7.4 Weigh final shipping container (SCO).

AA.5.7.5 Charge the test stand with an appropriate refrigerant charge.

AA.5.7.6 Run the test stand for 4 h with 100 % run time.

AA.5.7.7 Turn off the test stand for 12 h. During this period evaporate all condensation that has collected on the test stand during operation as per AA.5.7.6.

AA.5.7.7 Weigh the test stand (TSC).

AA.5.7.8 Recover refrigerant from the test stand and perform all operations needed to transfer the recovered refrigerant to one of the shipping containers weighed in step 4. All recovery and transfer operations are to be performed in accordance with the operating instructions provided by the system's vendor. The **compressor** in the test stand is to remain "off" or be turned "on" during the recovery operation depending on whether the test is for a non-working or working **compressor** performance evaluation. If a recovery efficiency is to be calculated for each recovery event, transfer the captured refrigerant to a shipping container and then skip to AA.5.7.13. Otherwise continue. If the system allows for multiple recovery operations to be performed before transferring recovered refrigerant to a shipping container, the transfer operation can be delayed until either the maximum number of recovery operations allowed before a transfer is required have been performed, or the last of the five recovery operations has been performed.

AA.5.7.9 Perform any oil removal or oil addition operations needed to properly maintain the test stand and the devices used for recovery or transfer operations. Determine the net weight of the oil added or removed from the recovery device and/or transfer device (OP1 for oil added, OP2 for oil removed).

AA.5.7.10 Evacuate the test stand to 20 microns vacuum for 4 h.

AA.5.7.11 Return to AA.5.7.2 unless five recovery operations have been performed.

AA.5.7.12 Weigh all final shipping containers that received recovered refrigerant (SCF).

AA.5.7.13 Weigh the equipment weighed in AA.5.7.3 above, (RSF). If a recovery efficiency is to be calculated for each recovery event, perform calculations and return to step 1 for additional recoveries.

AA.5.8 Calculations

AA.5.8.1 For five consecutive recoveries:

Refrigerant recoverable equals the summation of charged test stand weights minus original test stand weights:

$$\textit{Refrigerant recoverable} = \sum_{i=1} (TSC_i - TSO_i)$$

Oil loss equals the net weight of oil added to and removed from the recovery device and/or transfer device.

$$OL = \sum_{i=1} (OP1_i - OP2_i)$$

Refrigerant recovered equals the final weight of shipping containers minus the initial weight of final shipping containers, plus final recovery system weight, minus original recovery system weight, plus the net value of all additions and removals of oil from the recovery and transfer devices.

$$\textit{Refrigerant recovered} = (\sum_{i=1} \Sigma\, SCF_i) + RSF - RSO - OL$$

n = number of shipping containers used.

Recovery efficiency equals *Refrigerant recovered* divided by *Refrigerant recoverable* times 100 %.

$$\textit{Recovery efficiency} = \frac{\textit{Refrigerant recovered}}{\textit{Refrigerant recoverable}} 100\%$$

AA.5.8.2 For individual recoveries:

Refrigerant recoverable equals the charged test stand weight minus the original test stand weight.

$$Refrigerant\ recoverable = TSCO - TSO$$

Refrigerant recovered equals the final weight of the shipping container minus the initial weight of the shipping container plus the final weight of the recovery system minus the original recovery system weight.

$$Refrigerant\ recovered = SCF - SCO + RSF - RSO$$

Recovery efficiency equals *Refrigerant recovered* divided by *Refrigerant recoverable* times 100 %.

$$Recovery\ efficiency = \frac{Refrigerant\ recovered}{Refrigerant\ recoverable} 100\%$$

AA.5.8.3 Calculation of a statistically significant number of recoveries:

$$N_{add} = ((t \cdot sd)/(0{,}10 \cdot X))^2 - N$$

where:

N_{add} = the number of additional samples required to achieve 90 % confidence;

sd = standard deviation, or $(X/(N-1)^3)$;

X = sample average;

N = number of samples tested;

t = factor, as follows:

Number of samples	t for 90 % confidence
2	6,814
3	2,920
4	2,353
5	2,132
6	2,015
7	1,943
8	1,695
9	1,860
10	1,833

AA.5.8.3.1 Procedure: compute N_{add} after completing two recoveries.

~~**AA.5.8.3.2** If N_{add} > 0, then run an additional test.~~

~~**AA.5.8.3.3** Re-compute N_{add}. Continue to test additional samples until N_{add} < 0.~~

Annex AA
(normative)

Temperature and pressure test

The temperatures measured on the electric components and surfaces of the equipment shall not exceed those temperatures specified in Table 1.

The maximum pressure, including equalization pressures shall be used as a basis for the mechanical strength test, Clause 21.

Compressor motors shall operate continuously under the conditions of the temperature-pressure test without tripping any **protective device** in the circuit.

The equipment is to be fitted with pressure gauges on the high- and low-sides. Thermocouples are to be secured to electrical components, such as the **compressor** motor windings, starting-relay coil, capacitors, and wiring insulation, and to surfaces as indicated in Table 1. The temperature of motor windings or of coils may be measured by the change-in-resistance method, but the primary method of temperature measurement is to be the thermocouple method. The electrical input is to be measured with a voltmeter and an ammeter.

The equipment is to be installed in accordance with the manufacturer's instructions, and operated under the conditions specified in this annex, as applicable. The test potential is to be conducted per rated voltage.

If a general purpose receptacle is used, the resistive load is to be sized as described as follows.

When 15 A or 20 A general purpose sockets are provided and intended to be connected to the same circuit as the equipment, the starting test is to be conducted with an additional resistive load connected to the equipment. The resistive load is to be sized as follows:

a) The load is to be equal to 80 % of the rating of the receptacle when a single receptacle is employed.

b) The load is to be equal to 100 % of the rating of the largest receptacle when more than one receptacle is employed on the same circuit.

c) The load is to be equal to 100 % of the load(s) marked on or adjacent to the socket-outlet(s) if the equipment is marked as indicated and is provided with overcurrent protection as specified in the exception to 22.108.

The equipment is to be placed within a room maintained at 40 °C until the assembly reaches room temperature.

Other electrical loads that may operate concurrently with the **compressor** are to be energized during the test. Equipment is to be tested in the following applicable manner. The test sample is to be connected to a supply of liquid **refrigerant** greater in volume than the storage section of the **recovery**/recycling equipment. The test sample is to be started and operated recovering liquid **refrigerant** until temperatures and pressures have stabilized or until the equipment storage section(s) are filled as specified below.

- Equipment shall have a storage section to receive **refrigerant** during a **recovery** operation.
- Exception: Storage sections intended to contain low pressure **refrigerants** such as R123 shall have a means to cease the **recovery** operation when 90 % of the storage volume contains liquid **refrigerant** at 21,1 °C. There shall be means, such as a shutoff, to limit migrating liquid **refrigerant** from occupying more than 90 % of the volume of the storage section(s) at 21,1 °C upon termination of all **recovery** operations.

The test is repeated with the equipment connected to recover vapor **refrigerant**. The potential is to be maintained at rated voltage. The electrical input, the temperature of electrical components and surfaces, and high- and low-side pressures are to be recorded at intervals during the test. When applicable, the test shall be repeated using different **refrigerant** types to obtain maximum pressures and temperatures. When the equipment is provided with an integral means of throttling, manual throttling of **refrigerant** during this testing procedure can be conducted.

For the test of equipment of the water-cooled type, the condenser water flow is to be maintained at 26,7 °C inlet and 37,8 °C outlet temperatures. When the outlet water cannot attain a temperature of 37,8 °C because of product design considerations, the equipment is to be tested at 26,7 °C inlet water and 0, 241 MPa (2,41 bar) nominal pressure.

A motor-**compressor** shall operate continuously without tripping any **protective device** in the circuit.

Annex BB
(normative)

Particulate used in standard contaminated refrigerant

BB.1 Particulate specification

The particulate material (pm) will be a blend of 50 % coarse air cleaner dust as received, and 50 % retained on a 200-mesh screen.

BB.2 Preparation of particulate materials

To prepare the blend of contaminant, first wet screen a quantity of coarser air cleaner dust on a 200-mesh screen (particulate retention 74 pm).

This is done by placing a portion of the dust on a 200-mesh screen and running water through the screen while stirring the dust with the fingers. The fine contaminant particles passing through the screen are discarded. The larger 200-mesh particles collected on the screen are removed and dried for one hour at 110 °C. The blend of standard contaminant is prepared by mixing 50 % by weight of coarse air cleaner dust as received (after drying for one hour at 110 °C) with 50 % by weight of the >200-mesh screened dust.

BB.3 Particle size analysis

The coarse air cleaner dust as received and the blend used as the standard contaminant have the following approximate analysis:

Table BB.1 – Weight % in various size ranges pm

Size range	As received	Blend
0 – 5	12	6
5 – 10	12	6
10 – 20	14	7
20 – 40	23	11
40 – 80	30	32
80 – 200	9	38

Annex ~~CC~~ BB
(normative)

Compatibility requirements

~~CC.1 Compatibility test~~

~~CC.1.1~~ 1) **Refrigerant** containing components

Non-metallic components and/or electrical insulating materials used inside the **refrigerant** ~~storage sections~~ containing components shall be compatible with **refrigerants** and oils to be used with the **refrigerant recovery**/recycling appliance. Refer to ANSI 97 or similar test method.

~~CC.1.2~~ 2) **Recovery** equipment **compressors**

Refer to IEC 60335-2-34:2012, Annex BB and Annex CC which provide computability testing for **compressors**.

3) **Refrigerant recovery** fill limiting device

*A complete sample of the as-received fill limiting device shall be mounted inside a vessel that is filled to 80 % of its internal volume by a mixture of 5 % oil and 95 % **refrigerant** intended for use with the **refrigerant recovery**/recycling appliance. The vessel shall be placed in an air-circulating oven maintained at a minimum of 80 °C for a total of 60 days. Other values of time and temperature as noted in ~~Table CC.1~~ Table BB.1 can be employed. Immediately following this test, the fill limiting device shall be operated as intended and limit the fill of the storage section to 80 % or less of its capacity by volume.*

Table ~~CC.1~~ BB.1 – Alternate values of time and temperature for the compatibility test

Days	Temperature °C
60	80
45	85
30	90
22,5	95
15	100

Annex CC
(normative)

Pressure tests

CC.1 General

All refrigerating system parts shall withstand the maximum allowable pressure expected in **normal operation**, abnormal operation, and standstill.

A **compressor** tested for compliance with IEC 60335-2-34 need not be additionally tested.

Compliance is checked by the following tests.

*For all tests of Clause 21, if the **refrigerant** is a blend, the test pressure of CC.4.2 shall be carried out at the highest pressure under the specified temperature. The test value that is the maximum of Clauses CC.2, CC.3 or CC.4 shall be used for the test of Clause CC.4, respectively, for the high side and the low side components.*

CC.2 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 allowable pressure developed in the **refrigerating system** when tested under the conditions specified in Clause 11.

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

CC.3 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 allowable pressure developed in the **refrigerating system** when tested under the conditions specified in Clause 19.

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

CC.4 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 that is exposed only to low side pressure shall be subjected to measurement of the maximum allowable pressure developed in the **refrigerating system** under the condition of standstill.

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

Pressure gauges and control mechanisms need not be subjected to the test, provided the parts meet the requirements of the component.

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 at least 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. Additional sealing measures, such as an "O" ring, for pressure testing may be provided.

CC.5 Fatigue test option for Clause CC.2 and CC.4

The components shall be subjected to a test at 66,7 % of the test pressure determined by Clauses CC.2, CC.3 or CC.4, provided the components comply with the fatigue test in Clause CC.5. This test is conducted on a separate sample.

Three samples of each **refrigerant**-containing part shall be tested at the cyclic pressure values specified in Clause CC.5.

The samples shall be considered to comply with Clause CC.5 on completion of the test and if they do not rupture, burst, or leak.

The test samples shall be filled with fluid, and shall be connected to a pressure driving source. 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 1 For safety purposes, it is suggested that a non-compressible fluid is used for the test. The fluid fills the sample completely to prevent any significantly remaining gas.

If the operating temperatures of the appliance under the conditions of steady state operation of Clause 11 are 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 25 °C greater than the temperature of the part measured during the test of Clause 11 for copper or aluminium and 60 °C higher for steel. For other materials, 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.

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.

The total number of cycles shall be 250 000. The test pressures shall be determined by Clause CC.5 (except the first and last cycles as noted in Clause CC.5.

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.

   For hot water **heat pumps**, the upper pressure shall not be less than 80 % of the maximum allowable pressure under the conditions of Clause 11.

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.

For the final test cycle, the test pressure shall be increased to two times the minimum upper pressure specified in Clause CC.5.

NOTE 2 The objective is to avoid a test value that is a negative pressure but to require a lower pressure value.

Annex DD
(normative)

Requirements for swelling oil

DD.1 Swelling oil specification

The oil used for this application replaces the #3 oil that was suspected to be carcinogenic.

– Oil:	IRM903
– Gravity	22 API
– Product type:	Calsol
– Source:	R. E. Carroll Inc.
	1570 North Olden Ave.
	Trenton NJ USA

– Viscosity	33,5 CST @37,8 Cy
– Flash, COC,	340 °C
– Aniline point	69,5 °C
– Viscosity-gravity constant	0,882
– Naphthenic carbon atoms	49 % Cn
– Parafinnic carbon atoms	37 %Cp

Annex DD
(normative)

Leak simulation tests

DD.1 General

A leakage of **refrigerant** is simulated at the most critical point in the **refrigerating system**. The method to simulate a leakage at the most critical point is to inject **refrigerant** vapour through a suitable capillary tube at that point. A critical point is a joint in the **refrigerant** system tubing, a bend of more than 90°, or other point judged to be a weak point in the **refrigerant** containing system due to the thickness of the metal, exposure to damage, sharpness of a bend or the manufacturing process. A quantity of **refrigerant** leaked is equal to the rated **refrigerant charge** or the amount that will leak as determined by test. The **refrigerant** is injected at the most critical point and the most unfavourable direction at ambient temperature (20 °C to –25 °C). Where LFL is referenced in this annex, the LFL shall be taken at the nominal composition as specified in ISO 817.

DD.2 Test methods

The appliance is modified by introducing a simulated leak through a capillary tube. The leak rate shall be maintained at 25 % ± 5 % of the **refrigerant charge** in 1 min. During this test, the appliance is switched off or operated under **normal operation** at **rated voltage**, whichever gives the most unfavourable result unless a prepurge is activated prior to energizing any loads, in which case the test shall be conducted with the appliance operating. During a test where the appliance is operating, **refrigerant** gas injection is started at the same time as the appliance is switched on.

For **refrigerant** blends, the test shall be carried out using the nominal composition as defined in ISO 817.

If a zeotropic blend is used, the test is conducted maintaining the composition within a reasonable range. It is acceptable to use liquid phase of the blend extracted from the bottle then evaporated. Gas phase release with the pressure regulator from a large mixed gas tank is the best method, but care has to be taken to avoid any condensation occurring in the vessel.

The test is conducted in a room that is draft free and of sufficient size to conduct the test.

The minimum volume (V) is:

$$V = (15 \times m_c)/LFL \qquad \text{(DD.1)}$$

where

V is the minimum volume in m^3 with a ceiling height not less than 2,2 m;

m_c is the **refrigerant charge** in kg;

LFL is the lower flammability limit in kg/m^3.

The quantity of gas injected shall be measured with acceptable accuracy. Weighing the bottle is required.

Care shall be taken that the installation of the capillary tube does not unduly influence the results of the test and that the structure of the appliance does not unduly influence the results of the test.

The instrument used for monitoring the **refrigerant** gas concentration shall have a fast response to the gas concentration, typically 2 s to 3 s and shall be located so as to not unduly influence the results of the test.

If gas chromatography is used to measure the **refrigerant** gas concentrations, the gas sampling in confined areas shall not exceed 2 ml every 30 s.

The measured concentration of **refrigerant** gas surrounding the component shall not exceed 25 % of the LFL of the **refrigerant** gas, and shall not exceed 15 % of the LFL of the **refrigerant** gas for a time period of 5 min or the duration of the test if less than 5 min during and after the amount has been injected. The measured concentration of **refrigerant** gas surrounding a component that will not function during the prepurge time may exceed the 25 % of the LFL during the prepurge time. The LFL is as specified in ISO 817 for the **refrigerant** used.

Annex EE
(normative)

Manual – Installation and operating instructions

The equipment shall be provided with installation and operating instructions. The instructions shall contain such directions and information that the manufacturer considers necessary for installation, maintenance, and use of the equipment.

A copy of the manufacturer's operating and installation instructions, or equivalent information, intended to accompany the equipment is to be furnished with the sample submitted for investigation.

These instructions are to be used as a guide in the examination and test of the equipment. For this purpose, a printed edition is not required initially if rough draft instructions or information as to what the instructions will include are submitted for review as part of the investigation.

The instructions shall emphasize the importance of using interconnecting hoses of proper materials, of minimal length, and having shut-off devices within 12 in of the ends, such as the hoses provided with the equipment, in order to reduce the likelihood of **refrigerant** leakage to the atmosphere.

The instructions for portable equipment shall include information concerning suitable extension cords that may be used, consistent with the requirements in 11.1 to 11.7, and the need to keep such cords at a minimal length.

In addition to being marked on the equipment, the instructions for the equipment shall include the marking information included in Clause 7.

The instructions for all equipment shall include a hose evacuation procedure to be followed after each **recovery** and recharging operation. In addition, there shall be a marking and warning in the user's manual to not unplug **recovery** equipment while operating.

The instructions for all equipment shall include information that during a **recovery** operation, the equipment, while connected to the system being serviced, is to be shut off for a period of 5 min after which time the presence of **refrigerant** remaining in the system is to be determined. The process is to be repeated until the system is evacuated to less than atmospheric pressure.

The instructions for portable equipment with two power **supply cords** shall contain information as follows:

a) they shall clearly indicate that the use of two cords is involved and caution against unplugging only one during movement, testing or repair of the product (all products with two power **supply cords**);

b) when the attachment plug caps are different, the installation manual shall clearly state that different attachment plugs are used (indicating the ratings). When individual branch circuits are involved, the manual shall clearly state that individual branch circuits (indicating the ratings) are to be employed to supply the product and indicate what actions are required for a proper installation.

c) The operating instructions for non-automotive **recovery** or **recovery**/recycling equipment shall include a procedure to be followed to make sure that no oil is in the storage container prior to starting a **recovery** and/or recycling operation.

The instructions for all equipment shall contain the following marking:

"CAUTION – Should be operated by certified personnel."

For **flammable refrigerants**, these also shall apply.

Installation and operating instructions shall be provided with cautionary statements concerning the handling, moving, and use of the **refrigerant recovery**/recycling equipment to avoid either damaging the **refrigerant** tubing, or increasing the risk of a leak:

- requirements for flammable marking per Clause 7;
- construction requirements in Clause 22 (hoses which meet permeation, pull-test, grounding, appropriate left-hand valve fitting (side that works with machine), etc.;
- technicians shall access the local area with regards to safety hazards (live flames, sparking equipment, or other potential sources);
- technicians shall follow all local/regional regulations required for safe use.

If **recovery**/recycling equipment contains a **flammable refrigerant** when shipped, the shipping carton shall be marked with proper handling instructions in compliance with national regulations. The caution marking shall also appear on the shipping carton.

The instructions for equipment intended to service automotive air conditioning systems shall contain the following or equivalent information:

"Avoid breathing A/C **refrigerant** and lubricant vapor or mist. Exposure may irritate eyes, nose and throat. To remove **refrigerant** from the A/C system, use only equipment certified for the type of **refrigerant** being removed to meet the requirements of SAE J2210, SAE J2843, or SAE J3030. Additional health and safety information may be obtained from **refrigerant** and lubricant manufacturers."

"Caution – Do not pressure test or leak test equipment and/or vehicle air conditioning systems with compressed air. Some mixtures of air and **refrigerant** have been shown to be combustible at elevated pressures. These mixtures, if ignited, may cause injury or property damage. Additional health and safety information may be obtained from **refrigerant** manufacturers."

The installation and operating instructions shall indicate that component parts shall be replaced with like components and that servicing shall be done by factory authorized service personnel, so as to minimize the risk of possible ignition due to incorrect parts or improper service.

Installation and operating instructions shall specifically describe any user maintenance operations, such as a filter change or tank evacuation. The instructions shall outline the method used to collect and/or vent any residual **refrigerant** before the maintenance operations are performed.

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

ANSI/ASHRAE Standard 97-2007, *Sealed Glass Tube Method Test The Chemical Stability of Materials For Use Within Refrigerant Systems*

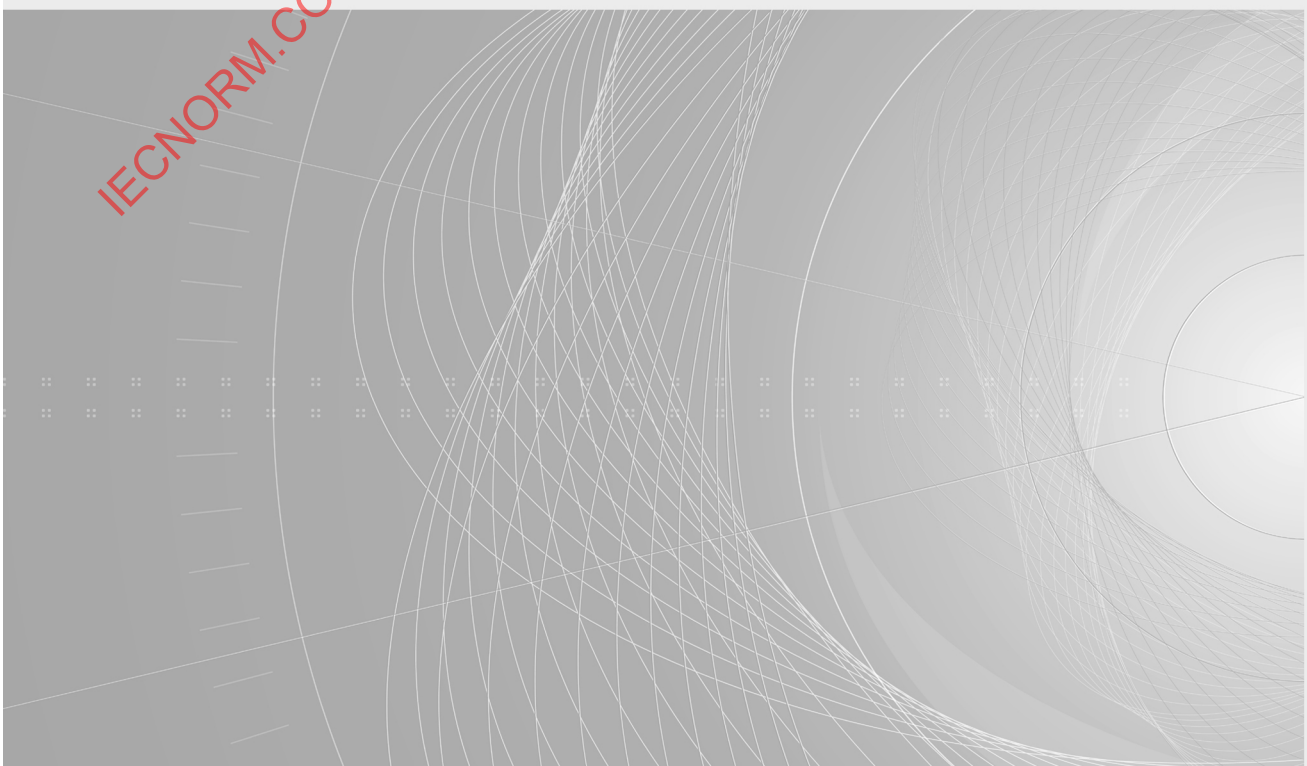
IEC 60335-2-104

Edition 2.0 2021-05

INTERNATIONAL STANDARD

colour inside

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



IEC 60335-2-104:2021-05(en)

CONTENTS

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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8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

This part 2 is to be used in conjunction with the 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 **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 300 V for single phase appliances and 600 V for all other 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 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[1], *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

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

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

[1] Withdrawn.

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 5149-2, *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, A*utomotive 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

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.

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

3.104
recovery
pumping out (removal) of **refrigerant** from air conditioning or refrigeration equipment

3.105
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 each **refrigerant,** one of the following:

  - the chemical name;
  - the **refrigerant** number (R designation) per ISO 817;

– 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.

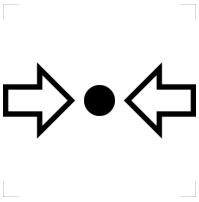
For **flammable refrigerants**, any tubing or other devices through which the **refrigerant** is intended to be serviced shall be painted or colored red. This color shall be present at all places where service puncturing, or otherwise creating an opening in the **refrigerant** circuit might be expected. 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
 (X) MPa	[symbol ISO 7000-1701 (2004-01)]	pressure
	[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 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 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 1.* ***Protective devices*** *shall not operate and sealing compound shall not flow out. Pressures are recorded and used in Clause 21.*

Table 1 – Temperature limits

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

Part	Temperature °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 ***supplementary insulation*** *or* ***reinforced insulation***	*425*
– thermoplastic material [f]	-
Wood, in general [g]	*90*
Wooden walls of the test casing	*90*
Outer surface of capacitors [h]	
– with marking of maximum operating temperature (T) [i]	*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 ***stationary appliance*** *not provided with a* ***supply cord****:*	
– if the instructions require the use of supply wires with a temperature rating (T)	*T*
– in other cases [e]	*75*

[a] *Not required for motor-**compressors** that comply with IEC 60335-2-34.*

[b] *The temperatures within parentheses apply when thermocouples are used. The figures without parentheses apply when the resistance method is used.*

[c] *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.

[d] *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.*

[e] *This limit applies to cables, cords and wires complying with the relevant IEC standards; for others, it may be different.*

[f] *There is no specific limit for thermoplastic material, which shall withstand the tests of 30.1 or 30.2 of Part 1, for which purpose the temperature shall be measured.*

[g] *The limit specified concerns the deterioration of wood and it does not take into account the deterioration of surface finishes.*

[h] *There is no limit for the temperature rise of capacitors which are short-circuited in 19.7.*

[i] *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_1 is the resistance at the beginning of the test;

R_2 is the resistance at the end of the test;

T_1 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 are at ambient temperature.

the resistance of windings at the end of the test 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 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 IPXO 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 °C ± 5 °C.

If the temperature of the motor windings does not exceed 90 °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 °C and the temperature of the windings shall not exceed the values shown in Table 2.

Table 2 – Maximum winding temperature

Type of appliance	***Class of insulating material and limiting temperature*** °C							
	A	***E***	***B***	***F***	***H***	***200***	***220***	***250***
– *If impedance protected*	*150*	*165*	*175*	*190*	*210*	*230*	*250*	*280*
– *If protected by **protective devices** 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 **recovery** equipment is operated under conditions in Clause 11 and at **rated voltage**, with any form of operation, or any 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 2 and the appliance shall comply with the conditions specified in 19.10. In particular, **live parts** shall not be accessible, 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 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 19.6.2 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 can be expected to give the most unfavourable results.

NOTE 103 In general, the tests take into account any failure which can arise from perturbations on the mains supply. However, where more than one component can be affected simultaneously, it 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 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 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 14.3 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 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 3.

Table 3 – Maximum abnormal temperature

Parts	Temperature °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 [a]	$[1{,}5\times(T-25)]+25$ where T is the value specified in Table 1
[a] There is no specific limit for supplementary insulating and reinforced insulation of thermoplastic material, which shall withstand the tests of 30.1 of Part 1, for which purpose the temperature 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 **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 **system** component that is exposed to pressure shall be subjected to measurement of the maximum pressure developed in the **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 **system** component that is exposed to pressure shall be subjected to measurement of the maximum pressure developed in the **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 **system** component which is exposed only to low side pressure shall be subjected to measurement of the maximum pressure developed in the **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.*

*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.

*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 **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 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 **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 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 **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** unit during the core change should be removed by evacuation and not by flushing out or purging with the **refrigerant**.

– 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 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 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.*