

INTERNATIONAL STANDARD



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



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INTERNATIONAL STANDARD



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

INTERNATIONAL
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COMMISSION

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CONTENTS

FOREWORD	5
INTRODUCTION	9
1 Scope	10
2 Normative references	11
3 Terms and definitions	12
4 General requirement	19
5 General conditions for the tests	19
6 Classification	20
7 Marking and instructions	20
8 Protection against access to live parts	26
9 Starting of motor-operated appliances	26
10 Power input and current	26
11 Heating	27
12 Void	32
13 Leakage current and electric strength at operating temperature	32
14 Transient overvoltages	32
15 Moisture resistance	32
16 Leakage current and electric strength	34
17 Overload protection of transformers and associated circuits	34
18 Endurance	34
19 Abnormal operation	34
20 Stability and mechanical hazards	39
21 Mechanical strength	39
22 Construction	39
23 Internal wiring	49
24 Components	49
25 Supply connection and external flexible cords	50
26 Terminals for external conductors	51
27 Provision for earthing	51
28 Screws and connections	51
29 Clearances, creepage distances and solid insulation	51
30 Resistance to heat and fire	51
31 Resistance to rusting	51
32 Radiation, toxicity and similar hazards	52
Annexes	57
Annex D (normative) Thermal motor protectors	57
Annex I (normative) Motors having basic insulation that is inadequate for the rated voltage of the appliance	57
Annex AA (informative) Examples for operating temperatures of the appliance	58
Annex BB (normative) Selected information about refrigerants	59

Annex CC (informative) Transportation, marking and storage for units that employ flammable refrigerants	62
Annex DD (normative) Instruction manual for servicing refrigerant containing appliances Requirements for operation, service and installation manuals of appliances using flammable refrigerants	63
Annex EE (normative) Pressure tests	72
Annex FF (normative) Leak simulation tests	75
Annex GG (normative) Charge limits, ventilation requirements and requirements for secondary circuits	77
Annex HH (informative) Competence of service personnel	106
Annex II (Void)	109
Annex JJ (normative) Allowable opening of relays and similar components to prevent ignition of A2L refrigerants	110
Annex KK (normative) Test method for hot surface ignition temperature for A2L	112
Annex LL (normative) Refrigerant detection systems for A2L refrigerants	116
Annex MM (normative) Refrigerant sensor location confirmation test	118
Annex NN (normative) Flame arrest enclosure verification test for A2L refrigerants	120
Annex OO (normative) UV radiation conditioning	122
Bibliography	123
Figure 101 – Example of label for field charged units	53
Figure 101 102 – Arrangement for heating test of appliances with supplementary heater	55
Figure 102 103 – Supply circuit for locked-rotor test of a motor of the single-phase type – Revise as needed for three-phase test	56
Figure GG.1 – Unventilated area	102
Figure GG.2 – Mechanical ventilation	103
Figure GG.3 – Isosceles triangle arrow test gauge	103
Figure GG.4 – Measurement of vibration amplitude	103
Figure GG.5 – Relevant heights h_{inst} , h_0 and h_{rel} for calculation of A_{min} and m_{max}	104
Figure GG.6 – Airflow direction	105
Figure KK.1 – Front view of test apparatus labels	112
Figure KK.2 – Test apparatus with dimensions	113
Figure KK.3 – Top view of test apparatus	114
Table – Minimum room area (m^2) (see Note 2 of Clause GG.2)	83
Table – Maximum charge (kg) (see Note 2 of Clause GG.2)	83
Table – Mass of refrigerants	83
Table 3 – Temperature limits	30
Table 101 – UVC irradiance measurement location	52
Table AA.1 – Examples for operating temperatures of the appliance	58
Table BB.1 – Selected information about refrigerants	59
Table DD.1 – Mandatory clauses in each manual	63
Table GG.1 – Outline of Annex GG (informative)	78
Table GG.2 – Circulation airflow	83

Table GG.3 – Appliance with packaging	88
Table GG.4 – Appliance without packaging	89
Table GG.5 – Minimum airflow	101

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

**Part 2-40: Particular requirements for electrical heat pumps,
air-conditioners and dehumidifiers**

FOREWORD

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International Standard IEC 60335-2-40 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.

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

FDIS	Report on voting
61D/386/FDIS	61D/391/RVD

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

This sixth edition cancels and replaces the fifth edition published in 2013 and its Amendment 1:2016. This edition constitutes a technical revision.

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

- Clause 1 – limiting A2L refrigerants to those of a molar mass of more than or equal to 42 kg/kmol;
- Clause 7 – added requirements for A2L refrigerants,
- Clause 7 – added requirement for pre-charge pipe sets, detection systems, ventilation and the resulting charge;
- Clause 7 – added requirements for UV-C systems;
- Clause 7 – added requirements for transcritical refrigerating systems;
- Subclause 19.7 – amended text to match the intention of the subclause;
- Clause 21 – added requirements for transcritical refrigerating systems;
- Subclause 22 – added requirements for A2L refrigerants;
- Subclause 22 – added detection systems;
- Subclause 22 – added new requirements for enhanced tightness refrigerating systems;
- Subclause 22 – added new requirements for UV-C;
- Clause 23 – added new requirements for UV-C; Clause
- Clause 24 – added requirements for transcritical refrigerating systems;
- Subclause 24 – added requirements for detection systems and airflow;
- Clause 32 added new requirements for UV-C;
- Annex BB – revised to add surface temperatures;
- Annex DD – added requirements for A2L refrigerants and amended requirements for flammable refrigerants to exempt A2L refrigerants;
- Annex GG – added requirements for A2L refrigerants;
- Annex GG.1 – amended Table GG.1 and related wording
- Annex GG.7 – added requirement to test;
- Annex GG.8 to GG.13 – new coverage for A2L refrigerants;
- Annex HH – revised to take into account A2L refrigerants;
- Annex JJ – new coverage of allowable opening of relays and similar components to prevent ignition of A2L refrigerants;
- Annex KK – new coverage of test method for hot surface ignition temperature for A2L;
- Annex LL – new coverage of refrigerant detection systems for A2L Refrigerants;
- Annex MM – new coverage of refrigerant sensor location confirmation test;

- Annex NN – new coverage of flame arrest enclosure verification test for A2L refrigerants;
- Annex OO – new coverage of UV radiation conditioning
- Bibliography – added new references.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part 2-40 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of IEC 60335-1:2010, its Amendment 1:2013 and its Amendment 2:2016.

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

This part 2-40 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Safety requirements for electrical heat pumps, air-conditioners and dehumidifiers.

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

NOTE 2 The following numbering system is used:

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

NOTE 3 The following print types are used:

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

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

The following differences exist in the countries indicated below:

- 6.1: Class 0I appliances are allowed (Japan).
- 11.8: The temperature of the wooden walls in the test casing is limited to 85 °C (Sweden).

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.

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.

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

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INTRODUCTION

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

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

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 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

1 Scope

This clause of Part 1 is replaced by the following.

This part of IEC 60335 deals with the safety of electric **heat pumps**, including **sanitary hot water heat pumps**, **air conditioners**, and **dehumidifiers** incorporating motor-compressors and ~~hydronic-~~room~~ fan coils~~ **units**, their maximum **rated voltages** being not more than 250 V for single phase appliances and 600 V for all other appliances. **Partial units are within the scope of this International Standard.**

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 laymen in shops, in light industry and on farms, are within the scope of this standard.

~~This standard also applies to electric heat pumps, air conditioners and dehumidifiers containing flammable refrigerant. Flammable refrigerants are defined in 3.121.~~

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 'motor-compressor' is given in IEC 60335-2-34, which includes the statement that the term motor-compressor is used to designate either a hermetic motor-compressor or semi-hermetic motor-compressor.

NOTE 102 Requirements for ~~refrigeration~~ **refrigerating** safety are covered by ISO 5149-1, **ISO 5149-2**, and **ISO 5149-3**. Requirements for containers intended for storage of the heated water included in **sanitary hot water heat pumps** are, in addition, covered by IEC 60335-2-21.

This standard does not take into account ~~chemicals~~ **refrigerants** other than group A1, **A2L**, **A2** or **A3** as defined by ~~ANSI/ASHRAE 34~~ **ISO 817** classification, **A2L refrigerants** are limited to those of a molar mass of more than or equal to 42 kg/kmol based on WCF – Worst Case Formulation as specified in ISO 817.

This standard specifies particular requirements for the use of **flammable refrigerants**. Unless specifications are covered by this standard, including the annexes, requirements for refrigerating safety are covered by ISO 5149.

The parts of ISO 5149 of particular concern to this standard are as follows:

- ~~— Section 3: "Design and construction of equipment" applies to all appliances and systems.~~
- ~~— Section 4: "Requirements for utilization" applies to appliances and systems which are for "similar electrical appliances", i.e. commercial and light industrial.~~
- ~~— Section 5: "Operating procedures" applies to appliances and systems which are for "similar electrical appliances", i.e. commercial and light industrial.~~
- ISO 5149-1:2014, Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Definitions, classification and selection criteria.
- ISO 5149-2, Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation.

- ISO 5149-3:2014, Refrigerating systems and heat pumps – Safety and environmental requirements – Part 3: Installation site.

Supplementary heaters, or a provision for their separate installation, are within the scope of this standard, but only heaters which are designed as a part of the appliance package, the controls being incorporated in the appliance.

NOTE 103 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, for example, by the national health authorities responsible for the protection of labour and the national authorities responsible for storage, transportation, building constructions and installations.

NOTE 104 This standard does not apply to

- humidifiers intended for use with heating and cooling equipment (IEC 60335-2-88);
- 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).

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60068-2-52, *Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution)*

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

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

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

IEC 60335-2-51, *Household and similar electrical appliances – Safety – Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations*

IEC 60730-2-6, *Automatic electrical controls – Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

IEC 61032, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

ISO 817:~~2005~~, *Refrigerants – Designation ~~system~~ and safety classification*

ISO 1302, *Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-4, *Plastics – Methods of exposure to laboratory light sources – Part 4: Open-flame carbon-arc lamps*

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

ISO 5149-1:2014, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Definitions, classification and selection criteria*

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

ISO 5149-3:2014, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 3: Installation site*

ISO 5151, *Non-ducted air conditioners and heat pumps – Testing and rating for performance*

ISO 7010:2011, *Graphic symbols – Safety colours and safety signs – Registered safety signs*

ISO 13253, *Ducted air-conditioners and air-to-air heat pumps – Testing and rating for performance*

ISO 13256 (all parts), *Water-source heat pumps – Testing and rating for performance*

ISO 14903, *Refrigerating systems and heat pumps – Qualification of tightness of components and joints*

~~ANSI/ASHRAE 34:2010, Designation and safety classification of refrigerants~~

ISO 15042, *Multiple split-system air-conditioners and air-to-air heat pumps – Testing and rating for performance*

~~ASTM D4728-01:2001~~ D4728-06:2012, *Standard Test Method for Random Vibration Testing of Shipping Containers*

CAN/CSA-C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

UL 746A, *Standard for Polymeric Materials – Short Term Property Evaluations*

UL 746B, *Standard for Polymeric Materials – Long Term Property Evaluations*

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1.4 Addition:

Note 101 to entry: If the appliance comprises electrical accessories, including fans, the **rated power input** is based upon the total maximum **electrical power input** with all accessories energized, when operating continuously under the appropriate environmental conditions. If the **heat pump** can be operated in the heating or cooling mode, the **rated power input** is based upon the input in the heating or in the cooling mode, whichever is the greater.

3.1.9 Replacement:

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**heat pump**

appliance which takes up heat at a certain temperature and releases heat at a higher temperature

Note 1 to entry: When operated to provide heat (e.g., for space heating or water heating), the appliance is said to operate in the heating mode; when operated to remove heat (for example, for space cooling), it is said to operate in the cooling mode.

Note 2 to entry: A **heat pump** can contain a combination of **condensing unit or condenser unit** and an **evaporating unit or evaporator unit** and can be equipped to operate in a reverse cycle mode.

3.102**sanitary hot water heat pump**

heat pump intended to transfer heat to water suitable for human consumption

3.103**air conditioner**

encased assembly or assemblies designed as an appliance to provide delivery of conditioned air to an enclosed space, room or zone

Note 1 to entry: It includes an electrically operated ~~refrigeration~~ **refrigerating system** for cooling and possibly dehumidifying the air.

Note 2 to entry: It may have means for heating, circulating, cleaning and humidifying the air.

Note 3 to entry: An **air conditioner** can contain a combination of **condensing unit or condenser unit** and an **evaporating unit or evaporator unit**.

3.104**dehumidifier**

encased assembly designed to remove moisture from its surrounding atmosphere

Note 1 to entry: It includes an electrically operated ~~refrigeration~~ **refrigerating system** and the means to circulate air. It also includes a drain arrangement for collecting and storing and/or disposing of the condensate.

3.105~~**dehumidification — comfort**~~

~~dehumidification to reduce the humidity within a space to a level to satisfy the requirements of the occupants~~

3.106~~**dehumidification — process**~~

~~dehumidification to reduce the humidity within a space to a level necessary for the process or the storage of goods and/or materials or the drying out of the building fabric~~

3.107~~**dehumidification — heat recovery**~~

~~dehumidification where the latent and sensitive heat removed from the space together with the compressor heat is reused in another application rather than rejected outside to waste~~

3.108**wet-bulb temperature****WB**

temperature indicated when the temperature-sensitive element in a wetted wick has reached a state of constant temperature (evaporative equilibrium)

3.109

dry-bulb temperature

DB

temperature indicated by a dry, temperature-sensitive element shielded from the effects of radiation

3.110

evaporator

heat exchanger in which refrigerant liquid is vaporized by absorption of heat

3.111

heat exchanger

device specifically designed to transfer heat between two physically separated fluids

3.112

indoor heat exchanger

heat exchanger designed to transfer heat to the indoor parts of the building or to the indoor hot water supplies (e.g. sanitary water) or to remove heat therefrom

3.113

outdoor heat exchanger

heat exchanger designed to remove or release heat from the heat source (for example, ground water, outdoor air, exhaust air, water or brine)

3.114

supplementary heater

electric heater provided as part of the appliance to supplement or replace the output of the refrigerant circuit of the appliance by operation in conjunction with, or instead of, the ~~refrigeration~~ refrigerating circuit

3.115

pressure-limiting device

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

3.116

pressure-relief device

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

3.117

~~**self-contained unit**~~

~~complete appliance, in suitable frame(s) or enclosure(s), that is fabricated and shipped in one or more sections, and has no refrigerant containing parts connected in the field other than by companion or block valves~~

~~Note 1 to entry: A **self-contained unit** in a single frame or enclosure is called a single package unit.~~

~~Note 2 to entry: A **self-contained unit** in more than one frame enclosure is called a split package unit.~~

3.117

appliances accessible to the general public

appliances intended to be located in residential buildings or in commercial buildings

3.118

appliances not accessible to the general public

appliances which are ~~intended to be maintained by qualified service personnel and~~ located either in a secured location with restricted access (e.g. machine rooms, rooftop and the like) or at a level not less than 2,5 m or in secured rooftop areas

3.119**hydronic fan coil unit**

factory-made assembly which provides the function of forced circulation of air for heating and/or cooling, which may also include the function of **dehumidification** and/or filtering of air, but which does not include the source of cooling or heating

Note 1 to entry: **Hydronic fan coil units** can include provision for electric resistance heating. **Heat exchanger coils** are intended for hydronic heating and cooling only.

~~**3.120**~~~~**fan coil**~~~~**air handling unit**~~

~~factory-made assembly which provides one or more of the functions of forced circulation of air, heating, cooling, dehumidification and filtering of air, but which does not include the source of cooling or heating~~

~~Note 1 to entry: The device is normally designed for free intake of air from a room and delivery of air into the same room, but may be applied with duct work.~~

~~Note 2 to entry: This device may be designed for furred-in application or with an enclosure for application within the conditioned space.~~

3.120**flammable refrigerant**

~~refrigerant with a classification of class A2 or A3 in compliance with ANSI/ASHRAE 34 [ISO 817] classification~~ classified as class A2L, A2 or A3 according to ISO 817

3.121**refrigerating system**

combination of interconnected refrigerant containing parts constituting one closed refrigerant circuit in which refrigerant is circulated for the purpose of extracting heat at the low temperature side to reject heat at the high temperature side by changing the state of the refrigerant

3.122**maximum allowable pressure**

limit to the **refrigerating system** operating pressure, generally the maximum pressure for which the equipment is designed, as specified by the manufacturer

Note 1 to entry: **Maximum allowable pressure** constitutes a limit to the operating pressure whether the equipment is working or not, see Clause 21.

3.123**low-pressure side**

part(s) of a **refrigerating system** operating at the **evaporator** pressure

3.124**high-pressure side**

part(s) of a **refrigerating system** operating at the **condenser** pressure

3.125**service port**

means to access the refrigerant in a **refrigerating system** for the purpose of charging or servicing the system, typically a valve, tube extension or entry location

3.126**factory sealed-appliance single package unit**

~~appliance~~ factory assembly of components of **refrigerating system** fixed on a common mounting to form a discrete unit in which all **refrigerating system** parts have been sealed tight by welding, brazing or a similar permanent connection during the manufacturing process

3.127**pre-charged pipe sets**

interconnecting refrigerant lines which are supplied with the unit and supplied with a **refrigerant charge** for the purpose of completing the **refrigerating system** in the field for appliances that are made up of more than one subassembly and are assembled in the field to complete the **refrigerating system**

~~**3.128**~~~~**single package unit**~~

~~factory assembly of components of refrigeration system fixed on a common mounting to form a discrete unit~~

3.128**condenser**

heat exchanger in which refrigerant vapour is condensed by removal of heat

3.129**condensing unit**

factory-made assembly that includes one or more motor-compressors, **condenser** in cooling mode and motor-driven fan, blower or pump to circulate the heat transfer fluid through the **condenser** with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to an **evaporator unit**. A **condensing unit** can also be equipped to operate in the reverse cycle mode. A **condensing unit** can include expansion device(s).

3.130**condenser unit**

factory-made assembly that includes one or more **condensers** in cooling mode and motor-driven fan, blower or pump to circulate the heat transfer fluid through the **condenser** with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to an **evaporating unit**. A **condenser unit** can also be equipped to operate in the reverse cycle mode.

Note 2 to entry: A **condenser unit** does not include a motor compressor or expansion device.

3.131**evaporating unit**

factory-made assembly that includes one or more motor-compressors, **evaporator** in cooling mode, expansion device(s), and motor-driven fan, blower or pump to circulate fluid through the **evaporator** with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to a **condenser unit**. An **evaporating unit** can also be equipped to operate in the reverse cycle mode and can include provision for electric resistance heating or similar sources of auxiliary heat.

3.132**evaporator unit**

factory-made assembly that includes one or more **evaporators** in cooling mode, and may include a motor-driven fan, blower or pump to circulate fluid through the **evaporator** with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to a **condensing unit**. An **evaporator unit** can also be equipped to operate in the reverse cycle mode and can include provision for electric resistance heating or similar sources of auxiliary heat. An **evaporator unit** can include expansion device(s).

Note 2 to entry: An **evaporator unit** does not include a motor compressor.

3.133**partial unit**

condensing unit, evaporating unit, condenser unit, or evaporator unit which are part of a total assembly of a heat pump, air-conditioner, or **sanitary hot water heat pumps** where not all assemblies to create the complete **refrigerating system** are specified by the manufacturer

Note 1 to entry: **Partial units** are evaluated for safety as stand-alone.

3.134**installed height**

h_{inst}

height of the bottom of the appliance relative to the floor of the room after installation

Note 1 to entry: The **installed height** is given in metres.

3.135**release offset**

h_{rel}

distance from the bottom of the appliance to an opening where refrigerant can leave the appliance in the event of a refrigerant leak

Note 1 to entry: The **release offset** is given in metres.

3.136**refrigerant charge**

m_c

actual **refrigerant charge** of a single **refrigerating system**

Note 1 to entry: The **refrigerant charge** is expressed in kg.

3.137**maximum refrigerant charge**

m_{max}

maximum refrigerant charge for a single **refrigerating system** as result from a calculation for room area or similar

Note 1 to entry: The **maximum refrigerant charge** is expressed in kg.

3.138**refrigerant detection system**

sensing system which responds to a pre-set concentration of refrigerant in the environment

Note 1 to entry: A **refrigerant detection system** may have multiple sensing elements.

3.139**auto ignition temperature**

AIT

lowest temperature at or above which a chemical can spontaneously ignite in a normal atmosphere, without an external source of ignition, such as a flame or spark

[SOURCE: ISO 5149-1:2014, definition 3.7.7]

3.140**hot surface ignition temperature**

HSIT

highest temperature at which a refrigerant does not ignite when tested in accordance with Annex KK

3.141**A2L refrigerant**

refrigerant classed as A2L according to ISO 817

3.142**lower flammability limit****LFL****lower flammability limit** according to ISO 817**3.143****enhanced tightness refrigerating system****refrigerating system** in which the indoor units are designed and fabricated to ensure a high level of confidence that large refrigerant leak rates will not occur in normal and abnormal operation**3.144****refrigerant distribution assembly**

separate refrigerant assembly which is installed in the interconnecting refrigerant lines for the purpose of distributing refrigerant flow to one or more indoor units

3.145**potential ignition source****PIS**

hot surfaces, flames and current carrying devices which can be the source of arcing or sparking

Note 1 to entry: Examples of **potential ignition sources** are UV lights, electric heaters, pilot flames, brushed motors and similar devices.

3.146**circulation airflow**

mechanically induced airflow movement within the space or duct connected spaces

3.147**ultraviolet radiation****optical radiation** for which the wavelengths are shorter than those for **visible radiation**

Note 1 to entry: For ultraviolet (UV) radiation, the range between 100 nm and 400 nm is commonly subdivided into: UV-A, from 315 nm to 400 nm; UV-B, from 280 nm to 315 nm; and UV-C, from 100 nm to 280 nm.

[SOURCE: IEC 60050-845:1987, 845-01-05]

3.148**optical radiation**electromagnetic radiation at wavelengths between the region of transition to X-rays ($\lambda \approx 1$ nm) and the region of transition to radio waves ($\lambda \approx 1$ mm)

[SOURCE: IEC 60050-845:1987, 845-01-02]

3.149**visible radiation**any **optical radiation** capable of causing a visual sensation directly

Note 1 to entry: There are no precise limits for the spectral range of **visible radiation** since they depend upon the amount of radiant power reaching the retina and the responsivity of the observer. The lower limit is generally taken between 360 nm and 400 nm and the upper limit between 760 nm and 830 nm.

[SOURCE: IEC 60050-845:1987, 845-01-03]

3.150**UV-C lamp**source made to produce **optical radiation** for which the wavelengths are shorter than those for **visible radiation** and in the range of 100 nm to 280 nm wavelengths including **germicidal lamps**

Note 1 to entry: There are several types of such lamps used for photobiological, photochemical and biomedical purposes

3.151

germicidal lamp

low pressure mercury vapour lamp with a bulb which transmits the bactericidal ultraviolet-C radiation

[SOURCE: IEC 60050-845:1987, 845-07-53]

3.152

UV-C germicidal lamp system

auxiliary device which utilizes **germicidal lamps** that directly generate UV-C germicidal **ultraviolet radiation** typically used to supplement the normal unit air filters for enhanced air purification and surface cleaning of the **evaporator** coil and surrounding area

3.153

UV-C spectral irradiance

measured electromagnetic radiation power density at a particular wavelength of 254 nm at a specified distance

Note 1 to entry: The spectral irradiance E_{254} is measured in $\mu\text{W}/\text{cm}^2$

3.154

UV-C barrier

additional guard or shield that prevents UV-C light from exiting the unit or damaging internal non-metallic materials

3.155

transcritical refrigerating system

refrigerating system where evaporation occurs below the critical point and heat rejection may occur above the critical point of the refrigerant (e.g. R744)

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.2 Addition:

*The testing of Clause 21 may be carried out on separate samples. The testing of Clauses 11, 19 and 21 shall require that pressure measurements be made at various points in the **refrigerating system**.*

At least one additional specially prepared sample is required for the tests of Annex FF (Leak simulation tests), if that test option is selected.

The temperatures on the refrigerant piping should be measured during the test of Clause 11.

If the tests of Annex LL are carried out, at least two additional sensors are needed.

If the test of Annex NN has to be carried out, an additional appliance may be used.

NOTE Due to the potentially hazardous nature of the tests of Clause 21 and Annexes EE and FF, special precautions need to be taken when carrying out the tests.

5.6 Addition:

Any controls which regulate the temperature or humidity of the conditioned space are rendered inoperative during the test.

5.7 Replacement:

The tests and test conditions of Clauses 10 and 11 are carried out under the most severe operating conditions within the operating temperature range specified by the manufacturer. Annex AA provides examples of such temperature conditions.

5.10 Addition:

For split-package units, the refrigerant lines shall be installed in accordance with the installation instructions. The length of pipe shall be between 5 m and 7,5 m. The thermal insulation of the refrigerant lines shall be applied in accordance with the installation instructions.

5.101 Motor-compressors are also subjected to the relevant test of Clause 19 of IEC 60335-2-34:2012, unless the motor-compressor complies with that standard, in which case it is not necessary to repeat these tests.

5.102 Motor compressors that are tested and comply with IEC 60335-2-34 need not be additionally tested for Clause 21.

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 Modification:

Appliance shall be of **class I**, **class II** or **class III**.

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 (excluding laundry rooms) may be IPX0;
- appliances intended to be used in laundry rooms shall be at least IPX1.

6.101 Appliances shall be classified according to the accessibility either as **appliance accessible to the general public** or as **appliance not accessible to the general public**.

Compliance is checked by inspection and the relevant tests.

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;

Addition:

- **rated frequency**;
- ~~mass of the~~ **refrigerant charge** for each **refrigerating system**;
- refrigerant number in accordance with ~~ANSI/ASHRAE 34~~ [ISO 817];
- permissible excessive operating pressure for the storage tank (for **sanitary hot water heat pumps**);
- ~~maximum operating~~ **allowable pressure** in the water and/or brine circuit for the **heat exchanger** for **hydronic fan coil** ~~air handling units~~;
- ~~maximum operating~~ **allowable pressure** for the refrigerant circuit; if the permissible excessive operating pressure for the suction and discharge side differ, a separate indication is required;
- ~~IP number according to degree of protection against ingress of water, other than IPX0.~~
- for **pre-charged pipe sets**
 - refrigerant number in accordance with ISO 817;
 - the **refrigerant charge** in the line set;
 - **maximum allowable pressure**;
- ratings in watts and voltage of a **UV-C germicidal lamp system** if employed.

Appliances shall be marked with all of the designations and the rated inputs of the **supplementary heaters** for which they are intended to be used, and shall have provision for identifying the actual heater that is field installed.

Unless it is evident from the design, the enclosure of the appliance shall be marked, by words or by symbols, with the direction of the fluid flow.

~~The flame symbol and the instruction manual symbol of 7.6 shall be visible when a flammable refrigerant is employed and the following conditions exist:~~

- ~~— accessing parts expected to be subjected to maintenance or repair;~~
- ~~— observing the appliance under sale or installed conditions;~~
- ~~— observing the appliance packaging, if the appliance is charged with refrigerant.~~

For appliances using **flammable refrigerants**, the flame symbol ISO 7010-W021 (2011-05) and the operator's manual symbol described in 7.6 shall be visible when viewing the appliance after it has been installed. The marking may be behind a detachable part that has to be detached before maintenance or repair work. The perpendicular height of the triangle used for the symbol shall be at least 30 mm. For appliances that are not single packaged units, the required markings shall be provided on all indoor and outdoor units which complete the **refrigerating system** when installed. When an **A2L refrigerant** is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

If a **flammable refrigerant** is used, the symbols for “read operator's manual”, “operator's manual; operating instructions” and “service indicator; read technical manual” (symbols ISO 7000-0790 (2004-01), ~~ISO 7000-1641 (2004-01)~~ and ISO 7000-1659 (2004-01)) **including colour and format** shall be placed on the appliance in a location visible to the persons required to know the information. The perpendicular height **of the symbol** shall be at least 10 mm.

If a **flammable refrigerant** is used, an additional warning symbol (flame symbol: ISO 7010-W021 (2011-05)) shall be placed on the nameplate of the unit near the declaration of the refrigerant type and charge information. The perpendicular height of the symbol shall be at least 10 mm, and the symbol need not be in colour. ~~When installed, the marking should be visible after removing a detachable part.~~ When an **A2L refrigerant** is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

The following warning shall also be applied to the **non-fixed** appliance when a **flammable refrigerant** is employed. The warning shall be placed on the outside of the appliance such that it is visible when in service for **non-fixed appliance**.

WARNING

Appliance shall be installed, operated and stored in a room with a floor area larger than 'X' m² ~~(only applies to appliances that are not fixed appliances).~~

~~For appliances, which are not fixed appliances, the minimum room size X shall be specified on the appliance. The X in the marking shall be determined in m² by the procedure described in Clause GG.2 for unventilated areas and the X in the marking shall be 4 if the refrigerant charge of the appliance is less than m₁ (see GG.1.1).~~

~~The maximum allowable pressure for the low-pressure side and the high-pressure side shall be marked on the product.~~

The minimum room size X shall be specified on the appliance. The X in the marking shall be determined in m² according to Annex GG; the marking shall not be required if the **refrigerant charge** (m_c) of the appliance is up to m₁ according to GG.1.2.

NOTE ~~102~~ 101 For the **refrigerating system**, if the **maximum allowable pressure** of the **low-pressure side** and the **high-pressure side** is the same, a single indication is permitted.

If not already visible when accessing a **service port** and if a **service port** is provided, the **service port** shall be marked to identify the type of refrigerant. If the refrigerant is flammable, symbol ISO 7010-W021 (2011-05) shall be included, without specifying the colour. When an **A2L refrigerant** is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

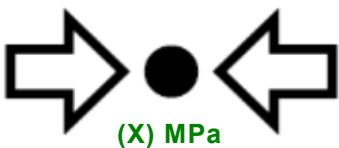
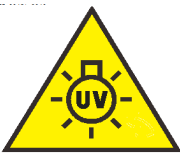
Appliances employing **refrigerating systems** with **maximum allowable pressures** greater than 7 MPa shall be marked with symbol ISO 7000-1701 (2004-01) followed by the text "(X) MPa" and the Operator's manual; operating instructions symbol ISO 7000-1641 (2004-01).

Where: "X" is not less than the **maximum allowable pressure** as determined in Annex EE.

7.6 Addition:

~~When a flammable refrigerant is employed, a warning symbol W021 of ISO 7010, including colour and format, shall be permanently placed on the appliance. The perpendicular height of the triangle containing the "Caution, risk of fire" symbol shall be at least 30 mm.~~

~~When a flammable refrigerant is employed, a symbol requiring reference to the manual [ISO 7000-0790 (2004-01)], including colour and format, shall be permanently placed on the appliance.~~

	[symbol ISO 7010-W021 (2011-05)]	warning; risk of fire flammable materials
	[symbol ISO 7000-1659 (2004-01)]	service indicator; read technical manual
	A2L symbol	warning; low burning velocity material
	[symbol ISO 7000-1701 (2004-01)]	pressure
	[symbol IEC 60417-6040 (2010-08)]	ultraviolet radiation, instructional safeguard
	[symbol ISO 7000-1641 (2004-01)]	operator's manual; operating instructions

7.12 Addition:

For **appliances not accessible to the general public**, the classification according to 6.101 shall be included.

For **appliances** using **flammable refrigerants**, an installation, service and operation manual, either separate or combined manuals, shall be provided and include the information given in Annex DD.

7.12.1 Addition:

In particular, the following information shall be supplied:

- that the appliance shall be installed in accordance with national wiring regulations;
- the dimensions of the space necessary for correct installation of the appliance including the minimum permissible distances to adjacent structures;
- for appliances with **supplementary heaters**, the minimum **clearance** from the appliance to combustible surfaces;
- a wiring diagram with a clear indication of the connections and wiring to external control devices and **supply cord**;
- the range of external static pressures at which the appliance was tested (add-on **heat pumps** and ducted appliances with **supplementary heaters** only);

- the method of connection of the appliance to the electrical supply and interconnection of separate components;
- indication of which parts of the appliance are suitable for outdoor use, if applicable;
- details of type and rating of fuses, or rating of circuit breakers;
- details of supplementary heating elements that may be used in conjunction with the appliance, including fitting instructions either with the appliance or with the **supplementary heater**;
- maximum and minimum water or brine operating temperatures;
- maximum and minimum water or brine operating pressures;
- instructions on charging of refrigerants when addition of charge is required by the manufacturer for completing the **refrigerating system**.

Open storage tanks of **heat pumps** for water heating shall be accompanied by an instruction sheet which shall state that the vent shall not be obstructed.

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 intended 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 or remote control assembly. 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**.

Compliance is checked by inspection.

7.102 If the product is intended for permanent connection to fixed wiring with aluminium wires, the marking shall so state.

Compliance is checked by inspection.

7.103 For appliances made up of more than one factory made assembly specified by the manufacturer to be used together, instructions shall be provided for completing the assembly to ensure compliance with the requirements.

7.104 For **partial units**, the instructions or markings shall include the following additional information.

- For **evaporating units** and **condensing units**, the instructions or markings shall include a wording to assure that the maximum operating pressure is considered when connecting to any **condenser unit** or **evaporator unit**.
- For **evaporating units**, **condensing units** and **condenser units**, the instructions or markings shall include refrigerant charging instructions.
- A warning to assure that **partial units** shall only be connected to an appliance suitable for the same refrigerant.
- This unit <model xxx> is a **partial unit air conditioner**, complying with **partial unit** requirements of this International Standard, and must only be connected to other units that have been confirmed as complying to corresponding **partial unit** requirements of this International Standard.
- The electrical interfaces shall be specified with purpose, voltage, current, and safety class of construction.

- The **SELV** connection points, if provided, are to be clearly indicated in the instructions. The connection point should be marked with the “read the instructions” symbol per ISO 7000-0790 (2004-01) and the Class III symbol according to IEC 60417-5180 (2003-02).

7.105 For appliances using **flammable refrigerants** that have safety features depending upon the proper function of a **refrigerant detecting system**, the instructions or unit markings shall contain the substance of the following:

“This unit is equipped with a refrigerant leak detector for safety. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.”

If any supplemental unit is employed to detect leaked refrigerant, such unit shall also apply this marking or be accompanied by such instructions.

Compliance is checked by inspection.

7.106 For appliances using **flammable refrigerants** that have safety features depending upon the proper function of ventilation, the instructions or unit markings shall contain the substance of the following:

“This unit is equipped with electrically powered safety measures. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.”

If any supplemental unit is employed to dilute leaked refrigerant, such unit shall also apply this marking or be accompanied by such instructions.

Compliance is checked by inspection.

7.107 For **flammable refrigerants**, when addition of charge is required by the manufacturer installation instructions for completing the **refrigerating system**, the manufacturer shall provide a label that allows the installer to note the resulting total **refrigerant charge** for each **refrigerating system**. See Figure 101 for an example of label for field charged units.

7.108 For appliances using **flammable refrigerants**, the flame symbol described in 7.6 shall be visible in each of the following conditions:

- on the packaging of the appliance if the appliance is charged with refrigerant excluding appliances with **A2L refrigerant charge** not exceeding m_1 ;
- when viewing the appliance on display for sale. This does not apply to appliances using **A2L refrigerants**.

For appliances that are not **factory sealed single packaged units**, the required markings shall be provided on all indoor and outdoor units which complete the **refrigerating system**.

7.109 Appliances employing **UV-C germicidal lamp systems** shall be marked with **ultraviolet radiation** hazard symbol IEC 60417-6040 (2010-08) and the Read operator's manual symbol ISO 7000-0790 (2004-01) in the following locations:

- doors and access panels that provide direct access to an area within the appliance where the measured **UV-C spectral irradiance** is greater than $1,7 \mu\text{W}/\text{cm}^2$;
- **user maintenance** access panels,
- **UV-C barriers**.

Compliance is checked by inspection.

7.110 For appliances that employ **UV-C germicidal lamp systems**, the instructions shall include the substance of the following:

- this appliance contains a **UV-C lamp**;
- read the maintenance instructions before opening the appliance;
- details for cleaning and other **user maintenance** of the appliance. They shall state that prior to cleaning or other maintenance, the appliance must be disconnected from the supply mains;
- the method, frequency of cleaning, and necessary precautions to be taken;
- precautions to be taken when replacing UV-C emitters and starters, if applicable;
- unintended use of the appliance or damage to the housing may result in the escape of dangerous UV-C radiation. UV-C radiation may, even in small doses, cause harm to the eyes and skin;
- appliances that are obviously damaged must not be operated;
- the appliance must be disconnected from the supply before replacing the **UV-C lamp**;
- doors and access panels bearing the **ultraviolet radiation** hazard symbol which may have **UV-C spectral irradiance** greater than $1,7 \mu\text{W}/\text{cm}^2$ are provided with an interlock switch to interrupt the power to the **UV-C lamps** for your safety. Do not over-ride;
- before opening doors and access panels bearing the **ultraviolet radiation** hazard symbol for the conducting **user maintenance**, it is recommended to disconnect the power;
- **UV-C barriers** bearing the **ultraviolet radiation** hazard symbol should not be removed;
- for appliances with **UV-C lamps**, information on the replacement of **UV-C lamps** shall be given, including the model and/or part number;
- if field installed, the factory specified **UV-C germicidal lamp systems** approved for use with the subject product shall be specified in the instructions by the specific model number;
- do not operate **UV-C lamps** outside of the appliance.

Compliance is checked by inspection

7.111 For appliances employing **refrigerating systems** with **maximum allowable pressures** greater than 7 MPa, the instructions shall include the substance of the following:

- **WARNING:** System contains refrigerant under very high pressure. The system must be serviced by qualified persons only.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

8.1.5 Addition:

As regards the products which have a dedicated installation panel or cover and which cannot be installed without them, compliance is checked according to 5.10 (after the installation as instructed in the installation manual).

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 or if there is 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 Appliances are 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;
- flow rates for liquid source or sink equipment shall be the minimum specified in the ~~manufacturer's~~ instructions except for **hydronic fan coils units** where the flow rates and liquid temperatures shall be the maximum specified in the ~~manufacturer's~~ instructions;
- the outlet duct connected to the appliance shall be subjected to the maximum static pressure given in the ~~manufacturer's~~ instructions;
- for appliances provided with means of adjusting the flow, the flow for the tests shall be the minimum obtainable;
- adjustable limit controls are set at the maximum cut-out setting and the minimum differential permitted by the control adjusting means.

For appliances provided with **supplementary heaters**, an additional test casing as described in 11.9 is used.

11.2.1 For heating tests of ducted appliances with **supplementary heaters**, an inlet duct is connected to the inlet air opening of the appliance (assuming that the appliance is intended to be so applied). The duct shall be the same size as the flanges, if flanges are provided. If flanges are not provided, the duct is the same size as the inlet opening.

An appliance that includes or has provision for **supplementary heater** is fitted with a metal outlet duct in accordance with Figure ~~101~~ 102a) or Figure ~~101~~ 102b), depending on the direction of the airflow.

The inlet duct is provided with an adjustable restricting means by which the airflow can be reduced.

The restriction should be uniform across the duct's cross sectional area, so that the full heating coil surface will be exposed to the airflow except when the restriction is closed.

11.2.2 A ducted appliance which does not include **supplementary heaters** is fitted with an outlet duct sized to fit the casing flanges, or opening without flanges, or locations marked for flanges, and arranged to discharge away from the return air inlet.

The outlet duct is provided with a restricting means to obtain the maximum static pressure given in the ~~manufacturer's~~ instructions.

11.2.3 For the evaluation and testing of **partial units**, the following test setup and conditions are to be applied.

- **evaporator units** and **condenser units** are tested as individual units at the maximum ambient temperature stated in the instructions. If not stated in the instructions, these units

shall be tested at an ambient temperature that is equal to the saturated temperature of the refrigerant at the marked **maximum allowable pressure** ($\pm 0,1$ MPa) minus 10 K (± 1 K).

- **condensing units** are tested in the cooling mode only, at the maximum specified ambient temperature with 9 K (± 1 K) sub-cooling and the maximum specified evaporating pressure with 11 K (± 1 K) superheat. For **condensing units** provided with expansion device(s), the superheat/sub-cooling is to be as under the normal control of the expansion device(s).
- **evaporating units**, intended for cooling only, are tested in the cooling mode only with a condensing pressure that is equal to the marked **maximum allowable pressure** ($\pm 0,1$ MPa) with 9 K (± 1 K) sub-cooling.
- **evaporating units** that are intended for reverse cycle operation are tested in the heating mode only, at the maximum specified evaporating pressure.

NOTE 101 Testing for **condensing units** and **evaporating units** requires connection to calorimeter stand or similar device capable of controlling the refrigerant entering and leaving conditions as specified in the test above. **Condenser units** and **evaporator units** do not require a calorimeter stand or similar device.

11.3 *Temperatures other than those of windings 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.

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 **clearances** and **creepage distances** below the values specified in Clause 29.*

Temperatures of windings are determined by the resistance method unless the windings are non-uniform or severe complications are involved in order to make the necessary connections, in which case the temperatures are determined by means of thermocouples.

The temperatures in the duct are to be measured by means of a thermocouple grid consisting of nine thermocouples of identical length, wired in parallel to form a grid with a thermocouple located centrally in each of nine equal duct areas in a plane perpendicular to the axis of the airflow.

11.4 *Appliances are operated under **normal operation** at a supply voltage between 0,94 times the lowest **rated voltage** and 1,06 times the highest **rated voltage**, the voltage chosen being that which gives the most unfavourable result. Heating elements shall be energized at a voltage which gives an electrical input of 1,15 times the maximum **rated power input**.*

11.5 *Where an appliance can be operated in the cooling mode as well as the heating mode, a test is conducted in each mode.*

*For appliances with **supplementary heaters** or provision for **supplementary heaters**, an additional test is conducted with all the heating elements operative by short circuiting **thermostats** or by reducing, if necessary, the air temperature to a value which causes all the elements to switch on.*

11.6 *Appliances with defrost facilities are additionally submitted for a defrost test in the most unfavourable conditions.*

11.7 *All appliances are operated continuously until steady conditions are achieved except for defrost tests.*

11.8 *During the test, the temperatures are monitored continuously and shall not exceed the values shown in Table 3, **protective devices** shall not operate and sealing compound shall not flow out.*

The temperature of the air in the outlet duct shall not exceed 90 °C.

The value of the temperature of a winding shall be 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 at ambient temperature.

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

Table 3 – Temperature limits

Parts	Temperature °C
<i>Windings of sealed motor-compressors ^a</i>	
– with synthetic insulation	140
– with other insulation	130
<i>External enclosure of appliances with or without supplementary heaters</i>	85
<i>Windings ^b if the winding insulation is (other than motor-compressors):</i>	
– of class 105 (A) material ^c	100 (90)
– of class 120 (E) material ^c	115 (105)
– of class 130 (B) material ^c	120 (110)
– of class 155 (F) material ^c	140
– of class 180 (H) material ^c	165
– of class 200 material ^c	185
– of class 220 material ^c	205
– of class 250 material ^c	235
<i>Terminals, including earthing terminals, for external conductors of stationary appliances, unless they are provided with a supply cord</i>	85
<i>Ambient of switches, and thermostats and temperature limiters ^d</i>	
– without T marking	55
– with T marking	T
<i>Rubber or polyvinyl chloride insulation of internal and external wiring, including supply cord:</i>	
– without temperature rating ^e	75
– with temperature rating (T)	T
<i>Cord sheaths used as supplementary insulation</i>	60
<i>Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:</i>	
– when used as supplementary insulation or reinforced insulation	65
– in other cases	75
<i>Lampholders with T-marking ^j</i>	
– B15 and B22 marked T1	165
– B15 and B22 marked T2	210
– other lampholders	T
<i>Lampholders without T-marking ^j</i>	
– E14 and B15	135
– B22, E26 NS E27	165
– other lampholders and starter holders for fluorescent lamps	80
<i>Material used as insulation other than that specified for wires and windings:</i>	
– 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	–

Parts	Temperature °C
Wood, in general ^g	90
Wooden walls of the test casing	90
Outer surfaces 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	75
• other capacitors	45
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 temperature rating (T)	T
– in other cases	75
<p>^a Not required for motor-compressors that comply with IEC 60335-2-34.</p> <p>^b The temperatures within parentheses apply when thermocouples are used. The figures without parentheses apply when the resistance method is used.</p> <p>^c The classification is in accordance with IEC 60085.</p> <p>Examples of Class A (class 105) material are:</p> <ul style="list-style-type: none"> – impregnated cotton, silk, artificial silk and paper; – enamels based on oleo or polyamide resins. <p>Examples of Class B (class 130) materials are:</p> <ul style="list-style-type: none"> – glass fibre, melamine-formaldehyde and phenol-formaldehyde resins. <p>Example of Class E (class 120) material are:</p> <ul style="list-style-type: none"> – 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. <p>For totally enclosed motors, the temperature limits for class A (class 105), class E (class 120) and class B (class 130) materials may be increased by 5 °C (5 K).</p> <p>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.</p> <p>^d T means the maximum operating temperature.</p> <p>The ambient 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.</p> <p>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. However, if a thermostat or other temperature limiter is mounted on a heat-conducting part, the declared temperature limit of the mounting surface (Ts) is also applicable. Therefore, the temperature of the mounting surface has to be measured.</p> <p>^e This limit applies to cables, cords and wires complying with the relevant IEC standards; for others, it may be different.</p> <p>^f There is no specific limit for thermoplastic material, which must shall withstand the tests of 30.1, for which purpose the temperature shall be measured.</p> <p>^g The limit specified concerns the deterioration of wood and it does not take into account deterioration of surface finishes.</p> <p>^h There is no limit for the temperature rise of capacitors which are short-circuited in 19.11.2 c).</p> <p>ⁱ Temperature marking for capacitors mounted on printed circuit boards may be given in the technical sheet.</p> <p>^j Locations for measuring the temperatures are specified in Table 12.1 of IEC 60598-1:2008.</p> <p>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.</p>	

NOTE 101 The temperature limit for metal applies to parts having a metal coating at least 0,1 mm thick and to metal parts having a plastic coating less than 0,3 mm thick.

NOTE 102 The temperature of the terminal's switches is measured if the switch is tested in accordance with Annex H.

11.9 Test casing

*The test casing consists of plywood walls having a thickness of about 20 mm, with dull black painted inside surfaces and all joints sealed. The distances between the casing and the surfaces of the appliance and the outlet duct, if any, are equal to the minimum **clearances** specified by the manufacturer.*

*For appliances not specified for installation with minimum **clearances**, as an alternative to the plywood test casing in direct contact with the appliance, glass fibre insulating material having a thickness of at least 25 mm and a density of at least 16 kg/m³ may be wrapped closely around the appliance and the outlet duct, provided this is agreed with the manufacturer.*

In that case, thermocouples are directly placed in contact with the enclosure.

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 **stationary class I appliances**, the leakage current shall not exceed 2 mA per kilowatt 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 as a result of rain, overflow from the drain pan, or defrosting.

Compliance is checked by the tests of 15.2, followed immediately by the overflow test of 15.3; and this is followed by the defrost test 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 **clearances** and **creepage distances** 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.

If ducts leading to the outside of a building are used, the test of 15.2 is carried out on the terminations of such ducts in an arrangement simulating the actual installation, according to the ~~manufacturer's~~ instructions.

For appliances intended to be mounted through a wall or a window, or for a split package unit, the test of 15.2 is carried out on that part or unit which, according to the ~~manufacturer's~~ instructions, is intended to be mounted outside the building.

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

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

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

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

15.3 The appliance is installed in its position of normal use. The drain pan discharge pipe is blocked, and the pan carefully filled to the brim without splashing. The drain pan is then subjected to a continuous overflow, the rate of which is adjusted to approximately 17 cm³/s per 1 m³/s airflow, and the fan(s) switched on. The test is continued for a period of 30 min, or until water drains from the appliance.

15.101 Spillage test

Indoor floor or wall-mounted **appliances accessible to the general public** are tested as follows.

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 ~~0,25 g of ordinary table salt~~ **approximately 1 % NaCl** is poured onto the unit in a manner which is most likely to cause entrance of water into or on electrical controls or **uninsulated live parts**.

After spillage is completed, the appliances shall withstand the tests of Clause 16.

The spillage test is not applicable to units if the minimum linear dimension of a horizontal or near horizontal top surface of the cabinet is 75 mm or less.

A unit whose top, when installed, has a height of greater than 2 m need not be tested.

NOTE The intent is that a 75 mm diameter glass cannot be placed on the surface of the appliance and spill.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.2 Modification:

*For **stationary class I appliances**, the leakage current shall not exceed 2 mA per kilowatt 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 applicable except as follows.

19.1 Modification:

Add after the second paragraph:

Failure of the transfer medium flow, or of any control devices, shall not result in a hazard.

Replace the 1st and 2nd paragraphs of the test specification by the following:

Appliances are subjected to the tests specified in 19.2 to 19.10, 19.101, 19.102 and 19.103, as applicable.

19.2 Replacement:

*All ducted appliances provided with **supplementary heaters** are subjected to the following test under the conditions specified in Clause 11:*

*After the airflow conditions specified are established, the indoor airflow is restricted to such an extent that the temperature of the air in the outlet, measured by means of the thermocouple grid (see 11.3), is 3 K below the temperature obtained after a temperature limiting control, a motor **protective device**, a pressure switch or similar device operates for the first time as a result of slowly restricting the free area of the inlet.*

This is achieved if the temperature rise is approximately 1 K per min.

*It is necessary to restrict the free area of the inlet until the first of the **protective devices** operates and then operation is resumed with sufficient restriction so that the temperature of the discharge air is 3 K below the temperature at the moment of cut-off.*

*Appliances are operated at **rated voltage** or at the upper limit of the **rated voltage range**.*

To facilitate this test, the **protective device** which has operated shall be short-circuited once the temperature at which it operates has been determined, if necessary.

*Non-ducted appliances provided with **supplementary heaters** are operated as specified in Clause 11. Thermal controls that operate during the test of Clause 11 are short circuited.*

When steady conditions are established, the airflow rate is reduced until it is just sufficient to prevent a thermal cut out from operating.

Under these conditions, the appliance is again operated until steady conditions are established or for 1 h, whichever is longer.

After this period, the airflow is further restricted to verify that the thermal cut out operates.

19.3 Replacement:

*If all electric heating elements are not energized under the conditions specified in 19.2 for the air entering the **evaporator**, an additional test is carried out at a lower temperature of the inlet air, this temperature being the highest that will permit all electric heating elements to be energized.*

*It is the intention that the operating point be just below the point of maximum restriction of the air entering the indoor coil assembly thus permitting continuous operation of both the motor-compressor and the electric heating elements. If the temperature of the air entering the **evaporator** required to permit all electric heating elements to be energized is less than the values specified, this lower temperature may be simulated by reducing the airflow through the **evaporator**, by blocking a part of the **evaporator**, or by similar means in order to obtain the operating conditions which would occur at this lower temperature of the air entering the **evaporator**.*

*Appliances are operated at **rated voltage** or at the upper limit of the **rated voltage range**.*

19.4 Addition:

*The appliance is operated under the conditions in Clause 11 and at **rated voltage**, with any form of operation or any defect that may be expected during normal use. Only one fault condition is reproduced at a time, the tests being made consecutively.*

Examples of fault conditions are

- *the timer, if any, stopping in any position;*
- *disconnection and reconnection of one or more phases of the supply;*
- *open-circuiting or short-circuiting of components, like relays, contactors, timers, **thermostats**, etc.*

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

19.7 Modification:

Replace the first paragraph ~~and Notes 1 and 2~~ by:

The motors, other than motor-compressors and stationary circulation pumps in compliance with IEC 60335-2-51, 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 their supplied voltage when the appliance is supplied at **rated voltage** or at the upper limit of the **rated voltage range**, in a circuit as shown in Figure ~~102~~ 103.

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

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

If the temperature of the motor windings does not exceed 90 °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.

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

At the end of the test, the leakage current, when measured as specified in 16.2 but with a test voltage of twice the **rated voltage** between all windings and the enclosure, shall not exceed 2 mA.

NOTE 101 Only for this test specified in 19.7 of 60335-2-40, the motor is locked and operated for 15 days (360 h) or until a protection device permanently opens the circuit. It is not the intention to repeat the 15-day locked rotor test up to two more time for motors having capacitors in the circuit of an auxiliary winding. Hence for all tests according to 19.7 of Part 1, the motor is operated under the conditions specified in 19.7 of 60335-1, including the time specifications.

Add after the last paragraph:

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 tests specified in 19.101, 19.102, 19.103 and 19.105 of IEC 60335-2-34:2012, if applicable, and shall comply with the requirements in 19.104 of IEC 60335-2-34:2012.

19.8 Replacement:

Three phase motors other than motor compressors 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.

19.9 This subclause of Part 1 is not applicable.

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, 19.11.3, 19.102 and 19.103.

~~Add after the second paragraph the following:~~

*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 ~~may~~ **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 ~~may~~ **can** possibly be influenced by the wiring and the metal housing of the final application. Therefore, ~~it is recommended that~~ 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.

19.11.4.8 Modification:

Add to the first sentence:

“at any temperature within the working range.”

19.13 Modification:

Footnote a) of Table 9 is not applicable.

19.14 Modification:

Add before the note:

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.

19.101 The appliance is operated under the conditions in Clause 11 at **rated voltage** or at the upper limit of the **rated voltage range**, at an ambient temperature of $23\text{ °C} \pm 5\text{ °C}$. When steady conditions are attained, the heat transfer medium flow of the **outdoor heat exchanger** is restricted or shut off, whichever is the most unfavourable without the appliance being non-operative.

*After this test, **protective devices** that may have operated are reset, and the test is repeated, with the heat transfer medium flow, fluid or air, of the **indoor heat exchanger**, restricted or shut off, whichever is the most unfavourable without the appliance being non-operative. In the*

case of appliances with defrosting systems, the heat transfer medium flow rate is additionally shut off at the beginning of the defrosting phase.

*Appliances incorporating a motor common to both the **indoor** and **outdoor heat exchangers** are subjected to the above test the motor being disconnected once steady conditions are attained.*

19.102 *The **indoor heat exchanger** of appliances using water as a heat transfer medium is subjected to the following test.*

*The appliance is operated under the conditions specified for Clause 10 at **rated voltage** or at the upper limit of the **rated voltage range** at the maximum water temperature specified by the manufacturer. The indoor water temperature shall be raised 15 K with a rate of 2 K/min and this temperature maintained for 30 min, after which the water temperature is lowered to its original value at the same velocity.*

19.103 *Air to air appliances are operated under the conditions specified in Clause 11.*

*The **dry-bulb temperature** is then reduced to a value 5 K below the minimum value specified by the manufacturer.*

*The test is repeated except that the **dry-bulb temperature** is increased to a value 10 K above the maximum temperature specified by the manufacturer.*

*The appliances are operated at **rated voltage** or at the upper limit of the **rated voltage range**.*

19.104 *All appliances provided with **supplementary heaters** and with free air discharge are subjected to the following test in each mode of operation.*

Appliances are operated under the conditions specified in Clause 11, with any controls which limit the temperature during the test of Clause 11 short-circuited, and with the appliance covered.

The covering is made with felt strips each having a width of 100 mm and lined with a single layer of textile material.

The felt has a specified mass of $4 \text{ kg/m}^2 \pm 0,4 \text{ kg/m}^2$ and a thickness of 25 mm.

The textile material consists of a prewashed double-hemmed cotton sheet having a mass between 140 g/m^2 and 175 g/m^2 in the dry condition.

Thermocouples are attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick.

The disks are spaced 50 mm apart and placed between the textile material and the felt on the vertical centre line of each strip.

The disks are supported in such a way as to prevent them from sinking into the felt.

The strips are applied with the textile material in contact with the appliance so that they cover the whole vertical dimension of the front, pass over the top and extend down the rear surface.

If the appliance is constructed to stand away from the wall or if it is for fixing to a wall so that the gap between the heater and the wall exceeds 30 mm and the horizontal components of

the distance between any two fixing points or spacers or between such points and the end of the appliance exceed 100 mm, the rear surface of the appliance shall be completely covered.

Otherwise, the rear surface is covered over a distance approximately equal to one-fifth of the vertical dimension of the heater.

The strips are applied to each half of the appliance in turn and then to the complete appliance.

During the test, the temperature shall not exceed 150 °C but an overshoot of 25 °C is permitted during the first hour.

*Thermal **protective devices** are allowed to operate.*

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.

21.1 Addition:

Safety requirements specified in ISO ~~14903~~ 5149-2 shall apply.

Safety requirements specified in Annex EE shall apply. The pressure test in Annex EE 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 ~~D4728-01~~ D4728-06. 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.*

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 enclosure.

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

22.14 Addition:

This requirement does not apply to the metallic fins of **heat exchangers**.

22.24 Replacement:

Bare heating elements shall be supported so that, in case of rupture or sagging, the heating conductor cannot come into contact with accessible metal parts nor give rise to a hazard. Bare heating elements shall not be used with wood or wood composite enclosures.

Compliance is checked by inspection and, if necessary, by cutting the element in the most unfavourable place.

NOTE 101 No force is applied to the conductor after it has been cut.

NOTE 102 This test is made after the tests of Clause 29.

22.46 Modification:

Add after the 1st paragraph:

If the **protective electronic circuit** software is a part of the **normal operation** control, inspection of software shall be limited to relevant source code of safety controls or related software controls. Alternative methods may be used if they demonstrate equivalent levels of safety.

22.101 Appliances 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 Appliances provided with supplementary heaters

22.102.1 Appliances provided with **supplementary heaters** for air shall be provided with at least two **thermal cut-outs**. The **thermal cut-out** intended to operate first ~~shall be a self-resetting thermal cut-out, the other thermal cut-out~~ shall be either a **self-resetting thermal cut-out** or a **non-self-resetting thermal cut-out**, ~~the other thermal cut-out shall be a non-self-resetting thermal cut-out.~~

Compliance is checked by inspection and during the tests of Clause 19.

NOTE If, during the tests of Clause 19, a **self-resetting control** operates, it would be necessary to short out this control to determine if the **non-self-resetting thermal cut-out** then operates.

22.102.2 Appliances provided with **supplementary heaters** for water shall incorporate a **non-self-resetting thermal cut-out**, providing **all-pole disconnection** that operates separately from **water thermostats**. However, for appliances intended to be connected to fixed wiring, the neutral conductor need not be disconnected.

Compliance is checked by inspection and during the tests Clause 19.

NOTE Anti-frost heaters are not considered to be **supplementary heaters** for water, if it is not possible to heat up the water to a temperature higher than 80 °C at the highest operating temperature within 6 h, with the temperature switch short circuited and with water flow stopped.

22.102.3 Thermal cut-outs of the capillary type shall be so designed that the contacts open in the event of leakage from the capillary tube.

Compliance is checked by inspection and test.

22.103 The sensing and switching elements of electromechanical non-self-resetting cut-outs shall be functionally independent of other control devices. If the switching element of a non-self-resetting cut-out is operating a relay or contactor, the relay or contactor may also be operated by other control devices. Protective electronic circuits are covered by Clause 19.

Compliance is checked by inspection.

22.104 Containers of **sanitary hot water heat pumps** shall withstand the water pressure occurring in normal use.

*Compliance is checked by subjecting the containers and **heat exchangers**, if any, to a water pressure which is raised to the value specified hereafter at a rate of 0,13 MPa per second and is maintained at that value for 5 min.*

The water pressure is

- *twice the permissible excessive operating pressure for closed containers;*
- *0,15 MPa for open containers.*

After the test, no water shall have leaked out and the containers shall not have ruptured.

NOTE If the container of **sanitary hot water heat pumps** incorporates a **heat exchanger**, the container and the **heat exchanger** are subjected to the pressure test in accordance with the relevant standard.

22.105 In the case of closed containers of **sanitary hot water heat pumps**, the formation of an air or vapour cushion of more than 2 % of the capacity, but not more than 10 % as a maximum, shall be provided.

Compliance is checked by inspection and, where necessary, by measurements.

22.106 Pressure-relief devices, whether incorporated in the container of **sanitary hot water heat pumps** or supplied separately, shall prevent the pressure in the container from exceeding the permissible excessive operating pressure by more than 0,1 MPa.

Compliance is checked by subjecting the container to a slowly increasing water pressure and by observing the pressure at which the relief device operates.

22.107 The outlet system of open containers of **sanitary hot water heat pumps** shall be free from obstructions that could limit the water flow to such an extent that the pressure in the container would exceed the permissible excessive operating pressure.

Vented containers of **sanitary hot water heat pumps** shall be so constructed that the container is always open to the atmosphere through an aperture of at least 5 mm in diameter or 20 mm² in area, with a width of at least 3 mm.

Compliance is checked by inspection and measurement.

NOTE The first requirement is considered to be met if the area of the water outlet from the heated part of the container of **sanitary hot water heat pumps** is equal or greater than the area of the water inlet to the heated part.

22.108 Storage tanks of **sanitary hot water heat pumps** shall be resistant to vacuum pressure impulses which may occur in normal use.

Compliance is checked by subjecting containers which are not vented in accordance with 22.104 to a vacuum of 33 kPa for 15 min.

After the test, the container shall show no deformation which might result in a hazard.

Anti-vacuum valves, if any, are not rendered inoperative.

NOTE This test can be carried out on separate containers.

22.109 Wiring connected to a **non-self-resetting thermal cut-out** designed to be replaced after its operation shall be so secured that replacement of the **thermal cut-out** itself or to a heating element assembly on which the **thermal cut-out** is mounted will not damage other connections or internal wiring.

Compliance is checked by inspection and, if necessary, by manual test.

22.110 **Non-self-resetting thermal cut-outs** designed to be replaced after their operation shall open the circuit in the intended manner without short-circuiting **live parts** of different potential and without causing **live parts** to come into contact with the enclosure.

Compliance is checked by the following test.

*The appliance is operated five times, each time with a new **non-self-resetting thermal cut-out**, any other thermally operated control devices being short-circuited.*

*Each time, the **thermal cut-out** shall operate appropriately.*

During the test, the enclosure of the appliance is connected to earth through a 3 A fuse; this fuse shall not blow.

After this test, the supplementary heating elements shall withstand an electric strength test as specified in 16.3.

22.112 The construction of the **refrigerating system** shall comply with the requirements of ISO 5149-2.

Appliances using **flammable refrigerants** shall comply with the requirements and tests of Annex GG.

22.113 When a **flammable refrigerant** is used, refrigerant tubing shall be protected or enclosed to avoid mechanical damage. The tubing shall be protected to the extent that it will not be handled or used for carrying during moving of the product. Tubing located within the confines of the cabinet is considered to be protected from mechanical damage.

Compliance is checked by inspection.

22.114 When a **flammable refrigerant** is used, low temperature solder alloys, such as lead/tin alloys, are not acceptable for pipe connections or any other refrigerant pressure containing purposes.

22.115 The ~~total refrigerant mass (M)~~ **charge (m_c)** of all **refrigerating systems** within the appliance employing ~~flammable~~ **A2 and A3 refrigerants** shall not exceed m_3 as defined in Annex GG.

The **refrigerant charge (m_c)** in each **refrigerating system** employing **A2L refrigerant** shall not exceed m_3 as defined in Annex GG.

The construction of the **refrigerating system** using **flammable refrigerants** shall comply with the requirements in Annex GG.

22.116 Appliances 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.

Separate components, such as **thermostats**, which are charged with less than 0,5 g of a flammable gas are not considered to cause a fire or explosion hazard in the event of leakage of the gas within the component itself.

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.

All electric components that could be a source of ignition and which could function under normal conditions or in the event of a leak, shall ~~be located in an enclosure which satisfies~~ comply with at least one of the following:

- shall ~~comply~~ 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 Annex FF. Electrical components not located in an area where a potentially flammable gas mixture will accumulate as demonstrated by the test of Annex FF are not considered an **potential ignition source**;
- for **A2L refrigerants**, located in an enclosure which is in compliance with 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 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.

The burning velocity (S_u) for the purpose of determining the maximum quenching diameter (d_q) in 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 $27\text{ °C} \pm 0,5\text{ °C}$ dew point at 101,3 kPa containing $21,0 \pm 0,1\%$ O_2 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.

For appliances with **A2L refrigerants**, electrostatic air cleaners and similar devices which may produce electrical arcing during **normal operation** that could ignite the refrigerant used, and which are installed in the unit airstream or connecting ducts, are not considered as a **potential ignition source** if the airflow is monitored and the energy source of the electric arcing is switched off when the airflow is below the minimum airflow according to Annex GG.

22.117 Hot surfaces

22.117.1 Temperatures on surfaces that may be exposed to leakage of **flammable refrigerants** shall not exceed the ~~auto-ignition~~ maximum allowable surface temperature ~~of the refrigerant reduced by 100 K; some typical values are~~ given in Annex BB.

For **flammable refrigerants** except **A2L refrigerants** not listed in Annex BB, the maximum allowable surface temperature is determined by **AIT** reduced by 100 K.

For **A2L refrigerants** not listed in Annex BB, the maximum allowable surface temperature is determined by the highest of **AIT** reduced by 100 K or, if tested per annex KK, the **hot surface ignition temperature** reduced by 100 K, but not higher than 700 °C .

*Compliance is checked by measuring the appropriate surface temperatures during the tests of Clauses 11 and 19, except those which during the tests of Clause 19 are terminated in a non-self-resetting way. Compliance for **A2L refrigerants** is checked by measuring the appropriate surface temperatures during the tests of Clause 11.*

Surfaces in compliance with this clause shall not be considered a **potential ignition source**.

22.117.2 Temperatures on surfaces that may be exposed to leakage of **A2L refrigerants** may exceed the maximum allowable surface temperature in case of loss of airflow when all the following applies:

- the temperatures are not exceeding the maximum allowable surface temperature with the minimum airflow;
- the airflow is supervised and the heat source of the hot surface is switched off, when the airflow is below the minimum airflow.

NOTE Proof of airflow can be provided by any reliable means, including detection of fan speed.

Compliance is checked by inspection and by measuring the appropriate surface temperatures during the tests of Clause 19.2, 19.3, 19.101 to 19.104.

22.117.3 Open source of ignition, including open flames, pilot flames, direct spark ignition or hot surface ignition or other similar sources of ignition in the combustion air-stream, if the combustion air is drawn from an unventilated space in which leaked refrigerant may enter through the combustion air intake, are allowed, when these appliances are provided with a flame arrest or equivalent to ensure that in the event of an ignition, the flame will not propagate.

Compliance is checked by inspection.

22.118 When a **flammable refrigerant** is used, all appliances shall be charged with refrigerant at the manufacturing location or charged on site as recommended by the manufacturer.

A part of an appliance that is charged on site, which requires brazing or welding in the installation, shall not be shipped with a **flammable refrigerant charge**. Joints made in the installation between parts of the **refrigerating system**, with at least one part charged, shall be made in accordance with the following.

- A brazed, welded, or mechanical connection shall be made before opening the valves to permit refrigerant to flow between the **refrigerating system** parts. A vacuum valve shall be provided to evacuate the interconnecting pipe and/or any uncharged **refrigerating system** part.
- Mechanical connectors used indoors shall comply with ISO 14903. When mechanical connectors are reused indoors, sealing parts shall be renewed. When flared joints are reused indoors, the flare part shall be re-fabricated.
- Refrigerant tubing shall be protected or enclosed to avoid damage.

Flexible refrigerant connectors (such as connecting lines between the indoor and outdoor unit) that may be displaced during **normal operations** shall be protected against mechanical damage.

Compliance is checked according to the ~~manufacturer's~~ installation instructions and a trial installation if necessary.

22.119 **Condensing units** and **evaporating units** shall be equipped with a **pressure-limiting device** or equivalent to assure that the equipment does not exceed the **maximum allowable pressure**.

NOTE Applies to **partial unit** types, **condensing units** and **evaporating units** only.

For **partial units**, the interconnection circuits for signal communication between each unit shall be of the same type.

SELV level connection is recommended.

22.120 **Partial units** shall be provided with a means of connection to the supply mains and shall not be powered by an electrical circuit from another appliance.

22.121 For the installation condition of appliances using an **A2L refrigerant** and where a **refrigerant detection system** is applied to fulfil the requirements of Annex GG, the refrigerant sensor of the system shall be located where leaking refrigerant is likely to stagnate. The sensor shall be located:

- within the unit for appliances connected via an air duct system to one or more rooms,
- within the unit where release height h_0 as determined in Clause GG.2 is not more than 1,5 m,
- where the release height h_0 as determined in Clause GG.2 is more than 1,5 m, the sensor may be located within
 - the unit, or
 - 100 mm or less directly below the unit, or
 - remote located within 300 mm above the floor. If a remote located sensor is specified by the manufacturer, the instructions shall state that the sensor shall be located within
 - 1) 10 m horizontal distance in line sight of the unit and on a wall within the room in which the unit is installed, or
 - 2) 7 m, if not in line sight of the unit, and on a wall within the room in which the unit is installed. The distance from the unit to the sensor shall be measured as the shortest horizontal unobstructed path between the unit and the nearest sensor.

For installations with field applied mechanical joints which are exposed in the occupied space, the instructions shall state that a sensor shall be located

- remote located within 2 m horizontal distance in line of sight of the unit and on a wall within the room in which the unit is installed; and
 - 100 mm above the floor where h_0 is not more than 300 mm from the floor; or
 - 300 mm above the floor where h_0 is greater than 300 mm from the floor.

The following mechanical joints shall not require that sensor:

- mechanical joints in compliance with ISO 14903;
- joints in enclosures which vent to the unit or to the outside.

NOTE 1 A single sensor can be used if it satisfies all of the requirements for the unit and the field applied joints.

NOTE 2 The appliance can need several refrigerant sensors in different locations to comply with this International Standard.

Compliance is checked by inspection and by testing in accordance with Annex MM. Remote located sensor location is not tested. Sensors located 100 mm or less directly below the unit are not considered remote sensors.

22.122 Refrigerant detection systems that are required by this standard for **A2L refrigerants** shall comply with Annex LL.

22.123 For appliances connected via an air duct system to one or more rooms using an **A2L refrigerant**

- which include a separate section with refrigerant containing components except pipes (e.g. compressors, **condensers**), and
- which are isolated from the airflow and located in a room smaller than $A_{\min}$ per Clause GG.2,

then Clause GG.4 (ventilated enclosure) can be applied, where the required ventilation can be provided by the ventilation system. That section shall have an opening to the outdoor or indoor air-stream to be able to ventilate the refrigerant to an area in compliance with Annex GG.

22.124 If a **refrigerant detection system** is used, care has to be taken that in the event of a leak, accumulating refrigerant will be detected properly in every operating mode (e.g. indoor fan off).

Compliance for sensors is checked by inspection and by testing in accordance with Annex MM. Remote located sensor location is not tested. Sensors located 100 mm or less directly below the unit are not considered remote sensors.

22.125 Refrigerating systems that fulfil all of the following conditions shall be considered **enhanced tightness refrigerating systems**:

- a) the compressor, pressure relief device or pressure vessel type refrigerant containing components of the **refrigerating system** shall be located in locations other than the occupied space,

NOTE Pressure vessel means any refrigerant-containing part of a **refrigerating system** other than

- compressors,
- pumps,
- component parts of sealed absorption systems,
- **evaporators**, each separate section of which does not exceed 15 l of refrigerant containing volume,
- coils,
- piping and its valves, joints and fittings,
- control devices, and
- pressure-containing components (including headers),

having an internal diameter or a largest cross-sectional dimension not greater than 152 mm.

- b) **refrigerant distribution assemblies** shall meet all applicable requirements of this standard,
- c) **refrigerating systems** shall use only permanent joints indoors except for site-made joints directly connecting the indoor unit to the refrigerant piping, or factory made mechanical joints in compliance with ISO 14903,
- d) refrigerant containing parts in indoor units shall be protected from damage in the event of catastrophic failure of moving parts, e.g. fans, belts,
- e) systems where the equipment pipes in the occupied space in question are installed in such a way that it is protected against accidental damage,
- f) the **refrigerating system** of each indoor unit shall be tightness tested at the factory with detection equipment with a capability of 3 grams per year of refrigerant or better under a pressure of at least 0,25 times the **maximum allowable pressure**. No leak shall be detected,

Compliance for bullet a) to bullet f) is checked by inspection.

- g) vibrations exceeding 0,30 G RMS, when measured with a low pass filter at 200 Hz, are not allowed in the refrigerant containing parts in the occupied space under **normal operation**.

Compliance is checked by testing:

The equipment shall be mounted per installation instructions. The outdoor unit shall be directly connected to the indoor unit by the shortest line set per the installation instructions. Testing shall be conducted in fan only mode, the heating mode and cooling mode if applicable.

Vibration level shall be measured over the full range of the compressor and indoor fan speeds as allowed by the controls in consideration of the operation modes. Care shall be taken that the measurement sensors do not influence the line vibration level, and that the rate of change of speed is sufficiently slow that the maximum vibration is captured.

- h) **indoor heat exchangers** shall be protected from damage in the event of freezing

Compliance is checked as follows:

- *Coils protected by controls. Compliance is checked by inspection, if in doubt, the test for non-freezing coils shall be executed.*
 - *Non-freezing coils. Compliance is checked by conducting the minimum cooling performance test as described in ISO 5151, ISO 13253, ISO 15042, or ISO 13256.*
 - *Freezing coils. Compliance is checked on 3 samples by testing as follows. Cycling testing of the **heat exchanger** under frosting conditions confirms that the **heat exchanger** has adequate strength to withstand freezing without failure. The appliance shall cycle as intended by the controls for 10 days. At the end of the test, the **heat exchanger** shall withstand the strength requirements of Annex EE.*
- i) the maximum speed of the fan, in **normal operation**, shall be less than 90 % of the maximum allowable fan speed as specified by the manufacturer of the fan wheel. If the manufacturer does not specify a maximum allowable fan speed then the fan wheel shall be tested as follows:
- The maximum allowable fan speed shall be established by running continuously at 120 % of maximum speed for 10 days. There shall be no structural failure of the fan.
- If non-metallic fan wheels have a minimum thermal index rating of 65 °C per UL 746B, preconditioning is not required.
- If no thermal index rating for the material is available, specimens shall be aged at 90 °C for 168 h. The samples shall not have more than a 50-percent reduction of the unconditioned property values for items a) to d) below when tested in accordance with CAN/CSA-C22.2 No. 0.17 and UL 746A:
- a) tensile strength,
 - b) flexural strength,
 - c) Izod impact,
 - d) tensile impact.

Compliance is checked by inspection.

22.126 For the purpose of this standard, **germicidal lamps** are limited to low pressure mercury lamps with a quartz envelope having a continuous spectral irradiance at 254 nm.

NOTE The quartz envelope blocks the 185 nm resonant wavelength for mercury that can generate ozone.

Compliance is checked by inspection.

22.127 The appliance enclosure, **UV-C lamps** and **UV-C barriers** shall be located in such a manner that the **UV-C spectral irradiance** is not emitted outside the unit into an occupied space at a level exceeding the irradiance limit specified in 32.101.1.

Compliance is checked by inspection and test per Subclause 32.101.

*The appliance indoor airflow inlet and outlet shall be considered as possible radiation paths. The unit filters are not considered **UV-C barriers**.*

22.128 For appliances that employ **UV-C germicidal lamp systems** and which have doors and/or panels that provide direct access to an area within the appliance where the measured **UV-C spectral irradiance** is greater than 1,7 µW/cm², the doors and/or panels shall be equipped with an interlock device that terminates the power to the lamps when opened.

Compliance is checked by inspection, manual test, and test per Subclause 32.101.

*If a switch is used to de-energize the **UV-C lamps** so as to meet the requirement, it shall not be possible to operate the switch with test probe B of IEC 61032.*