IEC 60335-2-40

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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

IEC 60335-2-40:2018-01 RLV(en)

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CONTENTS

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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.

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

INTRODUCTION

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

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

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~~ and 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 $\mu W/cm^2$

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' m^2 ~~(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 m^2 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 m_1 (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 m^2 according to Annex GG; the marking shall not be required if the **refrigerant charge** (m_c) of the appliance is up to m_1 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.

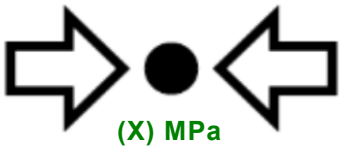
Appliances employing **refrigerating systems** with **maximum allowable pressures** greater than 7 MPa shall be marked with symbol ISO 7000-1701 (2004-01) followed by the text "(X) MPa" and the Operator's manual; operating instructions symbol ISO 7000-1641 (2004-01).

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 μW/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 μW/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 coil~~s~~ 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** (± 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** (± 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
Windings of sealed motor-compressors [a]	
– *with synthetic insulation*	*140*
– *with other insulation*	*130*
External enclosure of appliances with or without ***supplementary heaters***	*85*
Windings [b] *if the winding insulation is (other than motor-compressors):*	
– *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*
Terminals, including earthing terminals, for external conductors of ***stationary appliances****, unless they are provided with a* ***supply cord***	*85*
Ambient of switches, and ***thermostats*** *and* ***temperature limiters*** [d]	
– *without T marking*	*55*
– *with T marking*	*T*
Rubber or polyvinyl chloride insulation of internal and external wiring, including ***supply cord****:*	
– *without temperature rating* [e]	*75*
– *with temperature rating (T)*	*T*
Cord sheaths used as ***supplementary insulation***	*60*
Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:	
– *when used as* ***supplementary insulation*** *or* ***reinforced insulation***	*65*
– *in other cases*	*75*
Lampholders with T-marking [j]	
– *B15 and B22 marked T1*	*165*
– *B15 and B22 marked T2*	*210*
– *other lampholders*	*T*
Lampholders without T-marking [j]	
– *E14 and B15*	*135*
– *B22, E26 NS E27*	*165*
– *other lampholders and starter holders for fluorescent lamps*	*80*
Material used as insulation other than that specified for wires and windings:	
– *impregnated or varnished textile, paper or press board*	*95*
– *laminated bonded with:*	
• *melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins*	*110*
• *urea-formaldehyde resin*	*90*
– *printed circuit boards bonded with epoxy resin*	*145*
– *moulding of:*	
• *phenol-formaldehyde with cellulose fillers*	*110*
• *phenol-formaldehyde with mineral fillers*	*90*
• *melamine-formaldehyde*	*110*
• *urea-formaldehyde*	*90*
– *polyester with glass-fibre reinforcement*	*135*
– *silicone rubber*	*170*
– *polytetrafluoroethylene*	*290*
– *pure mica and tightly sintered ceramic material, when such materials are used as* ***supplementary insulation*** *or* ***reinforced insulation***	*425*
– *thermoplastic material* [f]	–

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*

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

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

[c] *The classification is in accordance with IEC 60085.*

Examples of Class A (class 105) material are:

– impregnated cotton, silk, artificial silk and paper;

– enamels based on oleo or polyamide resins.

Examples of Class B (class 130) materials are:

– glass fibre, melamine-formaldehyde and phenol-formaldehyde resins.

Example of Class E (class 120) material are:

– mouldings with cellulose fillers, cotton fabric laminates and paper laminates, materials bonded with melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins;

– cross-linked polyester resins, cellulose triacetate films, polyethylene terephthalate films;

– varnished polyethylene terephthalate textile bonded with oil-modified alkyd resin varnish;

– enamels based on polyvinyl formalin, polyurethane or epoxy resins.

For totally enclosed motors, the temperature limits for class A (class 105), class E (class 120) and class B (class 130) materials may be increased by 5 °C (5 K).

A totally enclosed motor is a motor so constructed that the circulation of the air between the inside and the outside of the case is prevented, but which is not necessarily sufficiently enclosed to be called airtight.

[d] *T means the maximum operating temperature.*
*The ambient of switches and **thermostats** is the temperature of the air at the hottest point at a distance of 5 mm from the surface of the switch and **thermostat** concerned.*
*For the purpose of this test, switches and **thermostats** marked with the individual ratings may be considered as having no marking for the maximum operating temperature, if this is requested by the manufacturer of the appliance. 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.*

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

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

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

[h] *There is no limit for the temperature rise of capacitors which are short-circuited in 19.11.2 c).*

[i] *Temperature marking for capacitors mounted on printed circuit boards may be given in the technical sheet.*

[j] *Locations for measuring the temperatures are specified in Table 12.1 of IEC 60598-1:2008.*

If these or other materials are used, they shall not be subjected to temperatures in excess of the thermal capabilities as determined by aging tests made on the materials themselves.

NOTE 101 The 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/m^3 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 cm^3/s per 1 m^3/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 °C ± 5 °C.

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

During the test, the temperature of the enclosure shall not exceed 150 °C and the temperature of the windings shall not exceed the values shown in Table 8.

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 °C ± 5 °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 kg/m^2 ± 0,4 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 mm^2 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 °C ± 0,5 C dew point at 101,3 kPa containing 21,0 ± 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 operation~~s~~** 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/cm^2, 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.*

22.129 For **user maintenance** access areas, the **UV-C spectral irradiance** shall not exceed the limit specified in 32.101.2 with the access panels opened or removed as needed to perform the required **user maintenance**. Panels that are opened or removed to perform **user maintenance** shall be required to be closed or put back in place for proper operation of the appliance.

Compliance is checked by inspection and test per Subclause 32.101.

22.130 If the replacement of the **UV-C lamp** is allowed by the user, the appliance shall be constructed so that

– the replacement of the **UV-C lamp** is easily possible;

– if screws or components are omitted or incorrectly positioned or fastened, the appliance is rendered inoperable or manifestly incomplete.

Compliance is checked by inspection.

22.131 Appliances that employ refrigerants in a **transcritical refrigerating system** shall be equipped with a **pressure-limiting device** that operates no greater than the **maximum allowable pressure** plus the tolerance of the **pressure-limiting device**.

Compliance is checked by inspection.

23 Internal wiring

This clause of Part 1 is applicable except as follows.

23.101 Internal wiring that is exposed to direct or reflected **UV-C radiation** shall be UV-C resistant.

Compliance is checked by the following test.

Samples of the internal wiring are conditioned in accordance with Annex OO.

On completion of the conditioning, the cable is wrapped in metal foil and is wound around a conductive mandrel 15 mm in diameter for three turns. A voltage of 2 000 V is applied for 15 min between the conductor and the mandrel. There shall be no breakdown.

24 Components

This clause of Part 1 is applicable except as follows.

24.1 *Addition:*

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

24.1.4 *Modification:*

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

Addition:

- ***thermostats*** *which control the motor-compressor* *100 000*

- *motor-compressor starting relays* *100 000*
- *automatic thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type* *min 2 000 (but not less than the number of operations during the locked rotor test)*
- *manual reset thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type* *50*
- *other automatic thermal motor protectors* *2 000*
- *other manual reset thermal motor protectors* *30*
- ***refrigerant detection systems self resetting*** *300*
- ***refrigerant detection systems non self resetting*** *30*
- *electromechanical proof of airflow control* *100 000*
- *self-resetting electrical* ***pressure-limiting device*** *3 000*
- *non-self-resetting electrical* ***pressure-limiting device*** *300*

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

The replacement part shall be marked accordingly.

Compliance is checked by inspection of the marking.

24.102 The **pressure-limiting devices** used in **transcritical refrigerating systems** shall comply with IEC 60730-2-6 and

– shall be of type 2A or 2B;
– shall have a trip free mechanism of type 2J;
– the deviation and drift shall not exceed + 0 %.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Addition:*

The appliances may be provided with a **supply cord** fitted with a plug

- if they are for indoor use only,
- if they have a marked rating of 25 A or less, and
- if they comply with the applicable code requirements for cord-connected appliances appropriate to the specific country in which they are to be used.

Modification:

Appliances shall not be provided with an appliance inlet.

25.7 *Addition:*

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

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable except as follows:

27.5 *Addition:*

NOTE If the ground continuity between system components meets the minimum values specified in 27.5, it is considered to meet the requirements without dedicated grounding conductors.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is not checked on parts relating to motor-compressors if the motor-compressor complies with IEC 60335-2-34. For motor-compressors not complying with IEC 60335-2-34, the additions and modifications specified in IEC 60335-2-34 are applicable.

29.2 *Addition:*

For insulation located in any airflow, the micro-environment is pollution degree 3 unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution due to normal use of the appliance.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2.2 Not applicable.

31 Resistance to rusting

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is checked by the salt mist test of IEC 60068-2-52, severity 2 being applicable.

Before the test, coatings are scratched by means of a hardened steel pin, the end of which has the form of a cone with an angle of 40°. Its tip is rounded with a radius of 0,25 mm ± 0,02 mm. The pin is loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches are made by drawing the pin along the surface of the coating at a speed of approximately 20 mm/s. Five scratches are made at least 5 mm apart and at least 5 mm from the edges.

After the test, the appliance shall not have deteriorated to such an extent that compliance with this standard, in particular with Clauses 8 and 27, is impaired. The coating shall not be broken and shall not have loosened from the metal surface.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable except as follows.

Addition:

32.101 UV-C irradiance test

32.101.1 For the occupied space outside the unit, a test shall be performed to determine the **UV-C spectral irradiance**. The emissions from the equipment shall not exceed a **UV-C spectral irradiance** limit of 0,2 µW/cm^2.

NOTE The **UV-C spectral irradiance** limit of 0,2 µW/cm^2 is equivalent to 0,1 µW/cm^2 effective irradiance at 254 nm (i.e., 0,2 µW/cm^2 multiplied by the hazard function, S_{UV} = 0,5 at 254 nm as defined in IEC 62471 equals 0,1 µW/cm^2). Effective irradiance of 0,1 µW/cm^2 is classified as exempt in IEC 62471.

32.101.2 For areas inside the unit that are accessible for anticipated **user maintenance** and are not equipped with the interlock required by Subclause 22.128, there shall be no **UV-C spectral irradiance** greater than 1,7 µW/cm^2. The **UV-C spectral irradiance** is measured at any point of accessibility required for **user maintenance**. When determining user accessibility, consideration should be given to the actual degree of exposure that the user would experience in performing his duties.

NOTE The **UV-C spectral irradiance** limit of 1,7 µW/cm^2 is equivalent to 0,85 µW/cm^2 effective irradiance at 254 nm (i.e., 1,7 µW/cm^2 multiplied by the hazard function, S_{UV} = 0,5 at 254 nm as defined in IEC 62471 equals 0,85 µW/cm^2). The exposure limit at 0,85 µW/cm^2 effective irradiance at this level is 60 min/day.

*Compliance is determined by measuring the **UV-C irradiance** per IEC 62471:2006, Clause 5 and Annex B.*

32.101.3 ***UV-C irradiance** shall be measured at the location in Table 101.*

Table 101 – UVC irradiance measurement location

	UV-C spectral irradiance limits		For compliance, UV-C irradiance is measured
	µW/cm^2	W/m^2	
Occupied space outside unit	≤ 0,2[a]	≤ 0,002	At 0,3 m from all outside surfaces of appliance[c]
Supply and return air openings	≤ 0,2[a]	≤ 0,002	At 0,3 m from the perpendicular plane of the opening
User maintenance openings[b]	≤ 1,7	≤ 0,017	At 0,3 m from the perpendicular plane of the access opening
UV-C lamp replacement			Not required – all power shall be disconnected

[a] Less than or equal to 0,1 µW/cm^2 effective irradiance is exempt per IEC 62471. This is 0,2 µW/cm^2 spectral irradiance at 254 nm.

[b] Based on maximum exposure time of 60 min.

[c] If the appliance has an inspection window, the measuring distance is reduced to 0,0 m.

32.101.4 *When conducting **UV-C irradiance** tests:*

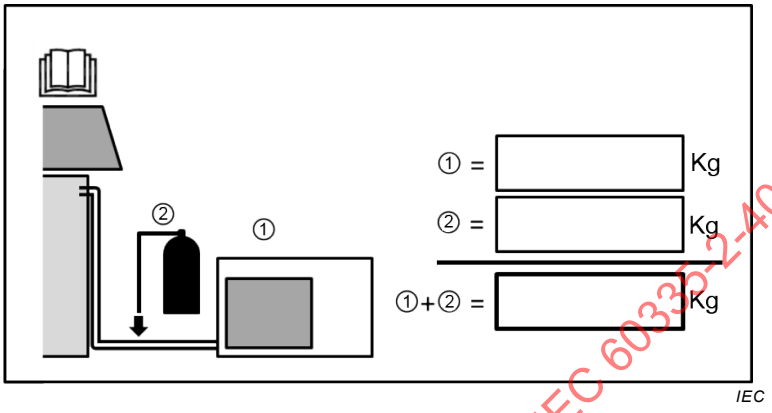
– *the **UV-C irradiance** measurements shall be conducted with a scanning spectroradiometer, or a narrow band range radiometer;*

– *all panels and components shall be positioned or adjusted in the most severe position;*

– *removable air filters shall be removed;*

– *measurements shall be made at the worst case location and angle of incidence;*

– *the minimum specified duct and configuration, including any duct liners, specified by the manufacturer shall be in place and the measurements taken at the opening at the end of the duct.*

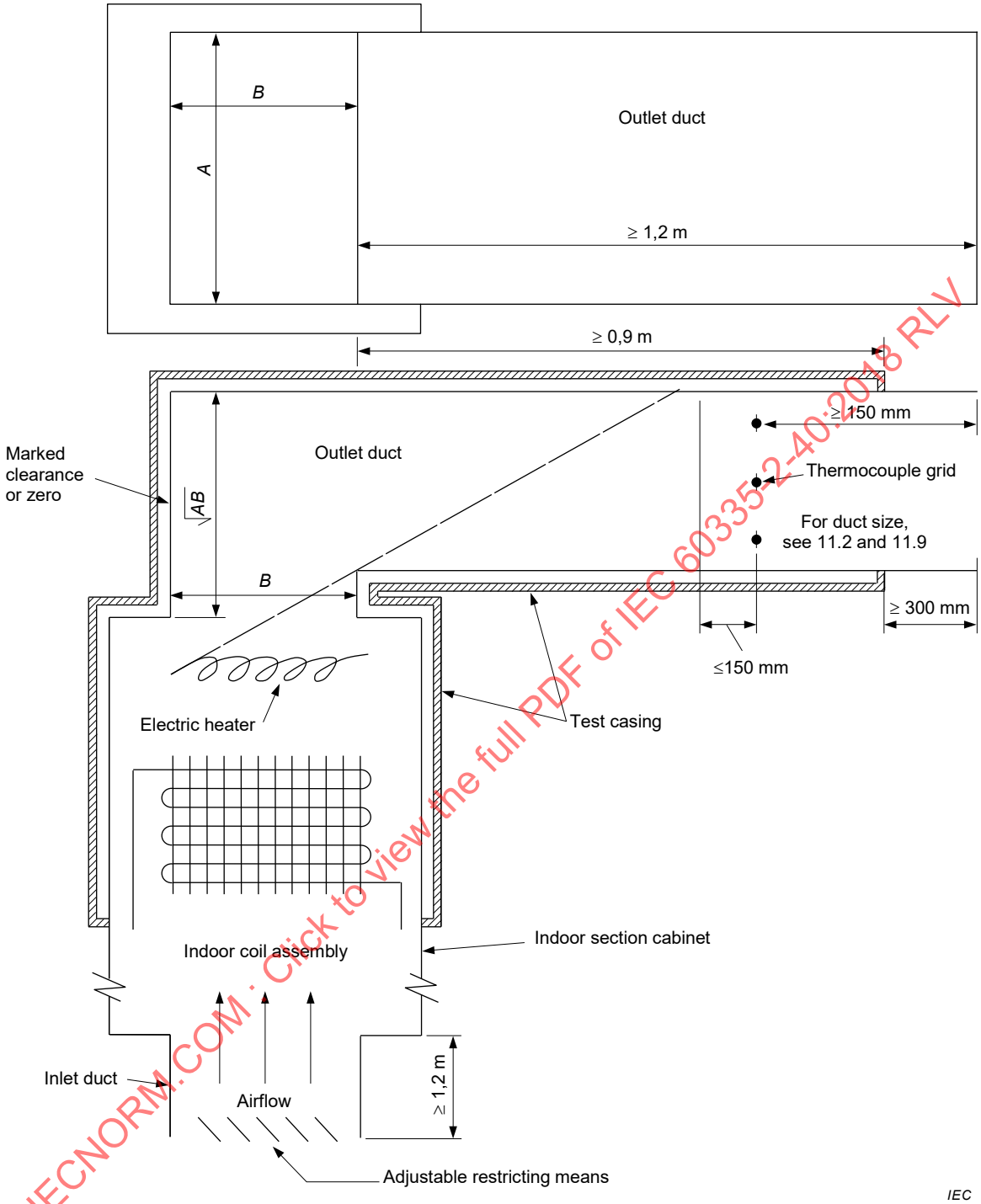


Key

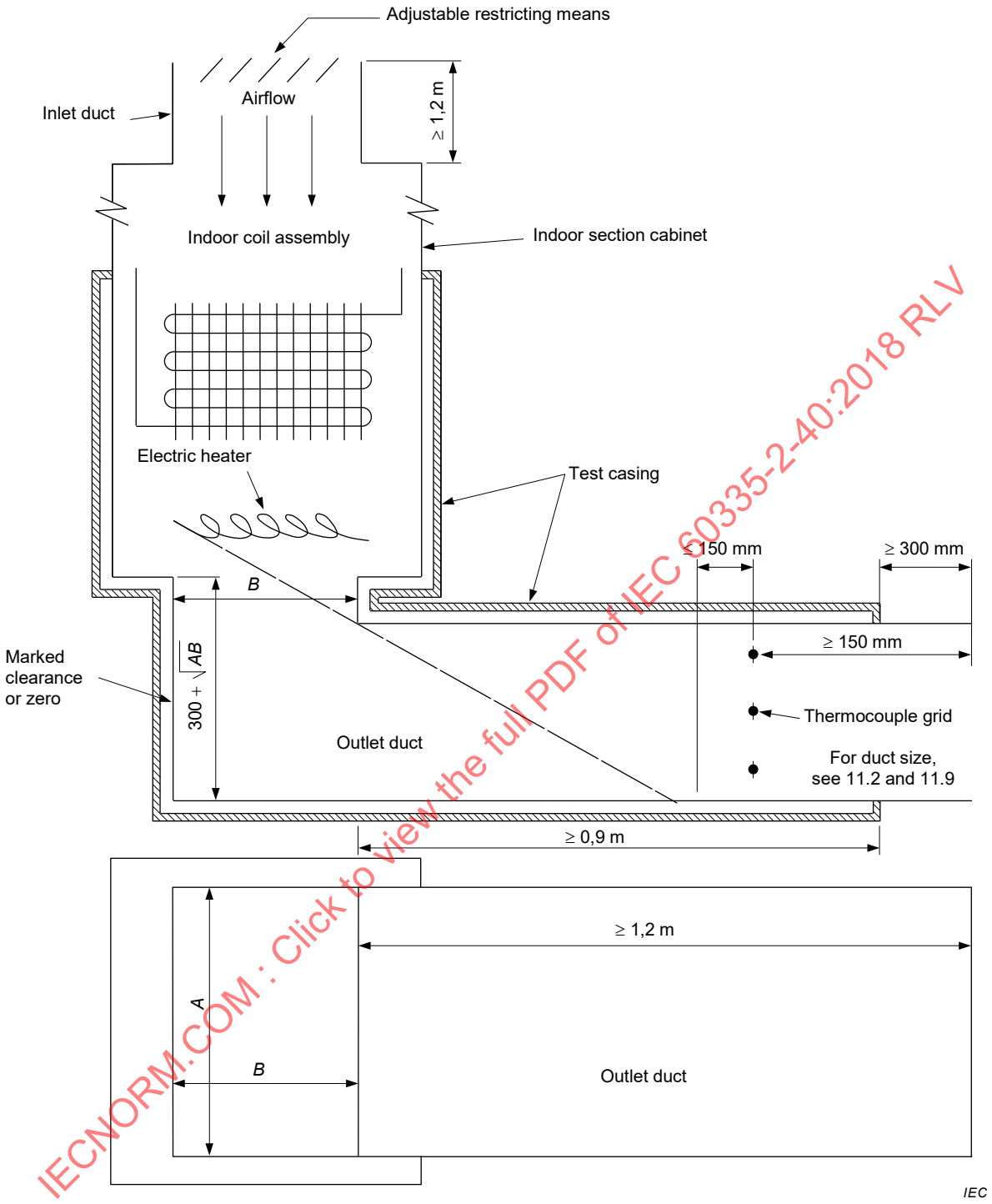
Example 1 **refrigerant charge** of the precharged part of the appliance

Example 2 **refrigerant charge** added during installation

Figure 101 – Example of label for field charged units

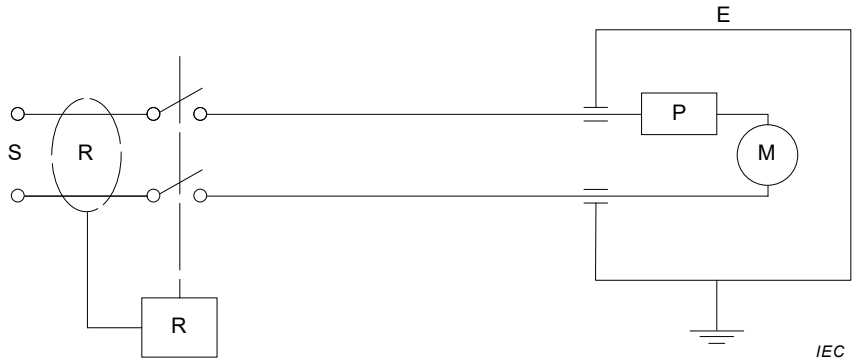


a) Upflow application



b) **Downflow application**

Figure ~~101~~ 102 – Arrangement for heating test of appliances with supplementary heater



Key

S supply

E motor enclosure

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

P protective device (external or internal)

M motor

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

Figure ~~102~~ 103 – Supply circuit for locked-rotor test of a motor of the single-phase type – Revise as needed for three-phase test

Annexes

The annexes of Part 1 are applicable except as follows.

Annex D
(normative)

Thermal motor protectors

This annex of Part 1 is not applicable.

Annex I
(normative)

Motors having basic insulation that is inadequate for the rated voltage of the appliance

This annex of Part 1 is not applicable.

Annex AA
(informative)

Examples for operating temperatures of the appliance

Table AA.1 – Examples for operating temperatures of the appliance

Function of appliance	Classification		Heating				Cooling			
			Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)		Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)	
			DB [a]	WB [b]	DB [a]	WB [b]	DB [a]	WB [b]	DB [a]	WB [b]
Outside air/ Recycled air	A7	A20	7	6	20	12	35	24	27	19
Exhaust air/ Recycled air	A20	A20	20	12	20	12	–	–	–	–
Exhaust air/ Fresh air	A20	A7	20	12	7	6	–	–	–	–
Outside air/Water	A7	W50	7	6	Water	50	35	24	Water	7
Exhaust air/Water	A20	W50	20	12	Water	50	–	–	–	–
Water/Water	W10	W50	Water	10	Water	50	Water	15	Water	7
Brine/Water	B0	W50	Brine	0	Water	50	Brine	15	Water	7
Brine/Recycled air	B0	A20	Brine	0	20	12	–	–	–	–
Water/Recycled air	W10	A20	Water	10	20	12	–	–	–	–
Water/Recycled air	W20	A20	Water	20	20	12	–	–	–	–
Dehumidification	Comfort		–	–					27	21
	Process								12	9
	Heat recovery (air cooled)						27	21	27	21
	Heat recovery (water cooled)						Water	24	27	21
Sanitary hot water heat pump										
Outside air/Water	A7	W45	7	6	Water	45	–	–	–	–
Ambient air/Water	A15	W45	15	12	Water	45	–	–	–	–
Exhaust air/Water	A20	W45	20	12	Water	45	–	–	–	–
Brine/Water	B0	W45	Brine	0	Water	45	–	–	–	–

NOTE Appliance can be classified according to function and temperature application as noted below:

Source		Sink		Classification		
Outside air		Recycled air		A –	A –	A *
Exhaust air		Recycled air		A –	A –	
Exhaust air		Outside air		A –	A –	
Outside air		Water		A –	W –	
Exhaust air		Water		A –	W –	
Water		Water		W –	W –	
Water		Recycled air		W –	A –	
Brine		Recycled air		B –	A –	
Brine		Water		B –	W –	

* For example, A7 A20 indicates an appliance designed for an outside air operating temperature of 7 °C DB and an inside air operating temperature of 20 °C DB.

[a] DB: dry bulb

[b] WB: wet bulb

Annex BB
(normative)

Selected information about refrigerants

~~The normative component of Annex BB involves the "Lower limit" column of Table BB.1. The rest of the annex is informative.~~

Table BB.1 – Selected information about refrigerants

NOTE This annex is not a complete list of suitable refrigerants. This International Standard applies to any refrigerants as defined in the scope.

Refrigerant designation [a]	Description	Formula (nominal composition mass fraction %)	Safety group [f]	Auto ignition temperature	Hot surface ignition temperature [g]	Maximum allowable surface temperature [g]	Density [b,~~e~~]	Molar mass [c] at nominal composition [h]	Molar mass [c] at worst case formulation [i]	Lower flammability limit [b,d] at nominal composition [h]		Lower flammability limit [b,d] at worst case formulation [i]
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3 ~~d~~	~~% v/v~~	kg/m^3
R32	Difluoromethane	CH_2F_2	A2L	648	> 800	700	2,13	52,0	NA	~~0,306~~ 0,307	~~14,4[g]~~	NA
R50	Methane	CH_4	A3	645		545	0,65	16,0	NA	0,032	~~4,9[h]~~	NA
R143a	1,1,1 – Trifluoroethane	CF_3CH_3	A2L	750		650	3,43	84,0	NA	0,282	~~8,2[g]~~	NA
R152a	1, 1 – Difluoroethane	CHF_2CH_3	A2	455		355	2,70	66,0	NA	0,130	~~4,8[g]~~	NA
R170	Ethane	CH_3CH_3	A3	515		415	1,23	30,1	NA	0,038	~~3,1[g]~~	NA
R290	Propane	$CH_3CH_2CH_3$	A3	470		370	1,80	44,1	NA	0,038	~~2,1[g]~~	NA
R600	n-Butane	$CH_3CH_2CH_2CH_3$	A3	365		265	2,37	58,1	NA	~~0,043~~ 0,038	~~1,8[i]~~	NA
R600a	Isobutane	$CH(CH_3)_3$	A3	460		360	2,37	58,1	NA	0,043	~~1,8[i]~~	NA
R1150	Ethylene	$CH_2=CH_2$	A3	425			1,15	28,1	NA	0,036	~~3,1[g]~~	NA
R1270	Propylene	$CH_2=CHCH_3$	A3	455		355	1,72	42,1	NA	~~0,040~~ 0,046	~~2,3[k]~~	NA
E170	Dimethylether	~~CH_3-CH_3~~ $(CH_3)_2O$	A3	235		135	1,88	46,1	NA	0,064	~~3,4[l]~~	NA

Refrigerant designation a	Description	Formula (nominal composition mass fraction %)	Safety group f	Auto ignition temperature	Hot surface ignition temperature g	Maximum allowable surface temperature g	Density b, ~~e~~	Molar mass c at nominal composition h	Molar mass c at worst case formulation i	Lower flammability limit b,d at nominal composition h		Lower flammability limit b,d at worst case formulation i
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3 ~~d~~	~~% v/v~~	kg/m^3
R142b	1-chloro-1,1-difluoroethane	CH_3CClF_2	A2L	750[e]		650	4,11	100,5	NA	0,329	~~8,09~~	NA
R1234yf	2,3,3,3-tetrafluoro-1-propene	$CF_3CF=CH_2$	A2L	405	> 800	700	4,66	114,0	NA	0,289		NA
R1234ze(E)	Trans-1,3,3,3-tetrafluoro-1-propene	$CF_3CF=CHF$	A2L	368	> 800	700	4,66	114.0	NA	0,303		NA
R-444A	R-32/152a/1234ze(E)	(12/5/83)	A2L	ND	> 800	700	4,03	96,7	95,2	0,324		0,323
R-444B	R-32/152a/1234ze(E)	(41.5/10/48.5)	A2L	ND	> 800	700	3,02	72,8	73,0	0,277		0,277
R-447A	R-32/125/1234ze(E)	(68/3.5/28.5)	A2L	ND			2,61	63,0	63,1	0,304		0,330
R-447B	R-32/125/1234ze(E)	(68/8/24)	A2L	ND	> 800	700	2,58	63,1	63,1	0,312		0,312
R-451A	R-1234yf/134a	(89.8/10.2)	A2L	ND	> 800	700	4,61	112,7	112,7	0,322		0,346
R-451B	R-1234yf/134a	(88.8/11.2)	A2L	ND	> 800	700	4,60	112,6	112,6	0,322		0,341
R-452B	R-32/125/1234yf	(67/7/26)	A2L	ND	> 800	700	2,60	63,5	63,7	0,309		0,310
R-454A	R-32/1234yf	(35/65)	A2L	ND	> 800	700	3,29	80,5	81,8	0,273		0,278
R-454B	R-32/1234yf	(68.9/31.1)	A2L	ND	> 800	700	2,56	62,6	63,0	0,307		0,301
R-454C	R-32/1234yf	(21.5/78.5)	A2L	ND	> 800	700	3,71	90,8	92,5	0,286		0,291
R-457A	R-32/1234yf/152a	(18/70/12)	A2L	ND			3,58	87,6	88,0	0,215		0,216

Refrigerant designation a	Description	Formula (nominal composition mass fraction %)	Safety group f	Auto ignition temperature	Hot surface ignition temperature g	Maximum allowable surface temperature g	Density b, ~~e~~	Molar mass c at nominal composition h	Molar mass c at worst case formulation i	Lower flammability limit b,d at nominal composition h		Lower flammability limit b,d at worst case formulation i
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3 ~~d~~	~~% v/v~~	kg/m^3

If any data in this table is missing or in conflict with the data in ISO 817 then the value in ISO 817 shall take precedence.

ND means non-determined. Consult the safety data sheet of the manufacturer.

NA means not applicable.

a The refrigerant designations are in accordance with ISO 817.

b These values are at 25 °C and at 1 013,2 mbar.

c For comparison, the molecular mass of air is taken equal to 28,8 kg/kmol.

d Multiply % *v*/*v* by the corresponding molar mass × 0,000 409 to give the flammability limit in kg/m^3.

~~e Divide molar mass by 24,465 to give the density in kg/m^3.~~

~~g WILSON, DP. and RICHARD, RG. Determination of Refrigerant Lower Flammability Limits in Compliance with Proposed Addendum p to Standard 34. *ASHRAE Transactions:* 2002 V. 108, Pt. 2.~~

~~h BURRELL, GA. and OBERFELL, GG. U.S. Bur. Mines, Tech. Paper 119, (1915)~~

~~i LAFFITTE, P. and DELBOURGO, R. *4th Symp. on Combust.*, p.114(1953)~~

~~j ZABETAKIS, MG., SCOTT, GS., JONES, GW. *Ind. Eng. Chem.*, 43, 2120, (1951)~~

~~k Estimated from LFL for propane analogs and data from JABBOUR, T., CLODIC, D. Burning Vel °City and Refrigerant Flammability Classification, Ecole de Mines, Paris, France. *ASHRAE Transactions* 2004.~~

~~l Atofina application to ASHRAE for safety classification of R-E170, 13 December 2001~~

e Estimated from molecular structure.

f Safety group of refrigerants based upon ISO 817.

g For **flammable refrigerants**, the maximum allowable surface temperature is determined by AIT reduced by 100 K .
For **A2L refrigerants**, 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.

h Nominal composition means design composition as stated in the refrigerant blend application, excluding any tolerances.

i Worst case formulation means the composition that results from application of the tolerances to the nominal composition resulting in the most toxic or most flammable formulation.

Annex CC
(informative)

Transportation, marking and storage for units that employ flammable refrigerants

CC.1 General

The following information is provided for units that employ **flammable refrigerants**.

CC.2 Transport of equipment containing flammable refrigerants

Attention is drawn to the fact that additional transportation regulations may exist with respect to equipment containing flammable gas. The maximum number of pieces of equipment or the configuration of the equipment permitted to be transported together will be determined by the applicable transport regulations.

CC.3 Marking of equipment using signs

Signs for similar appliances used in a work area are generally addressed by local regulations and give the minimum requirements for the provision of safety and/or health signs for a work location.

All required signs are to be maintained and employers should ensure that employees receive suitable and sufficient instruction and training on the meaning of appropriate safety signs and the actions that need to be taken in connection with these signs.

The effectiveness of signs should not be diminished by too many signs being placed together.

Any pictograms used should be as simple as possible and contain only essential details.

CC.4 Disposal of equipment using flammable refrigerants

See national regulations.

CC.5 Storage of equipment/appliances

The storage of ~~equipment~~ the appliance should be in accordance with the ~~manufacturer's~~ applicable regulations or instructions, whichever is more stringent.

CC.6 Storage of packed (unsold) equipment

Storage package protection should be constructed in such a way that mechanical damage to the equipment inside the package will not cause a leak of the **refrigerant charge**.

The maximum number of pieces of equipment permitted to be stored together will be determined by local regulations.

Annex DD
(normative)

~~Instruction manual for servicing refrigerant containing appliances~~ Requirements for operation, service and installation manuals of appliances using flammable refrigerants

DD.1 General

Each service manual shall include requirements of clauses according to Table DD.1. Different manuals can be combined into one manual.

Table DD.1 – Mandatory clauses in each manual

Clause	Installation	Maintenance and repair	Decommissioning	Note
DD.2	Yes	Yes	Yes	
DD.3.1	Yes	Yes	No	
DD.3.2	Yes	Yes	No	User manual also
DD.3.3	Yes	Yes	Yes	
DD.4	No	Yes	Yes	
DD.4.1	No	Yes	Yes	
DD.4.2	No	Yes	Yes	
DD.4.3	No	Yes	Yes	
DD.4.4	No	Yes	Yes	
DD.4.5	No	Yes	Yes	
DD.4.6	No	Yes	Yes	
DD.4.7	No	Yes	Yes	
DD.4.8	Yes	Yes	No	
DD.4.9	No	Yes	No	
DD.5.1	No	Yes	No	
DD.5.2	No	Yes	No	
DD.6	No	Yes	No	
DD.7	Yes	Yes	No	
DD.8	Yes	Yes	Yes	
DD.9	Yes	Yes	Yes	
DD.10	Yes	Yes	No	
DD.11	No	No	Yes	
DD.12	No	No	Yes	
DD.13	Yes	Yes	Yes	

DD.2 Symbols

The symbols referred to in 7.6 (without colours is permitted) and the information of the warning marking shall be provided as follows:

WARNING Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer. The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater. Do not pierce or burn. Be aware that refrigerants may not contain an odour.

The manufacturer may provide other suitable examples or may provide additional information about the refrigerant odour.

DD.3 Information in manual

DD.3.1 General

The following information shall be specified in the manual where the information is needed for the function of the manual and as applicable to the appliance:

– information for spaces where refrigerant pipes are allowed, including statements
  - that the installation of pipe-work shall be kept to a minimum;
  - that pipe-work shall be protected from physical damage and, in the case of **flammable refrigerants**, shall not be installed in an unventilated space, if that space is smaller than A_{min} in Annex GG, except for **A2L refrigerants** where the installed pipes comply with 22.116. In case of field charge, the effect on **refrigerant charge** caused by the different pipe length has to be quantified;
  - that compliance with national gas regulations shall be observed;
  - that mechanical connections made in accordance with 22.118 shall be accessible for maintenance purposes;
  - that, for appliances containing **flammable refrigerants**, the minimum floor area of the room shall be mentioned in the form of a table or a single figure without reference to a formula;
– the **maximum refrigerant charge** ~~amount (*M*)~~ (m_{max});
– instructions how to determine the additional **refrigerant charge** and how to complete the **refrigerant charge** on the label provided by the manufacturer considering the requirements in 7.107;
– the minimum rated airflow, if required by Annex GG;
– information for handling, installation, cleaning, servicing and disposal of refrigerant;
– ~~the minimum floor area of the room or the special requirements for the room in which an appliance containing **flammable refrigerants** can be located as defined in Annex GG, except where the refrigerant charge (*M*) is less than or equal to m_1 ($M \leq m_1$);~~
– for appliances using **flammable refrigerants**, instructions shall include the minimum **installed height** h_{inst} (when required to calculate A_{min}), **refrigerant charge** m_c and minimum room area of the space A_{min} or a minimum room area of conditioned space TA_{min} where applicable. Additional minimum room area data may be provided based on other **installed heights** and/or charge levels.

– detailed instructions on how to install the appliance to ensure that the release height h_0 as determined in Clause GG.2 of the installed appliance is not lower than h_0 used for the calculation of A_{min};

– a warning to keep any required ventilation openings clear of obstruction;

– a notice that servicing shall be performed only as recommended by the manufacturer;

– a warning that ducts connected to an appliance shall not contain a **potential ignition source**;

– instructions for wiring to external zoning dampers and/or mechanical ventilation, if required to comply with Clause GG.9, to ensure that upon detection of a leak, the zoning dampers are driven fully open and additional mechanical ventilation is activated;

– for appliances relying on safety measures according to GG.8.3 instructions for wiring to external ventilation;

– when a remote located refrigerant sensor is specified by the manufacturer, the instructions shall state when it is required and how to install and connect the sensor;

– for appliances using **A2L refrigerants**, connected via an air duct system to one or more rooms, the supply and return air shall be directly ducted to the space. Open areas such as false ceilings shall not be used as a return air duct;

– the following information requirements apply **for enhanced tightness refrigerating systems** using **A2L refrigerants**:

  - Equipment piping in the occupied space shall be installed in such a way to protect against accidental damage in operation and service.
  - Precautions shall be taken to avoid excessive vibration or pulsation to refrigerating piping.
  - Protection devices, piping and fittings shall be protected as far as possible against adverse environmental effects, for example, the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris.
  - Provision shall be made for expansion and contraction of long runs of piping.
  - Piping in **refrigerating systems** shall be so designed and installed to minimize the likelihood hydraulic shock damaging the system.
  - Solenoid valves shall be correctly positioned in the piping to avoid hydraulic shock.
  - Solenoid valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.
  - Steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation.
  - Flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces. They should be checked for mechanical damage annually.
  - The indoor equipment and pipes shall be securely mounted and guarded such that accidental rupture of equipment cannot occur from such events as moving furniture or reconstruction activities.
  - Where safety shut off valves are specified, the minimum room area may be determined based on the maximum amount of refrigerant that can be leaked as determined in GG.12.2.
  - Where safety shut off valves are specified, the location of the valve in the **refrigerating system** relative to the occupied spaces shall be as described in GG.12.1.
  - Field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of 5 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.

– For mechanical ventilation as specified in GG.8.3, the air extraction opening from the room shall be located equal or below the refrigerant release point. For floor mounted units, it

shall be as low as practicable. The air extraction openings shall be located in a sufficient distance from the air intake openings to prevent re-circulation to the space.

DD.3.2 Unventilated areas

For appliances containing more than m_1 for any refrigerating circuit, the manual shall include a statement advising that an unventilated area where the appliance using **flammable refrigerants** is installed shall be so constructed that should any refrigerant leak, it will not stagnate so as to create a fire or explosion hazard. This shall include:

– a warning that the non-**fixed appliance** shall be stored in an ~~well-ventilated~~ area where the room size corresponds to the room area as specified for operation;

– a warning that the non-**fixed appliance** shall be stored in a room without continuously operating open flames (for example an operating gas appliance) ~~and~~ or other **potential ignition sources** (for example an operating electric heater, hot surfaces);

– a warning that if appliances with **A2L refrigerants** connected via an air duct system to one or more rooms are installed in a room with an area less than A_{min} as determined in Clause GG.2, that room shall be without continuously operating open flames (for example an operating gas appliance) or other **potential ignition sources** (for example an operating electric heater, hot surfaces). A flame-producing device may be installed in the same space if the device is provided with an effective flame arrest;

– for appliances using **A2L refrigerants** connected via an air duct system to one or more rooms, a warning with the substance of the following: "Auxiliary devices which may be a **potential ignition source** shall not be installed in the duct work. Examples of such **potential ignition sources** are hot surfaces with a temperature exceeding X°C and electric switching devices";

NOTE X is the maximum allowable surface temperature as defined in 22.117.

– for appliances using **A2L refrigerants** connected via an air duct system to one or more rooms, a warning that only auxiliary devices approved by the appliance manufacturer or declared suitable with the refrigerant shall be installed in connecting ductwork. The manufacturer can list in the instructions all approved auxiliary devices by the manufacturer and model number for use with the specific appliance, if those devices have a potential to become an ignition source.

The manufacturer should specify other potential continuously operating sources known to cause ignition of the refrigerant used.

The appliance shall be stored so as to prevent mechanical damage from occurring.

DD.3.3 Qualification of workers

The manual shall contain specific information about the required qualification of the working personnel for maintenance, service and repair operations. Every working procedure that affects safety means shall only be carried out by competent persons according to Annex HH.

Examples for such working procedures are:

- breaking into the refrigerating circuit;
- opening of sealed components;
- opening of ventilated enclosures.

DD.4 Information on servicing

DD.4.1 General

The manual shall contain specific information for service personnel according to DD.4.2 to DD.4.10.

DD.4.2 Checks to the area

Prior to beginning work on systems containing **flammable refrigerants**, safety checks are necessary to ensure that the risk of ignition is minimised. For repair to the **refrigerating system**, DD.4.3 to DD.4.7 shall be completed prior to conducting work on the system.

DD.4.3 Work procedure

Work shall be undertaken under a controlled procedure so as to minimise the risk of a flammable gas or vapour being present while the work is being performed.

DD.4.4 General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided. ~~The area around the workspace shall be sectioned off. Ensure that the conditions within the area have been made safe by control of flammable material.~~

DD.4.5 Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

DD.4.6 Presence of fire extinguisher

If any hot work is to be conducted on the ~~refrigeration~~ refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO_2 fire extinguisher adjacent to the charging area.

DD.4.7 No ignition sources

No person carrying out work in relation to a ~~refrigeration~~ **refrigerating system** which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. “No Smoking” signs shall be displayed.

DD.4.8 Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

DD.4.9 Checks to the ~~refrigeration~~ refrigerating equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer’s maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer’s technical department for assistance.

*The following checks shall be applied to installations using **flammable refrigerants**:*

– *the actual **refrigerant charge** ~~size~~ is in accordance with the room size within which the refrigerant containing parts are installed;*

– *the ventilation machinery and outlets are operating adequately and are not obstructed;*

– *if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;*

– *marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;*

– ~~*refrigeration*~~ *refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.*

DD.4.10 Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

Initial safety checks shall include:

- that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- that no live electrical components and wiring are exposed while charging, recovering or purging the system;
- that there is continuity of earth bonding.

DD.5 Repairs to sealed components

DD.5.1 During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

DD.5.2 Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatus is mounted securely.

Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications.

DD.6 Repair to intrinsically safe components

Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.

Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating.

Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

NOTE The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

DD.7 Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

DD.8 Detection of flammable refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

~~**DD.8 Leak detection methods**~~

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of **flammable refrigerants**, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the ***LFL*** of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

NOTE Examples of leak detection fluids are

– bubble method,

– fluorescent method agents.

If a leak is suspected, all naked flames shall be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. ~~For appliances containing **flammable refrigerants**, oxygen free nitrogen (OFN) shall then be purged through the system both before and during the brazing process.~~ Removal of refrigerant shall be according to Clause DD.9.

DD.9 Removal and evacuation

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for **flammable refrigerants** it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to:

- remove refrigerant;
- purge the circuit with inert gas (optional for A2L);
- evacuate (optional for A2L);
- purge ~~again~~ with inert gas (optional for A2L);
- open the circuit by cutting or brazing.

The **refrigerant charge** shall be recovered into the correct recovery cylinders. For appliances containing **flammable refrigerants** other than **A2L refrigerants**, the system shall be ~~"flushed"~~ purged with oxygen-free nitrogen to render the ~~unit~~ appliance safe for **flammable refrigerants**. This process may need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing **flammable refrigerants**, other than **A2L refrigerants**, **refrigerants** ~~flushing~~ purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. This operation is absolutely vital if brazing operations on the pipe-work are to take place.

Ensure that the outlet for the vacuum pump is not close to any **potential ignition sources** and that ventilation is available.

DD.10 Charging procedures

In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimise the amount of refrigerant contained in them.
- Cylinders shall be kept ~~upright~~ in an appropriate position according to the instructions.
- Ensure that the ~~refrigeration~~ **refrigerating system** is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the ~~refrigeration~~ **refrigerating system**.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

DD.11 Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of ~~reclaimed~~ recovered refrigerant. It is essential that electrical power is available before the task is commenced.

a) Become familiar with the equipment and its operation.

b) Isolate system electrically.

c) Before attempting the procedure, ensure that:

- mechanical handling equipment is available, if required, for handling refrigerant cylinders;
- all personal protective equipment is available and being used correctly;
- the recovery process is supervised at all times by a competent person;
- recovery equipment and cylinders conform to the appropriate standards.

d) Pump down refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with ~~manufacturer's~~ instructions.

h) Do not overfill cylinders (no more than 80 % volume liquid charge).

i) Do not exceed the maximum working pressure of the cylinder, even temporarily.

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another ~~refrigeration~~ **refrigerating system** unless it has been cleaned and checked.

DD.12 Labelling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing **flammable refrigerants**, ensure that there are labels on the equipment stating the equipment contains **flammable refrigerant**.

DD.13 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, **flammable refrigerants**. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.

The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that **flammable refrigerant** does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Annex EE
(normative)

Pressure tests

EE.1 General

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

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

Compliance is checked by the following tests.

For all tests of Clause 21, if the refrigerant is a blend, the test pressure of EE.4.2 shall be carried out at the highest pressure under the specified temperature.

The test value that is the maximum of Clauses EE.2, EE.3 or EE.4 shall be used for the test of EE.4.2, respectively, for the high side and the low side components.

EE.2 Pressure test value determined under testing carried out in Clause 11

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

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

EE.3 Pressure test value determined under testing carried out in Clause 19

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

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

EE.4 Pressure test value determined under testing carried out under standstill conditions

EE.4.1 In order to determine the standstill pressure, the appliance shall be soaked in the highest operating temperature specified by the manufacturer for 1 h with power off.

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

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

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

EE.4.2 The pressure test shall be carried out on three samples of each component. The test samples are filled with a liquid, such as water, to exclude air and are connected in a hydraulic pump system. The pressure is raised gradually until the required test pressure is reached. The pressure is maintained for at least 1 min, during which time the sample shall not leak.

Where gaskets are employed for sealing parts under pressure, leakage at gaskets is acceptable, provided the leakage only occurs at a value greater than 120 % of the **maximum allowable pressure** and the test pressure is still reached for the specified time. Additional sealing measures, such as an "O" ring, for pressure testing may be provided.

EE.5 Fatigue test option for Clause EE.1 and EE.4.2

EE.5.1 The components shall be subjected to a test at 66,7 % of the test pressure determined by Clauses EE.2, EE.3 or EE.4, provided the components comply with the fatigue test in Clause EE.5. This test is conducted on a separate sample.

EE.5.2 Three samples of each refrigerant-containing part shall be tested at the cyclic pressure values specified in EE.5.7 and EE.5.8 for the number of cycles specified in EE.5.6, as described in EE.5.4.

EE.5.3 The samples shall be considered to comply with EE.5.5 on completion of the test and if they do not rupture, burst, or leak.

EE.5.4 The test samples shall be filled with fluid, and shall be connected to a pressure-driving source. The pressure shall be raised and lowered between the upper and lower cyclic values at a rate specified by the manufacturer. The pressure shall reach the specified upper and lower values during each cycle. The shape of the pressure cycle shall be such that the upper and lower pressure values shall be maintained for at least 0,1 s.

NOTE For safety purposes, it is suggested that a non-compressible fluid is used for the test. The fluid fills the sample completely to prevent any significantly remaining gas.

If the operating temperatures of the appliance under the conditions of steady state operation of Clause 11 are less than or equal to 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the component part or assembly shall be at least 20 °C. If the continuous operating temperature of the component exceeds 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the parts or assemblies that are at these temperatures, and subjected to the pressure, shall be at least 25 °C greater than the temperature of the part measured during the test of Clause 11 for copper or aluminium and 60 °C higher for steel. For other materials, the effects of temperature on the material fatigue characteristics shall be evaluated by conducting the test at the higher temperatures and considering the material characteristics at the higher temperatures.

EE.5.5 The pressure for the first cycle shall be the maximum evaporating pressure for **low-pressure side** components or the maximum condensing pressure for the **high-pressure side** components.

EE.5.6 The total number of cycles shall be 250 000. The test pressures shall be determined by EE.5.7 (except the first and last cycles as noted in EE.5.5 and EE.5.8).

EE.5.7 The pressure for the test cycles shall be as follows:

a) For components subject to high side pressures, the upper pressure value shall not be less than the saturated vapour pressure of the refrigerant at 50 °C and the lower pressure value shall not be greater than the saturated vapour pressure of the refrigerant at 5 °C. For hot water **heat pumps**, the upper pressure shall not be less than 80 % of the **maximum allowable pressure** under the conditions of Clause 11.

b) For components subjected to only low side pressures, the upper pressure value shall be not less than the saturated vapour pressure of the refrigerant at 30 °C and the lower pressure value shall be between 0 bar and the greater of 4,0 bar or the saturated vapour pressure of the refrigerant at –13 °C.

EE.5.8 For the final test cycle, the test pressure shall be increased to two times the minimum upper pressure specified in EE.5.7.

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

Annex FF
(normative)

Leak simulation tests

FF.1 General

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

FF.2 Test methods

FF.2.1 The appliance is modified by introducing a simulated leak through a capillary tube. The leak rate shall be maintained at 25 % ± 5 % of the ~~total appliance~~ **refrigerant charge** in 1 min.

FF.2.2 During this test, the appliance is switched off or operated under **normal operation** at **rated voltage**, whichever gives the most unfavourable result unless a prepurge is activated prior to energizing any loads, in which case the test shall be conducted with the appliance operating. During a test where the appliance is operating, refrigerant gas injection is started at the same time as the appliance is switched on.

FF.2.3 ~~If a blend refrigerant is used that can fractionate, the test is carried out using the worst fractionated formulation that has the smallest value of *LFL* (lower flammable limit) defined in ANSI/ASHRAE 34-2001.~~ For refrigerant blends, the test shall be carried out using the nominal composition as defined in ISO 817.

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

FF.2.4 The test is conducted in a room that is draft free and of sufficient size to conduct the test.

The minimum volume (V) is:

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

where

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

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

LFL is the **lower** ~~**flammable**~~ **flammability limit** in kg/m^3 ~~from Annex BB~~.

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

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

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

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

FF.2.5 The measured concentration of refrigerant gas surrounding the component shall not exceed 25 % of the ***LFL*** of the refrigerant gas, and shall not exceed 15 % of the ***LFL*** of the refrigerant gas for a time period of 5 min or the duration of the test if less than 5 min during and after the amount has been injected. The measured concentration of refrigerant gas surrounding a component that will not function during the prepurge time may exceed the 25 % of the ***LFL*** during the prepurge time. The ***LFL*** is as specified in Annex BB for the refrigerant used.

Annex GG
(normative)

Charge limits, ventilation requirements and requirements for secondary circuits

GG.1 Requirements for refrigerant charge limits

GG.1.1 General

When a **flammable refrigerant** is used, the requirements for installation space of appliance and/or ventilation requirements are determined according to

– the ~~mass~~ **refrigerant** charge ~~amount (M)~~ (m_c) used in the appliance,
– the installation location,
– the type of ventilation of the location or of the appliance.

~~See Table GG.1.~~

~~Determine the case applicable based on the relationship of the mass charge amount employed and m_1, m_2, m_3 defined as follows:~~

~~$m_1 = (4\ m^3) \times LFL$~~
~~$m_2 = (26\ m^3) \times LFL$~~
~~$m_3 = (130\ m^3) \times LFL$~~

~~where *LFL* is the lower flammable limit in kg/m^3 from Annex BB for the refrigerant used.~~

~~Determine the column for indoor or outdoor application. The requirements are identified in the appropriate box and the product and installation requirements are identified.~~

~~NOTE 1 The factors in the formulas (4, 26, 130) are in cubic meters and are the incremental room sizes that relate to increasing charge amounts and the type of ventilation permitted or required for the room that avoid reaching the lower flammable limit if the entire charge is released and mixed with the room air. The formulas governing the charge amount are based on a consideration of non-uniform mixing, if the refrigerant is heavier or lighter than air.~~

~~NOTE 2 The method to determine the *LFL* of a blend refrigerant is under consideration by ASHRAE 34 [ISO 817]. For the *LFL* of a refrigerant not included in Annex BB, it must be referred to ASHRAE 34 [ISO 817].~~

~~**Table GG.1 – Mass of refrigerants**~~

~~Maximum mass of refrigerants~~	~~Outdoor all installations~~	~~Indoor installed or stored below or above ground level~~
~~$M \leq m_1$~~	~~Shall comply with 22.116 and 22.117~~	~~Shall comply with 22.116 and 22.117~~
~~$m_1 < M \leq m_2$~~	~~Shall comply with 22.116 and 22.117~~	~~Shall comply with 22.116 and 22.117~~ ~~The installation for unventilated and mechanical ventilation shall comply with Clause GG.2 or GG.3 below.~~
~~$m_2 < M \leq m_3$~~	~~Shall comply with 22.116 and 22.117~~	~~Shall comply with 22.116 and 22.117~~ ~~The installation for mechanical ventilation shall comply with Clause GG.3 below.~~
~~$M > m_3$~~	~~National standards apply~~	~~National standards apply~~

~~NOTE 3 The requirements applicable to a higher charge amount are permitted for each range in Table GG.1.~~

Symbol m_c denotes the **refrigerant charge** of a single **refrigerating system**. Where multiple **refrigerating systems** are servicing the same space, the **refrigerating system** with the largest **refrigerant charge** shall be used.

Where the parameters **lower flammability limit** (***LFL***) and molecular weight (*M*) are referenced in Annex GG, the values used shall be based on WCF – Worst Case Formulation as defined in ISO 817.

NOTE 1 Table GG.1 is provided as guidance when applying Annex GG.

NOTE 2 The factors in the formulas are in cubic metres and are the incremental room sizes that relate to increasing **refrigerant charge** and the type of ventilation permitted or required for the room that avoid reaching the **lower flammability limit**, if the entire **refrigerant charge** is released and mixed with the room air. The formulas governing the **refrigerant charge** are based on a consideration of non-uniform mixing, if the refrigerant is heavier or lighter than air.

NOTE 3 For the ***LFL*** of a refrigerant not included in Annex BB, it is referred to ISO 817. If the ***LFL*** is also not listed in ISO 817, the method to determine the ***LFL*** of a blend refrigerant is defined in ISO 817.

NOTE 4 Determine the column for indoor or outdoor application. The requirements are identified in the appropriate box and the product and installation requirements are identified.

NOTE 5 The requirements applicable to a higher **refrigerant charge** are permitted for each range in Table GG.1.

Table GG.1 – Outline of Annex GG (informative)

<table>
<tr><th rowspan="3">Refrigerant charge</th><th colspan="3">Direct system [a]</th><th rowspan="3">Indirect system [b]</th></tr>
<tr><th colspan="3">Indoor space</th><th rowspan="2">Outdoors</th></tr>
<tr><th>Refrigerant charge and room area</th><th>Refrigerant charge, room area and additional requirements</th><th>Additional ventilation</th></tr>
<tr><td>$m_c \leq m_1$</td><td colspan="3">No room size restriction</td><td rowspan="4">No room size restriction</td><td rowspan="4">No room size restriction,
GG.6</td></tr>
<tr><td>$m_1 < m_c \leq 2 \times m_1$
(non-fixed appliance)</td><td>Not allowed</td><td>GG.7</td><td>Not allowed</td></tr>
<tr><td>$m_1 < m_c \leq m_2$</td><td>GG.2.1</td><td>GG.2.2[c], GG.9[c], GG.10[c,d]</td><td>GG.3, GG.8[c], GG.10[c,d]</td></tr>
<tr><td>$m_2 < m_c \leq m_3$</td><td>Not allowed</td><td>GG.9[c], GG.10[c,d]</td><td>GG.3, GG.8[c], GG.10[c,d]</td></tr>
<tr><td>$m_c > m_3$</td><td colspan="5">Beyond the scope of this standard. National standards apply</td></tr>
</table>

[a] Direct system means a **refrigerating system** in which a single rupture of the refrigerant circuit results in a refrigerant release to a space, irrespective of the location of the refrigerant circuit.

[b] Indirect system means a **refrigerating system** in which a single rupture of the refrigerant circuit does not leak into an indoor space, irrespective of the location of the refrigerant circuit.

[c] These clauses are only applicable to appliances with **A2L refrigerant**.

[d] **Refrigerant charge** is limited to $m_1 < m_c \leq 4 \times m_2$.

GG.1.2 Determination of the case applicable

Determine the case applicable based on the relationship of the **refrigerant charge** (m_c) and m_1, m_2, m_3, defined as follows:

$$m_1 = 4 \times LFL \qquad \text{(GG.1)}$$

$$m_2 = 26 \times LFL \quad \text{(GG.2)}$$

$$m_3 = 130 \times LFL \quad \text{(GG.3)}$$

where *LFL* is the **lower flammability limit** in kg/m^3 for the refrigerant used.

For **A2L refrigerants**, m_1, m_2, m_3 is defined as follows:

$$m_1 = 6 \times LFL \quad \text{(GG.4)}$$

$$m_2 = 52 \times LFL \quad \text{(GG.5)}$$

$$m_3 = 260 \times LFL \quad \text{(GG.6)}$$

where *LFL* is the **lower flammable limit** in kg/m^3 for the refrigerant used.

If an appliance with **A2L refrigerant** has more than one **refrigerating system**, **refrigerant charge** (m_c) refers to the **refrigerating system** with the largest charge serving the same space.

GG.1.3 Determination of unventilated room area for appliances using A2L refrigerants

For the purpose of determination of room area (A) when used to calculate the **maximum** allowable **refrigerant charge** (m_{max}) in an unventilated space, the following shall apply.

The room area (A) shall be defined as the room area enclosed by the projection to the floor of the walls, partitions and doors of the space in which the appliance is installed.

Spaces connected by only drop ceilings, ductwork, or similar connections shall not be considered a single space.

For units mounted higher than 1,6 m, and in compliance with GG.2.2, spaces divided by partition walls which are no higher than 1,6 m shall be considered a single space.

For **fixed appliances**, rooms on the same floor and connected by an open passageway between the spaces can be considered a single room when determining compliance to A_{min}, if the passageway complies with all of the following.

- It is a permanent opening.
- It extends to the floor.
- It is intended for people to walk through.

For **fixed appliances**, the area of the adjacent rooms, on the same floor, connected by permanent opening in the walls and/or doors between occupied spaces, including gaps between the wall and the floor, can be considered a single room when determining compliance to A_{min}, provided all of the following are met.

- The space shall have appropriate openings according to GG.1.4.
- The minimum opening area for natural ventilation Anv_{min} shall not be less than the following:

$$Anv_{min} = \frac{m_c - m_{max}}{LFL \times 104} \times \sqrt{\frac{A}{g \times m_{max}} \times \frac{M}{M - 29}} \quad \text{(GG.7)}$$

where

Anv_{min}	is the minimum opening for natural ventilation in m^2;
m_c	is the actual **refrigerant charge** of refrigerant in the system in kg;
m_{max}	is the allowable **maximum refrigerant charge** in the system in kg, calculated according to Clause GG.2 or m_2, whichever is lower;
LFL	is the **lower flammability limit** in kg/m^3;
A	is the room area in m^2;
M	is the molar mass of the refrigerant
g	is the gravity acceleration of 9,81 m/s^2;
29	is the average molar mass of air in kg.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.1.4 Opening conditions for connected rooms and natural ventilation

When the openings for connected rooms or natural ventilation are required, the following conditions shall be applied.

- The area of any openings above 300 mm from the floor shall not be considered in determining compliance with Anv_{min}.
- At least 50 % of the required opening area Anv_{min} shall be below 200 mm from the floor.
- The bottom of the lowest openings shall not be higher than the point of release when the unit is installed and not more than 100 mm from the floor.
- Openings are permanent openings which cannot be closed.
- The height of the openings between the wall and floor which connect the rooms are not less than 20 mm.
- A second higher opening shall be provided. The total size of the second opening shall not be less than 50 % of minimum opening area for Anv_{min} and shall be at least 1,5 m above the floor.

NOTE The requirement for the second opening can be met by drop ceilings, ventilation ducts, or similar arrangements that provide an airflow path between the connected rooms.

GG.2 Requirements for charge limits in unventilated areas

~~This is applicable for appliances with a charge amount $m_1 < M \leq m_2$ and for **non-fixed factory sealed single package units** with a charge amount of $m_1 < M \leq 2 \times m_1$:~~

~~See Figure GG.1.~~

~~For **non-fixed factory sealed single package units** with a charge amount of $m_1 < M \leq 2 \times m_1$ the requirements of Clause GG.8 apply.~~

~~For other appliances with a charge amount of $m_1 < M \leq m_2$:~~

~~The maximum charge in a room shall be in accordance with the following:~~

$$m_{max} = 2{,}5 \times (LFL)^{(5/4)} \times h_0 \times (A)^{1/2}$$

~~or the required minimum floor area A_{min} to install an appliance with refrigerant charge M (kg) shall be in accordance with following:~~

~~$A_{min} = (M / (2,5 \times (LFL)^{(5/4)} \times h_0))^2$~~

~~where~~

~~m_{max} is the allowable maximum charge in a room, in kg;~~

~~M is the refrigerant charge amount in appliance, in kg;~~

~~A_{min} is the required minimum room area, in m^2;~~

~~A is the room area, in m^2;~~

~~LFL is the lower flammable limit, in kg/m^3;~~

~~h_0 is the installation height of the appliance, in metres for calculating m_{max} or A_{min}:~~

~~0,6 m for floor location;~~

~~1,8 m for wall mounted;~~

~~1,0 m for window mounted;~~

~~2,2 m for ceiling mounted;~~

~~where the LFL is in kg/m^3 from Annex BB and the molecular weight of the refrigerant is greater than 42.~~

~~NOTE 1 This formula cannot be used for refrigerants lighter than 42 kg/kmol.~~

~~NOTE 2 Some examples of the results of the calculations according to the above formula are given in Tables GG.4 and GG.5.~~

GG.2.1 General

Clause GG.2 is applicable for appliances with a **refrigerant charge** $m_1 < m_c \leq m_2$ and for **non-fixed factory sealed single package units** with a **refrigerant charge** of $m_1 < m_c \leq 2 \times m_1$:

See Figure GG.1.

For **non-fixed factory sealed single package units** with a **refrigerant charge** of $m_1 < m_c \leq 2 \times m_1$, the requirements of Clause GG.7 apply.

For systems using **A2L refrigerants** with a **refrigerant charge** of $m_1 < m_c \leq m_3$ that comply with the conditions in 22.125, the requirements of Clause GG.10 can apply.

For other appliances with a **refrigerant charge** of $m_1 < m_c \leq m_2$:

The **maximum refrigerant charge** in a room shall be in accordance with the following:

$$m_{max} = 2,5 \times (LFL)^{(5/4)} \times h_0 \times (A)^{1/2}, \text{ not to exceed } m_{max} = SF \times LFL \times h_0 \times A \quad \text{(GG.8)}$$

or the required minimum floor area A_{min} to install an appliance with **refrigerant charge** m_c (kg) shall be in accordance with following:

$$A_{min} = (m_c / (2,5 \times (LFL)^{(5/4)} \times h_0))^2, \text{ not less than } A_{min} = m_c / (SF \times LFL \times h_0) \quad \text{(GG.9)}$$

where

m_{max} is the allowable **maximum refrigerant charge** in a room, in kg;

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

A_{min} is the required minimum room area, in m^2;

A is the room area, in m^2;

LFL is the **lower flammability limit**, in kg/m^3;

SF is a safety factor with a value of 0,75;

h_0 is the release height, the vertical distance in metres from the floor to the point of release when the appliance is installed (see Figure GG.5).

$h_0 = (h_{inst}+h_{rel})$ or 0,6 m, whichever is higher.

h_{rel} is the **release offset** in metres from the bottom of the appliance to the point of release (see Figure GG.5). Cumulative openings smaller than 5 cm^2 and openings with a single dimension of not more than 0,1 mm are not considered as openings where leaking refrigerant can escape. Openings for routing of wires and tubing which are not sealed openings shall include the total area of the opening without consideration of the area occupied by the tubing or wire.

h_{inst} is the **installed height** in metres of the unit (see Figure GG.5).

Reference **installed heights** are given below:

h_{inst} = 0,0 m for portable and floor mounted;

h_{inst} = 1,0 m for window mounted;

h_{inst} = 1,8 m for wall mounted;

h_{inst} = 2,2 m for ceiling mounted.

If the minimum **installed height** given by the manufacturer is higher than the reference **installed height**, then in addition A_{min} and m_{max} for the reference **installed height** have to be given by the manufacturer. An appliance may have multiple reference **installed heights**. In this case, A_{min} and m_{max} calculations shall be provided for all applicable reference **installed heights**.

For appliances serving one or more rooms with an air duct system, the lowest opening of the duct connection to each conditioned space or any opening of the indoor unit greater than 5 cm^2, at the lowest position to the space, shall be used for h_0. However, h_0 shall not be less than 0,6 m. A_{min} shall be calculated as a function of the opening heights of the duct to the spaces and the **refrigerant charge** for the spaces where leaked refrigerant may flow to, considering where the unit is located. A_{min} shall be calculated for the spaces where a duct is connected or an indoor unit is located. If all spaces have room area more than respective A_{min}, no further measure is required. If any room area of spaces is below A_{min}, measures according to Clause GG.8 or GG.9 shall be provided for appliances using **A2L refrigerants**.

NOTE This formula is not applicable for refrigerants lighter than 42 kg/kmol.

GG.2.2 Appliances using A2L refrigerants with incorporated circulation airflow

GG.2.2.1 General

Incorporated **circulation airflow** applies to fixed appliances only.

When the fan incorporated to an appliance is continuously operated or operation is initiated by a **refrigerant detection system** with a sufficient **circulation airflow** rate (see also Table GG.2), the **maximum refrigerant charge** can be increased or minimum room area can be reduced according to the following:

The **maximum refrigerant charge** in a room shall be in accordance with the following:

$$m_{max} = 0{,}75 \times LFL \times h_{ra} \times A \qquad \text{(GG.10)}$$

or the required minimum room area A_{min} of installed appliance with **refrigerant charge** m_c (kg) shall be in accordance with following;

$$A_{min} = m_c/(0{,}75 \times LFL \times h_{ra}) \quad \text{(GG.11)}$$

where

m_{max} is the allowable **maximum refrigerant charge** in the system in kg;

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

A_{min} is the required minimum room area in m^2;

h_{ra} is the estimate reaching height of airflow in m;

A is the room area in m^2;

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

Table GG.2 – Circulation airflow

Appliances	Airflow direction Φ[c] (°)	Airflow		Estimated reaching height h_{ra}[b] (m)
		Minimum velocity[a] v (m/s)	Minimum airflow rate (m^3/h)	
All	Downwards $-90° \leq \varphi \leq 0°$	1	$30 \times m_c/LFL$	h_a
Installed with lower edge of air inlet within 0,2 m from the floor	Upwards $0° < \varphi \leq 90°$			$h_a + h_d$
h_a is the air delivery height in upper side in m. h_d is the dynamic reaching height of airflow in m.				
[a] Velocity shall be calculated as airflow divided by the nominal face area of the outlet. The grill area shall not be deducted. [b] h_{ra} shall not exceed 2,2 m. [c] See Figure GG.6 for examples.				

$$h_d = \left(1 + \frac{2{,}35}{LFL\left(1 - \frac{1{,}2}{\rho}\right) + 0{,}05}\right) \times \left(0{,}0183 \times v^2 \times \sin^2 \varphi\right) \quad \text{(GG.12)}$$

where

v is the **circulation airflow** velocity in m/s;

φ is the **circulation airflow** elevation angle from horizontal in degrees ($0° \leq \emptyset \leq 90°$);

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

ρ is the gas density of the refrigerant at atmospheric pressure and 25 °C in kg/m^3.

See Figure GG.6.

GG.2.2.2 Continuous circulation airflow

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

- Disable the compressor operation.

- Warn user that airflow is reduced.

Compliance is checked by inspection.

GG.2.2.3 Circulation airflow activated by a refrigerant detection system

If a **refrigerant detection system** is activated per Annex LL, the following actions shall be taken and continue for at least 5 min after the **refrigerant detection system** has reset:

- The fan shall be switched on.
- Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

Where a remote **refrigerant detection system** is used in a room with multiple units, all of the detection system activated safety measures shall be applied to all units in the room which rely on the remote **refrigerant detection system**.

Compliance is checked by inspection.

GG.3 Requirements for charge limits in areas with mechanical ventilation

~~NOTE~~ Clause GG.3 is applicable for appliances with a **refrigerant charge** ~~amount~~ of $m_1 <$ ~~M~~ $m_c \leq m_3$.

See Figure GG.2.

Mechanical ventilation applies to **fixed appliances** only.

Mechanical ventilation occurs when the appliance enclosure or the room is provided with a ventilating system that, in the event of a leak, is intended to vent refrigerant into an area where there is not a **potential ignition source** and the gas can be readily dispersed. The appliance enclosure shall have a ventilation system that produces airflow within the appliance enclosure and meets the requirements of Clause GG.4 or is intended to be installed in a room that meets the requirements of Clause GG.5.

GG.4 Requirements for mechanical ventilation within the appliance enclosure

The refrigerating circuit is provided with a separate enclosure that does not ~~communicate with~~ allow flow from inside the enclosure to the room. The appliance enclosure shall have a ventilation system that produces airflow from the appliance interior to the outside through a ventilation shaft. The manufacturer shall specify the ventilation shaft width and height, the maximum length and number of bends. ~~The appliance shall provide for airflow between the room and the interior of the appliance enclosure.~~ The negative pressure measurement in the interior of the appliance enclosure shall be 20 Pa or more and the flow rate to the exterior shall be at least Q_{min}. ~~The ventilation duct does not contain any components.~~

~~$Q_{min} = S \times 15\ (m_c/\rho)$ (with a minimum of 2 m^3/h)~~

~~where~~

~~S = 4 (safety factor);~~

~~ρ is the density of the refrigerant at atmospheric pressure at 25 °C, in kg/m^3;~~

~~Q_{min} is the minimum required volume flow of the ventilation, in m^3/h;~~

~~m_c is the refrigerant charge mass, in kg.~~

$$Q_{min} = S \times 15\ (24{,}5 \times m_c/M)\ \text{(with a minimum of 2 m}^3/h) \qquad \text{(GG.13)}$$

where

S is a safety factor of 4;

M is the molar mass of refrigerant in g/mol;

Q_{min} is the minimum required volume flow of the ventilation in m^3/h;

m_c is the **refrigerant charge**;

24,5 is the gas constant in l/mol;

15 is the conversion from per minute to per hour with 4 min scenario.

NOTE 1 The constant 15 above is based on the assumptions used for the charge size formulas, i.e. releasing the full **refrigerant charge** ~~amount~~ within 4 min.

NOTE 2 For blends, the molar mass is the mole fraction weighted average of the molar masses of the components.

Compliance for the appliance ventilation system is checked by the following tests.

The appliance shall be installed in accordance with the ~~manufacturer's~~ instructions and the ventilation shaft shall not exceed the maximum length and number of bends specified by the manufacturer.

The room shall be at least 10 times the volume of the appliance and with sufficient make-up air to replace any air exhausted during the test. The air pressure differential is measured between the interior of the appliance enclosure and the room. The airflow rate shall be measured at the outside end of the ventilation shaft.

Ventilation shall be to the outside or to a room with a minimum volume as specified under the unventilated area case.

The airflow is detected continuously or monitored continuously and the appliance or the motor compressor is switched off within 10 s in the event that the airflow is reduced below Q_{min},

or

*The ventilation is switched on by a refrigerant ~~gas sensor~~ detection system before 25 % of the **LFL** (**lower ~~flammable~~ flammability limit**) is obtained. The sensor shall be suitably located considering the density of the refrigerant and periodically proved in accordance to the ~~manufacturer's~~ instructions. The airflow is periodically checked and detected and the appliance or the motor compressor is switched off within 10 s in the event that the airflow is reduced below Q_{min}.*

GG.5 Requirements for mechanical ventilation for rooms complying with ISO 5149

~~*The appliance shall be designed to meet the requirements of ISO 5149.*~~ Machinery rooms shall meet the requirements of Clause 5 of ISO 5149-3:2014.

GG.6 Requirements for ~~refrigeration~~ refrigerating systems employing secondary heat exchangers

If a **flammable refrigerant** is used and the system contains a secondary **heat exchanger**, the **heat exchanger** shall not allow the release of refrigerant into areas served by the secondary **heat exchanger** fluid if these areas are covered by Annex GG. The following may be considered to comply with this requirement:

– an open loop secondary system vented to the outside; or

– ~~an automatic air/refrigerant separator within the secondary circuit on the outlet pipe from the **evaporator** or the **condenser**. Such devices shall be at a high level relative to the **heat exchanger**. The air/refrigerant separator shall have a flow rating rated to discharge the refrigerant that can be released through the **heat exchanger**. The air separator shall discharge the refrigerant into the machinery room, the unit enclosure, a designated space or the outside; or~~

– an automatic air/refrigerant separator and pressure relief valve is placed in the secondary circuit on the outlet pipe from the **evaporator** or the **condenser**. The air/refrigerant separator and pressure relief valve is at a high level relative to the outlet of the **heat exchanger** where leaked refrigerant may accumulate. The pressure relief valve shall have a flow rating rated to discharge the refrigerant that can be released through the **heat exchanger**. The air/refrigerant separator and pressure relief valve shall discharge the refrigerant into a space compliant with the charge limitations in Annex GG or to the outside; or

– a double wall **heat exchanger**, or

– a refrigerant system where the pressure of the secondary circuit is always greater than the pressure of the primary circuit in the area of contact, or

– the bursting of the secondary **heat exchanger** is avoided by

1) the use of a freezing protection device (testing of which is described in item 2) below) which considers

- fluid freezing point;
- distribution through the **heat exchanger**;
- glide of the evaporating refrigerant;
- service procedures that could lead to freeze damage, for example adding or removing the refrigerant in liquid phase from a **heat exchanger** containing standing water;

2) specifying requirements for specific properties of the secondary **heat exchanger** fluid to prevent corrosion, including:

- water: the manufacturer shall specify in the installation manual the water quality necessary for the specified **heat exchanger**;
- brine: the manufacturer shall specify in the installation manual the type of brine and its permitted concentration range for which the **heat exchanger** is suitable.

*An appliance whose **heat exchangers** may be damaged as a result of freezing (i.e. water to water **heat pumps**, water to air **heat pumps** or chillers) shall be tested as follows:*

*a) The appliance shall be allowed to run under stable conditions. The volume flow through the **evaporator** shall be monitored.*

b) The circulation pump will be switched off.

c) The freezing protection device shall switch off the compressor.

d) After 1 min, the circulation pump will be switched on again and the compressor will restart.

e) The procedures of items b) and d) shall be repeated 10 times.

*f) After 10 repetitions, the volume flow through the **evaporator** shall not be lower than the flow measured in item a). Allowance for the measurement tolerance has to be taken into account.*

*g) The appliance shall be tested with the minimum water flow at the **rated voltage** and frequency under the following temperature conditions.*

- *The water outlet is set just above the lowest cut out (taking into account tolerances) of the safety devices for protection against freezing of the **evaporator**.*
- *The **condenser** side is set so as to get the lowest condensation temperature within the **normal operation** range.*

- *The test equipment shall be set so that there is no automatic adjustment of the water flow on the **evaporator** side.*
- *The appliance shall operate continuously for a period of 6 h. During 6 h, none of the following conditions, indicating the start of freezing, shall appear:*
  1) *the water flow on the **evaporator** side will not drop more than 5 % compared to the initial water flow;*
  2) *the evaporating temperature will not drop more than 2 K;*
  3) *the temperature difference between inlet and outlet water temperature of the **evaporator** will not drop more than 30 % compared to the initial temperature difference.*

~~**GG.7 Additional testing**~~

The appliance shall then be tested with a maximum water flow under the conditions described in item g).

GG.7 Non fixed factory sealed single package units with a refrigerant charge ~~amount~~ of $m_1 <$ ~~M~~ $m_c \leq 2 \times m_1$

GG.7.1 Determination of refrigerant charge

For non-**fixed factory sealed single package units** (i.e. one functional unit in one enclosure) with a **refrigerant charge** ~~amount~~ of $m_1 <$ ~~M~~ $m_c \leq 2 \times m_1$, the **maximum refrigerant charge** in a room shall be in accordance with the following:

$$m_{max} = 0{,}25 \times A \times LFL \times 2{,}2 \qquad \text{(GG.14)}$$

or the required minimum floor area, A_{min}, to install an appliance with **refrigerant charge** ~~M~~ m_c shall be in accordance with the following:

$$A_{min} = \text{~~M~~}\ m_c/(0{,}25 \times LFL \times 2{,}2) \qquad \text{(GG.15)}$$

where

m_{max} is the allowable **maximum refrigerant charge** in a room in kg;

~~M~~ m_c is the **refrigerant charge** ~~amount~~ in the appliance in kg;

A_{min} is the required minimum room area in m^2;

A is the room area in m^2;

LFL is the **lower flammability limit** in kg/m^3, as referred in Annex BB;

2,2 is the minimum ceiling height employed in metres (m);

0,25 is a safety factor.

The appliance can be placed at any height above the floor.

When the appliance is switched on, a fan shall operate continuously supplying a minimum airflow as under normal steady state conditions, even when the compressor is switched off by the **thermostat**.

Compliance is checked by inspection.

GG.7.2 Mechanical requirements

GG.7.2.1 General

The appliance shall withstand the effects of dropping and vibration during transport and normal use without leaking refrigerant.

The appliance is subjected to the tests of GG.7.2.2 to GG.7.2.5. There shall be no refrigerant leakage.

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 tests of GG.7.2.2, GG.7.2.3 and GG.7.2.4 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.~~

GG.7.2.2 Random vibration test

The appliance is tested in its final packaging for transport and shall withstand a random vibration test for 180 min according to ASTM ~~D 4728-01~~ D 4728-06. The power spectral density profiles to be applied are those specified in Figure X1.1 and Table X1.1 of ASTM ~~D 4728-01:2001~~ D 4728-06:2012 for truck transportation.

GG.7.2.3 Drop test with packaging

The appliance is tested in its final packaging for transport and shall withstand the following number of drops on a horizontal hardwood board 20 mm thick placed on a concrete or similar hard surface:

- one with the appliance held upright;
- one for each of the four edges of the bottom side, with the bottom side forming an angle of about 30° to the horizontal.

The drop height depends on the weight of the appliance according to the following Table GG.3:

Table GG.3 – Appliance with packaging

Appliance weight kg	**Drop height** cm
< 10	80
≥ 10 and < 20	60
≥ 20 and < 30	50
≥ 30 and < 40	40
≥ 40 and < 50	30
≥ 50	20

GG.7.2.4 Drop test without packaging

The tests of GG.7.2.3 are repeated on the appliance without its packaging and with the drop height according to the following Table GG.4:

Table GG.4 – Appliance without packaging

Appliance weight kg	Drop height cm
< 10	20
≥ 10 and < 20	17
≥ 20 and < 30	15
≥ 30 and < 40	12
≥ 40	10

GG.7.2.5 Test after installation

The appliance is installed in accordance with the installation instructions. It is supplied at **rated voltage** or at the upper limit of the **rated voltage range** and operated at ambient temperature.

The appliance is operated ~~in cycles for 10 days (240 h)~~ for 960 cycles, each cycle consisting of the compressor running for 10 min minimum followed by a rest period of 5 min minimum.

This test may be made on a separate sample.

GG.7.3 Vibration test

The appliance shall be constructed so that its operation does not cause resonance points in the piping connected to the compressor.

Compliance is checked by the following test:

*The appliance is installed in accordance with the installation instructions. It is supplied at **rated voltage** or at the upper limit of the **rated voltage range** and operated at ambient temperature.*

*The supply frequency is increased in steps of 1 Hz between ~~0,8~~ 0,9 times and ~~1,2~~ 1,1 times the **rated frequency**.*

The vibration amplitude is measured at critical points in the piping. There shall be no sudden increase of the amplitude when increasing the supply frequency within the specified range.

NOTE 1 The vibration amplitude can be measured, for example, by sliding an arrow gauge along the piping. The arrow gauge is an isosceles triangle with a height equal to 10 times the base (see Figure GG.3) and is held against the piping with the arrow axis perpendicular to the direction of the vibration to be measured. The amplitude is the value of A (see Figure GG.4) divided by 10.

NOTE 2 Critical points are those with a larger vibration amplitude.

This test may be made on a separate sample.

Table GG.4 – Maximum charge (kg) (see Note 2 of Clause GG.2)

Category	*LFL* kg/m³	h_a m	Floor area m²						
			4	7	10	15	20	30	50
R290	0,038	0,6	0,05	0,07	0,08	0,10	0,11	0,14	0,18
		1,0	0,08	0,11	0,13	0,16	0,19	0,23	0,30
		1,8	0,15	0,20	0,24	0,29	0,34	0,41	0,53
		2,2	0,18	0,24	0,29	0,36	0,41	0,51	0,65
R32	0,306	0,6	0,68	0,90	1,08	1,32	1,53	1,87	2,41
		1,0	1,14	1,51	1,80	2,20	2,54	3,12	4,02
		1,8	2,05	2,71	3,24	3,97	4,58	5,61	7,24
		2,2	2,50	3,31	3,96	4,85	5,60	6,86	8,85
R1270	0,040	0,6	0,05	0,07	0,08	0,10	0,12	0,15	0,19
		1,0	0,09	0,12	0,14	0,17	0,21	0,24	0,32
		1,8	0,16	0,21	0,25	0,31	0,36	0,44	0,57
		2,2	0,20	0,26	0,31	0,38	0,44	0,54	0,70

Table GG.5 – Minimum room area (m²) (see Note 2 of Clause GG.2)

Category	*LFL* kg/m³	h_a m	Charge amount (*M*) in kg Minimum room area m²						
			0,152 kg	0,228 kg	0,304 kg	0,456 kg	0,608 kg	0,76 kg	0,988 kg
R290	0,038	0,6		82	146	328	584	912	1541
		1,0		30	53	118	210	328	555
		1,8		9	16	36	65	101	171
		2,2		6	11	24	43	68	115
			1,224 kg	1,836 kg	2,448 kg	3,672 kg	4,896 kg	6,12 kg	7,956 kg
R32	0,306	0,6		29	51	116	206	321	543
		1,0		10	19	42	74	116	196
		1,8		3	6	13	23	36	60
		2,2		2	4	9	15	24	40
			0,14 kg	0,21 kg	0,28 kg	0,42 kg	0,56 kg	0,7 kg	0,91 kg
R1270	0,040	0,6	27	61	109	245	436	681	1150
		1,0	10	22	39	88	157	245	414
		1,8	3	7	12	27	48	76	128
		2,2	2	5	8	18	32	51	86

GG.8 Ventilated area requirements for appliances using A2L refrigerants

GG.8.1 General

Clause GG.8 is applicable for appliances with a **refrigerant charge** $0 < m_c \leq m_3$.

Ventilation shall be employed when **refrigerant charge** is $m_c > m_{max}$.

Natural and mechanical ventilation apply to **fixed appliances** only.

GG.8.2 Natural ventilation requirements for appliances using A2L refrigerants

GG.8.2.1 General

Natural ventilation shall be permitted for **A2L refrigerants** on the conditions as outlined in GG.8.2.2 and GG.8.2.3.

Subclause GG.8.2 is applicable for appliances with a **refrigerant charge** of $m_c < m_3$.

GG.8.2.2 Natural ventilation to occupied indoor space

If natural ventilation is applied in occupied space, all of the following shall be met.

– Natural ventilation shall be made to a room where sufficient air is available to dilute the refrigerant below the ***LFL***.

– Natural ventilation from an occupied space shall not be made to outdoor.

NOTE User can block the natural ventilation to the outside if it is cold outside.

– For natural ventilation opening provided to an unoccupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation shall have a room area more than A_{min} according to Clause GG.2 for m_c. If the total room area is not large enough, the measure of GG.8.3 or Clause GG.9 shall be taken.

– The openings for natural ventilation shall comply with GG.1.4.

The minimum opening area for natural ventilation shall be calculated using the following equation:

$$Anv_{min} = \frac{m_c - m_{max}}{LFL \times 104} \times \sqrt{\frac{A}{g \times m_{max}} \times \frac{M}{M - 29}} \qquad \text{(GG.16)}$$

where

Anv_{min} is the minimum opening area for natural ventilation in m^2;

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

m_{max} is the allowable **maximum refrigerant charge** for a system in kg calculated in accordance with Clause GG.2 or m_2, whichever is lower;

LFL is the **lower flammability limit** (LFL) in kg/m^3;

A is the room area in m^2;

M is the molar mass of the refrigerant;

g is the gravity acceleration of 9,81 m/s^2.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.8.2.3 Natural ventilation to outdoors or unoccupied indoor space

If natural ventilation is applied in occupied space, all of the following shall be met.

– Natural ventilation to the outside is not allowed below ground level.

– For natural ventilation opening provided to an unoccupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation, shall have a room area more than A_{min} according to Clause GG.2

for m_c. If the total room area is not large enough, other measure of GG.8.3 or Clause GG.9 shall be taken.

– The openings for natural ventilation shall comply with GG.1.4.

– The minimum opening area for natural ventilation shall be calculated using the following equation:

$$m_{max} = \frac{\left(\frac{Anv_{min}}{0{,}14}\right)^2}{\frac{0{,}04}{LFL}} \quad \text{(GG.17)}$$

$$Anv_{min} = 0{,}14 \times \sqrt{m_c \times \frac{0{,}04}{LFL}} \quad \text{(GG.18)}$$

where

m_c is the **refrigerant charge** of a system in kg;

m_{max} is the **maximum refrigerant charge** for a system in kg;

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

Anv_{min} is the total minimum opening area in m^2;

0,14 is a constant derived from the gravity acceleration, flow coefficient, etc.;

0,04 is the conversion constant from hydrocarbon to other ***LFL***.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.8.3 Mechanical ventilation requirements for rooms with appliances using A2L refrigerants

GG.8.3.1 Operation of mechanical ventilation

Where mechanical ventilation is required, GG.8.3.1.1 or GG.8.3.1.2 shall apply.

GG.8.3.1.1 Continuous operation of the fan

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

– Warn user that airflow is reduced.

GG.8.3.1.2 Fan activated by a refrigerant detection system

If a **refrigerant detection system** is activated per Annex LL, the following actions shall be taken and continue for at least 5 min after the **refrigerant detection system** has reset:

– The fan shall be switched on.

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

The **refrigerant detection system** and controls shall maintain the purge cycle for at least 5 min after the **refrigerant detection system** has reset.

GG.8.3.2 Required airflow

The airflow shall be calculated using of the formula below. Losses caused by ducts or other components in the air stream shall be considered.

$$Q = \frac{m_c - m_{max}}{4 \times LFL} \times 2 \times 60 \quad \text{(GG.19)}$$

where

Q is the required airflow volume in m^3/h;

m_{max} is the **maximum refrigerant charge** for the system in the room in kg according to Clause GG.2, or m_2, whichever is lower, or Clause GG.9;

m_c is the actual **refrigerant charge** of a single **refrigerating system** expressed in kg;

4 is the assumed leak time (4 min);

2 is a safety factor of 2;

60 is the conversion minutes to hours;

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

Mechanical ventilation shall be made to the outdoor or the indoor space where the room volume is larger than the minimum room volume calculated using the following formula:

$$V = 4 \times m_c / LFL \quad \text{(GG.20)}$$

where

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

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

V is the minimum room volume in m^3;

4 is the assumed leak time (4 min).

GG.8.3.3 Requirement for opening

The lower edge of the opening of the mechanical ventilation shall not be more than 100 mm above the floor.

The air extraction openings shall be located at sufficient distance from the air intake openings to prevent re-circulation to the space.

GG.9 Charge limits for appliances using A2L refrigerants connected via an air duct system to one or more rooms

GG.9.1 General

Clause GG.9 is applicable for appliances with a **refrigerant charge** $0 < m_c \leq m_3$. The **maximum refrigerant charge** can be increased or the minimum room area can be reduced if the following requirements are met.

- The appliance shall be provided with a **refrigerant detection system** according to Annex LL, or the fan shall operate continuously and the airflow shall be monitored continuously.
- m_{max} shall be determined based on the total area of the conditioned space (TA) connected by ducts taking into consideration that the **circulation airflow** distributed to all the rooms by the appliance integral indoor fan will mix and dilute the leaking refrigerant before entering any room. In the case when no **refrigerant detection system** is provided then,

spaces where the airflow may be limited by zoning dampers shall not be included in the determination of *TA*.

The minimum airflow shall be determined as:

$$Q_{min} = 60 \times m_c / LFL \quad \text{(GG.21)}$$

where

Q_{min} is the minimum **circulation airflow** circulated to the total conditioned space in m^3/h;

m_c is the actual **refrigerant charge** for a single **refrigerating system** expressed in kg;

LFL is the **lower flammability limit** in kg/m^2.

The **maximum refrigerant charge** based on the room area for the total conditioned space shall be in accordance with the following:

$$m_{max} = SF \times LFL \times H \times TA \quad \text{(GG.22)}$$

or

the required minimum total conditioned room area TA_{min} of installed appliance with **refrigerant charge** m_c (kg) shall be in accordance with following:

$$TA_{min} = m_c/(SF \times LFL \times H) \quad \text{(GG.23)}$$

where

SF is the safety factor of 0,50;

m_{max} is the allowable **maximum refrigerant charge** in the system in kg;

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

TA_{min} is the required minimum area of the total conditioned space in m^2;

H is the height of the room = 2,2 m;

TA is the area of the total conditioned space in m^2;

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

If *TA* is smaller than TA_{min}, additional ventilation shall be employed.

The minimum additional mechanical ventilation and fresh air make up airflow shall be determined according to GG.8.3.

The additional mechanical ventilation shall exhaust to the outside or to an area such that the combined area exhausted to and the total conditioned area is greater than TA_{min}.

GG.9.2 Continuous circulation airflow

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

– Disable the compressor operation.

– Warn user that airflow is reduced.

Compliance is checked by inspection.

GG.9.3 Circulation airflow activated by a refrigerant detection system

When a **refrigerant detection system** according to Annex LL operates, the following shall be initiated.

- Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount of charge released to the indoor space.
- Fully open all zoning damper of the appliance and energize control signals to open any external zoning dampers if applicable.
- Activate additional mechanical ventilation, if required.

Compliance is checked by inspection.

The **refrigerant detection system** and controls shall maintain the above action until at least 5 min after the **refrigerant detection system** has reset. Building fire and smoke systems may override this function.

If the continuous operation of duct fan is employed, additional ventilation shall also be continuously operated.

GG.10 Allowable charge for enhanced tightness refrigerating systems

GG.10.1 General

Clause GG.10 is applicable to **enhanced tightness refrigerating systems** using **A2L refrigerants** with **refrigerant charge** $m_1 < m_c \leq$ number of indoor units × m_2, not to exceed 4 x m_2.

For appliances with more than one indoor unit, individual indoor unit cooling capacity shall not exceed 35 kW when tested in accordance with ISO 5151, ISO 13253, or ISO 15042 at T1 conditions. For heating only appliances with more than one indoor unit, individual indoor unit heating capacity shall not exceed 35 kW when tested in accordance with ISO 5151, ISO 13253, or ISO 15042 at H1 conditions.

The appropriate measures to be taken shall be ventilation (natural or mechanical), safety shut-off valves and safety alarm, in conjunction with **refrigerant detection systems** as specified in GG.10.2 to GG.10.5. A safety alarm alone shall not be considered as an appropriate measure where occupants are restricted in their movement (see Clause GG.13).

GG.10.2 Requirement for units with incorporated circulation airflow to prevent stagnation

GG.10.2.1 General

For indoor units where h_0 as determined in Clause GG.2 is less than 1,8 m, and for indoor units connected to one or more spaces by ducts which supply or return air from the space at a height less than 1.8 m, **circulation airflow** for the purpose of mixing the air in the room shall be provided. Where mechanical ventilation is required per Subclause GG.10.4 or Subclause GG.10.5, units where h_0 is equal or greater than 1,8 m, air circulation for the purpose of mixing the air in the room shall also be provided.

The circulation shall operate continuously or be turned on by **refrigerant detection systems**. The minimum air velocity and minimum airflow shall be as follows:

- Minimum airflow = 240 m^3/h
- Minimum air velocity

$$v_{min} = (-4{,}0 \times 10^{-5} \times M^2 + 0{,}010\ 8 \times M + 1{,}42)/\sin \varphi \qquad \text{(GG.24)}$$

where

v_{min} is the minimum air velocity in m/s;

M is the molar mass;

φ is the airflow angle above horizontal in degrees.

- The unit air velocity (v) shall be calculated as airflow divided by the nominal face area of the outlet. The grill area shall not be deducted.

NOTE The formula is based on appliances with a refrigerant release on floor level, which represents the most stringent situation.

As an alternative, for airflow angles between 15 degrees and 90 degrees, the minimum air velocity (v_{min}) can be determined by linear interpolation of the values included in Table GG.5.

Compliance is checked by testing.

Where a single remote **refrigerant detection system** sensor is used in a room with multiple units, this requirement shall apply to all units in the room which do not have a dedicated **refrigerant detection system**.

GG.10.2.2 Continuous circulation airflow

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

– Warn user that airflow is reduced.

GG.10.2.3 Circulation airflow initiated by a refrigerant detection system

When any **refrigerant detection system** is activated per Annex LL in response to a detected leak into the space, all indoor units in that room which are served by the same outdoor unit shall take the following actions and continue for at least 5 min:

– The fan shall be switched on.

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

GG.10.3 Required measures for allowable refrigerant charge

GG.10.3.1 Spaces except lowest underground floor of the building

Where the **refrigerant charge** does not exceed **maximum refrigerant charge** in GG.10.4, no additional measures are required.

Where the charge exceeds the **maximum refrigerant charge** in GG.10.4 but is less than or equal to the **maximum refrigerant charge** in GG.10.5, then at least one additional measure shall be taken in accordance with Clause GG.11, GG.12, or GG.13.

Where the **refrigerant charge** exceeds the **maximum refrigerant charge** in GG.10.5, at least two additional measures are taken in accordance with Clause GG.11, GG.12, or GG.13.

GG.10.3.2 Lowest underground floor of the building

Where the **refrigerant charge** exceeds the **maximum refrigerant charge** in GG.10.4, two additional measures shall be taken in accordance with Clause GG.11, GG.12, or GG.13.

The **refrigerant charge** shall not exceed the **maximum refrigerant charge** in GG.10.5.

GG.10.4 Maximum refrigerant charge

The **maximum refrigerant charge** m_{max} in a room and the required minimum room area A_{min} of the installed appliance with **refrigerant charge** m_c shall be in accordance with the following:

$$m_{max} = 0{,}25 \times LFL \times H \times A \quad \text{(GG.25)}$$

$$A_{min} = m_c/(0{,}25 \times LFL \times H) \quad \text{(GG.26)}$$

where

m_{max} is the **maximum refrigerant charge** in kg;

m_c is the total **refrigerant charge** in the **refrigerating system** in kg;

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

H is the room height in m but not more than 2,2 m unless h_0 as determined in Clause GG.2 is higher than 2,2 m;

A is the room floor area in m^2;

A_{min} is the required minimum room area in m^2.

For room areas exceeding 250 m^2, m_{max} shall be calculated with a room area (A) of 250 m^2.

GG.10.5 Maximum refrigerant charge when employing additional measures

The **maximum refrigerant charge** m_{max} and minimum room area A_{min} are calculated in accordance with the following:

$$m_{max} = 0{,}50 \times LFL \times H \times A \quad \text{(GG.27)}$$

$$A_{min} = m_c /(0{,}50 \times LFL \times H) \quad \text{(GG.28)}$$

where

m_{max} is the **maximum refrigerant charge** in kg;

m_c is the total **refrigerant charge** in the **refrigerating system** in kg;

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

H is the room height in m but not more than 2,2 m unless h_0 as determined in Clause GG.2 is higher than 2,2 m;

A is the room floor area in m^2;

A_{min} is the required minimum room area in m^2.

For room areas exceeding 250 m^2, m_{max} shall be calculated with a room area (A) of 250 m^2.

GG.11 Ventilation for enhanced tightness refrigerating systems using A2L refrigerants

GG.11.1 General

Ventilation shall be made to a place where sufficient air is available to dilute the leaked refrigerant such as outdoors or a large space. The indoor place used to provide ventilation air shall have sufficient volume, including the volume of the room in which the indoor unit is installed, to ensure that the **maximum refrigerant charge** specified in GG.10.4 is not exceeded.

GG.11.2 Natural ventilation

If natural ventilation is applied, all of the following shall be met.

– Natural ventilation from an occupied space shall not be made to outdoors.

NOTE User can block the natural ventilation to the outside if it is cold outside

– For natural ventilation opening provided to an occupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation shall have a room area more than A_{min} according to Clause GG.2 for m_c. If the total room area is not large enough, the measure of GG.11.3 shall be taken.

– Openings for natural ventilation shall comply with GG.1.4.

– The minimum opening area for natural ventilation shall be calculated using equation (GG.29):

$$Anv_{min} = \frac{1}{720 \times LFL} \times \sqrt{\frac{M}{LFL \times (M - 29)}} \qquad \text{(GG.29)}$$

where

Anv_{min} required natural ventilation opening area in m^2;

M molar mass in kg;

LFL **lower flammability limit** expressed in kg/m^3;

720 is the coefficient resulting from calculating all the constants used to establish the formula;

29 is the average molar mass of air in kg.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.11.3 Mechanical ventilation

GG.11.3.1 Operation of mechanical ventilation

Operation shall be according to GG.8.3.1, and for all indoor units in the same space which are served by a single **refrigerating system**, the fan shall be switched on to provide the minimum **circulation airflow** per GG.10.2.

GG.11.3.2 Required airflow

For $(Q \times 0{,}25 * LFL)/10 < 1$, the airflow of the mechanical ventilation shall be at least the quantity that satisfies the following formula:

$$m_c = -\frac{10 \times V}{Q} \ln\left(1 - \frac{Q \times 0{,}25 \times LFL}{10}\right) \qquad \text{(GG.30)}$$

For $(Q \times 0{,}25 * LFL)/10 \geq 1$, the airflow shall be determined according the following formula:

$$Q = \frac{10}{0{,}25 \times LFL} \qquad \text{(GG.31)}$$

where

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

V is the room volume in m^3;

10 is the expected maximum leak rate in kg/h;

Q is the ventilation airflow in m^3/h;

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

Losses caused by ducts or other components in the air stream shall be considered.

GG.11.3.3 Mechanical ventilation openings

The upper edge of the air extraction opening from the room shall be located equal or below the refrigerant release point. For floor mounted units, openings shall be according to GG.8.3.3.

GG.11.3.4 Operation of mechanical ventilation

Mechanical ventilation shall be operated continuously or shall be switched on by a **refrigerant detection system**.

GG.12 Safety shut-off valves for enhanced tightness refrigerating systems using A2L refrigerants

GG.12.1 Location

Safety shut-off valves shall be located in a space with a room volume large enough so that the **maximum refrigerant charge** complies with GG.10.4, GG.10.5, or outside. Safety shut-off valve shall be positioned to enable access for maintenance by an authorized person.

GG.12.2 Design

Safety shut-off valves shall be designed to close in the event of an electric power failure, e.g. spring return solenoid valves.

If safety shut-off valves are used to comply with GG.10.4 or GG.10.5, then the released amount of refrigerant shall be limited to 0,5 × ***LFL*** × room volume.

The amount of refrigerant that can be leaked shall consider the response time of the sensor and the controller that activates the valves and the remaining amount of refrigerant that is contained in each section of the **refrigerating system** after the valves are closed.

NOTE Liquid migration in the off cycle may be the worst case condition for determination of the charge contained in the systems after closing of the safety shut-off valves.

GG.13 Safety alarms for enhanced tightness refrigerating systems using A2L refrigerants

GG.13.1 General

If an alarm is employed to warn of a leak in the occupied space, the alarm shall warn of a refrigerant leak in accordance with GG.13.2. The alarm shall be turned on by the signal from the **refrigerant detection system**. The alarm shall also alert an authorized person to take appropriate action.

GG.13.2 Alarm system warning

GG.13.2.1 General

The alarm system shall warn both audibly and visibly, such as both a loud (15 dBA above the background level) buzzer and a flashing light.

GG.13.2.2 Alarm for general occupancy

At least one alarm inside the occupied space shall be installed. For the occupancy listed below, the alarm system shall also warn at a supervised location, such as the night porter's location, as well as the occupied space.

Rooms, parts of buildings, building where

- sleeping facilities are provided,
- people are restricted in their movement,
- an uncontrolled number of people are present, or
- to which any person has access without being personally acquainted with the necessary safety precautions.

Table GG.5 – Minimum airflow

Minimum airflow v_{min} (m/s)							
H_a (m)	M	Airflow angle above horizontal φ (degrees)					
		15	30	45	60	75	90
< 0,3	50	7,08	3,67	2,59	2,12	1,90	1,83
	60	7,40	3,83	2,71	2,21	1,98	1,92
	70	7,62	3,94	2,79	2,28	2,04	1,97
	80	7,78	4,03	2,85	2,32	2,08	2,01
	90	7,90	4,09	2,89	2,36	2,12	2,04
	100	8,00	4,14	2,93	2,39	2,14	2,07
	110	8,07	4,18	2,96	2,41	2,16	2,09
	120	8,14	4,21	2,98	2,43	2,18	2,11
< 0,60	50	6,47	3,35	2,37	1,93	1,73	1,67
	60	6,76	3,50	2,47	2,02	1,81	1,75
	70	6,96	3,60	2,55	2,08	1,86	1,80
	80	7,10	3,68	2,60	2,12	1,90	1,84
	90	7,21	3,73	2,64	2,16	1,93	1,87
	100	7,30	3,78	2,67	2,18	1,96	1,89
	110	7,37	3,82	2,70	2,20	1,97	1,91
	120	7,43	3,85	2,72	2,22	1,99	1,92
< 0,90	50	5,78	2,99	2,12	1,73	1,55	1,50
	60	6,04	3,13	2,21	1,81	1,62	1,56
	70	6,22	3,22	2,28	1,86	1,67	1,61
	80	6,35	3,29	2,32	1,90	1,70	1,64
	90	6,45	3,34	2,36	1,93	1,73	1,67
	100	6,53	3,38	2,39	1,95	1,75	1,69
	110	6,59	3,41	2,41	1,97	1,77	1,71
	120	6,64	3,44	2,43	1,99	1,78	1,72
< 1,20	50	5,01	2,59	1,83	1,50	1,34	1,30
	60	5,23	2,71	1,92	1,56	1,40	1,35
	70	5,39	2,79	1,97	1,61	1,44	1,39
	80	5,50	2,85	2,01	1,64	1,47	1,42
	90	5,59	2,89	2,04	1,67	1,50	1,45
	100	5,65	2,93	2,07	1,69	1,52	1,46
	110	5,71	2,96	2,09	1,71	1,53	1,48
	120	5,75	2,98	2,11	1,72	1,54	1,49
< 1,50	50	4,09	2,12	1,50	1,22	1,10	1,06
	60	4,27	2,21	1,56	1,28	1,15	1,11
	70	4,40	2,28	1,61	1,31	1,18	1,14
	80	4,49	2,32	1,64	1,34	1,20	1,16
	90	4,56	2,36	1,67	1,36	1,22	1,18
	100	4,62	2,39	1,69	1,38	1,24	1,19

Minimum airflow v_{min} (m/s)							
H_a (m)	M	Airflow angle above horizontal φ (degrees)					
		15	30	45	60	75	90
	110	4,66	2,41	1,71	1,39	1,25	1,21
	120	4,70	2,43	1,72	1,40	1,26	1,22
< 1,80	50	2,89	1,50	1,06	0,86	0,77	0,75
	60	3,02	1,56	1,11	0,90	0,81	0,78
	70	3,11	1,61	1,14	0,93	0,83	0,81
	80	3,18	1,64	1,16	0,95	0,85	0,82
	90	3,23	1,67	1,18	0,96	0,86	0,83
	100	3,26	1,69	1,19	0,98	0,87	0,84
	110	3,30	1,71	1,21	0,99	0,88	0,85
	120	3,32	1,72	1,22	0,99	0,89	0,86
h_a is the air delivery height in upper side in m.							

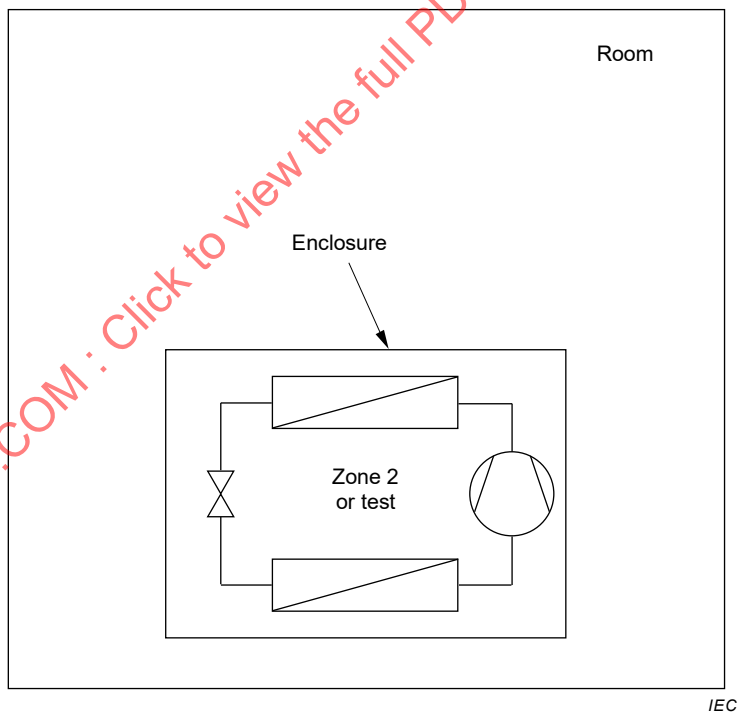


Figure GG.1 – Unventilated area

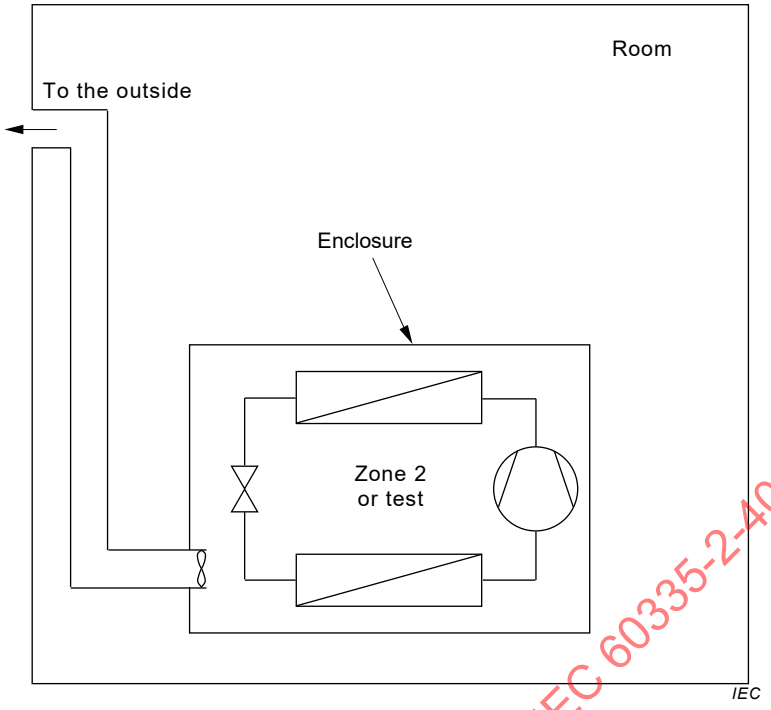


Figure GG.2 – Mechanical ventilation

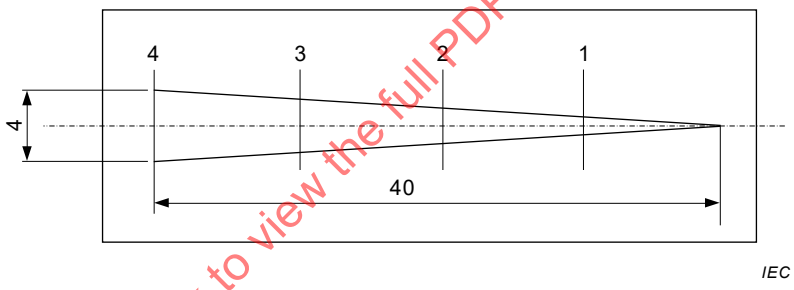


Figure GG.3 – Isosceles triangle arrow test gauge

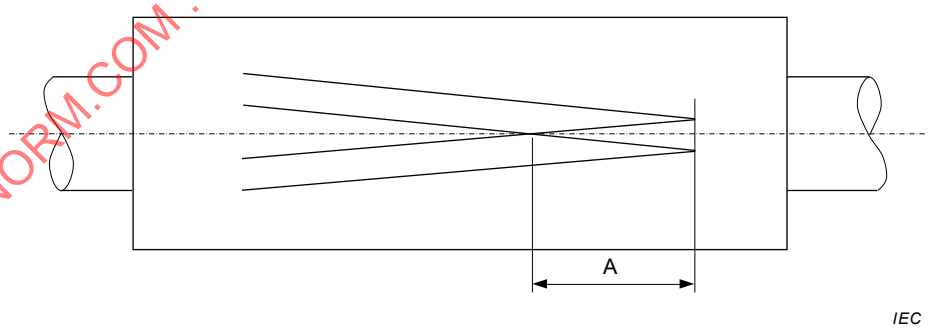


Figure GG.4 – Measurement of vibration amplitude

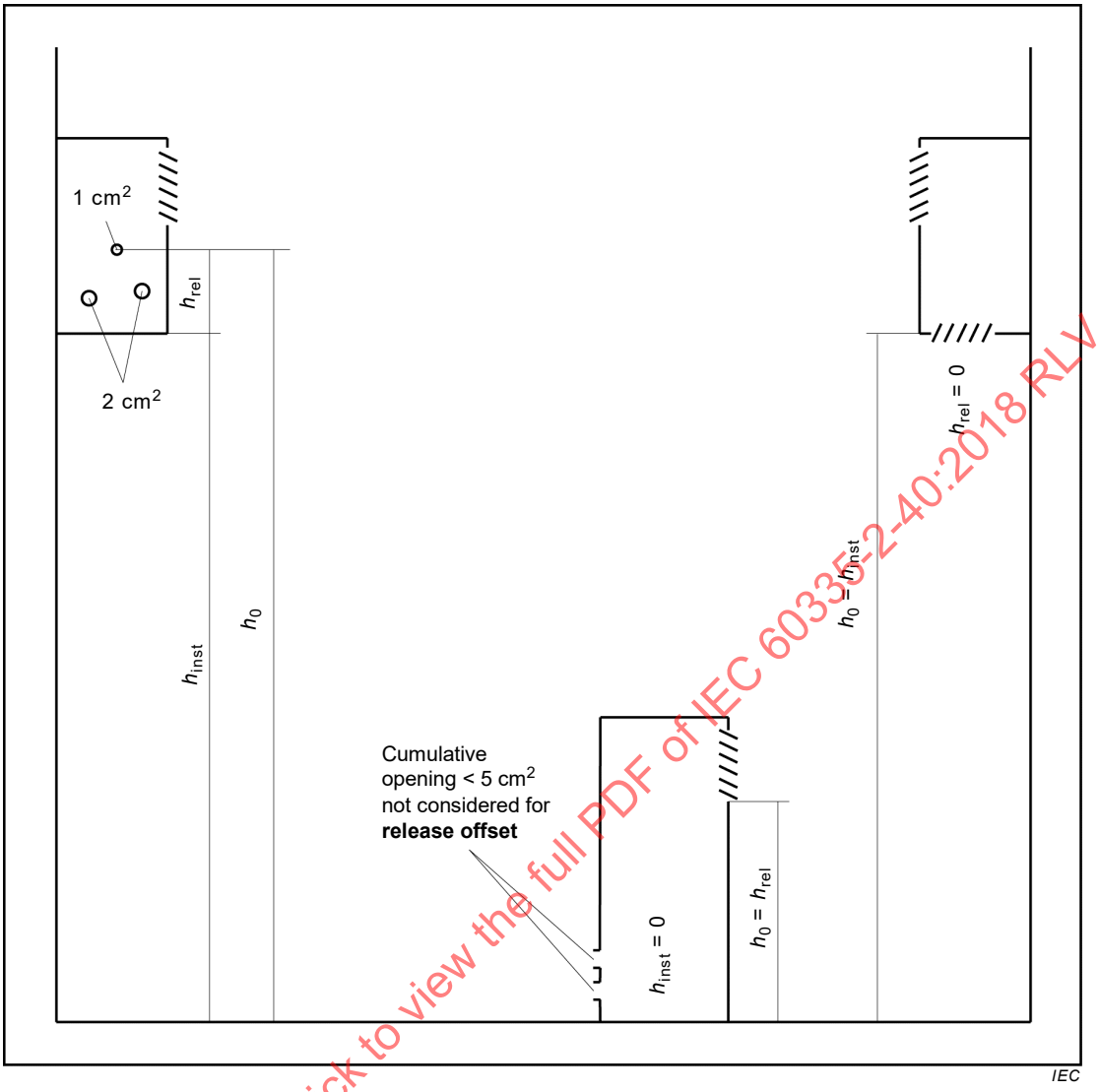
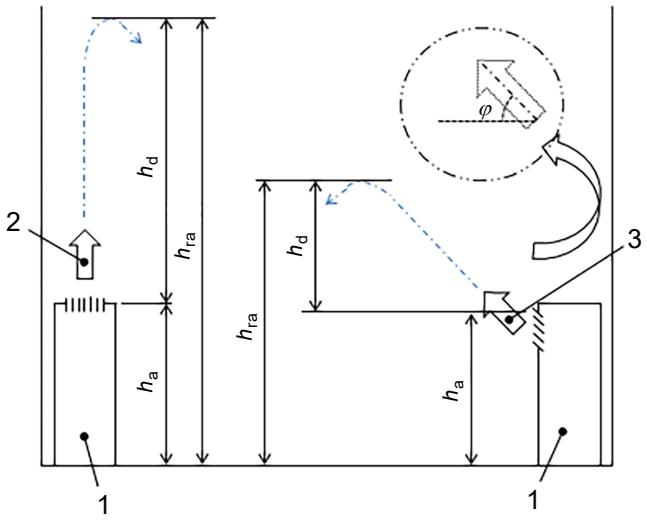


Figure GG.5 – Relevant heights h_{inst}, h_0 and h_{rel} for calculation of A_{min} and m_{max}



Key

1 appliance

2 airflow direction: Upwards (vertical φ = 90°)

3 airflow direction: Upwards

Figure GG.6 – Airflow direction

Annex HH
(informative)

Competence of service personnel

HH.1 General

~~Special training additional to usual refrigerating equipment repair procedures is required when equipment with **flammable refrigerants** is affected.~~

~~In many countries, this training is carried out by national training organisations that are accredited to teach the relevant national competency standards that may be set in legislation.~~

Information of procedures additional to usual information for refrigerating appliance installation, repair, maintenance and decommission procedures is required when an appliance with **flammable refrigerants** is affected.

The training of these procedures is carried out by national training organisations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation.

The achieved competence should be documented by a certificate.

HH.2 Information and training

HH.2.1 The training should include the substance of the following:

HH.2.2 Information about the explosion potential of **flammable refrigerants** to show that flammables may be dangerous when handled without care.

HH.2.3 Information about **potential ignition sources**, especially those that are not obvious, such as lighters, light switches, vacuum cleaners, electric heaters.

HH.2.4 Information about the different safety concepts:

Unventilated – (see Clause GG.2) Safety of the appliance does not depend on ventilation of the housing. Switching off the appliance or opening of the housing has no significant effect on the safety. Nevertheless, it is possible that leaking refrigerant may accumulate inside the enclosure and flammable atmosphere will be released when the enclosure is opened.

Ventilated enclosure – (see Clause GG.4) Safety of the appliance depends on ventilation of the housing. Switching off the appliance or opening of the enclosure has a significant effect on the safety. Care should be taken to ensure sufficient ventilation before.

Ventilated room – (see Clause GG.5) Safety of the appliance depends on the ventilation of the room. Switching off the appliance or opening of the housing has no significant effect on the safety. The ventilation of the room shall not be switched off during repair procedures.

HH.2.5 Information about refrigerant detectors:

- Principle of function, including influences on the operation.
- Procedures, how to repair, check or replace a refrigerant detector or parts of it in a safe way.

- Procedures, how to disable a refrigerant detector in case of repair work on the refrigerant carrying parts.

HH.2.6 Information about the concept of sealed components and sealed enclosures according to IEC 60079-15:2010.

HH.2.7 Information about the correct working procedures:

a) Commissioning

- Ensure that the floor area is sufficient for the **refrigerant charge** or that the ventilation duct is assembled in a correct manner.
- Connect the pipes and carry out a leak test before charging with refrigerant.
- Check safety equipment before putting into service.

b) Maintenance

- Portable equipment shall be repaired outside or in a workshop specially equipped for servicing units with **flammable refrigerants**.
- Ensure sufficient ventilation at the repair place.
- Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.
- Discharge capacitors in a way that won't cause any spark. The standard procedure to short circuit the capacitor terminals usually creates sparks.
- Reassemble sealed enclosures accurately. If seals are worn, replace them.
- Check safety equipment before putting into service.

c) Repair

- Portable equipment shall be repaired outside or in a workshop specially equipped for servicing units with **flammable refrigerants**.
- Ensure sufficient ventilation at the repair place.
- Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.
- Discharge capacitors in a way that won't cause any spark.
- When brazing is required, the following procedures shall be carried out in the right order:
  - Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
  - Evacuate the refrigerant circuit.
  - Purge the refrigerant circuit with nitrogen for 5 min (not required for **A2L refrigerants**).
  - Evacuate again (not required for **A2L refrigerants**).
  - Remove parts to be replaced by cutting, not by flame.
  - Purge the braze point with nitrogen during the brazing procedure.
  - Carry out a leak test before charging with refrigerant.
- Reassemble sealed enclosures accurately. If seals are worn, replace them.
- Check safety equipment before putting into service.

d) Decommissioning

- If the safety is affected when the equipment is putted out of service, the **refrigerant charge** shall be removed before decommissioning.

- Ensure sufficient ventilation at the equipment location.
- Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.
- Discharge capacitors in a way that won't cause any spark.
- Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
- When **flammable refrigerants** except **A2L refrigerants** are used,
  - Evacuate the refrigerant circuit.
  - Purge the refrigerant circuit with nitrogen for 5 min.
  - Evacuate again.
  - Fill with nitrogen up to atmospheric pressure.
  - Put a label on the equipment that the refrigerant is removed.

e) Disposal

- Ensure sufficient ventilation at the working place.
- Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.
- When **flammable refrigerants** except **A2L refrigerants** are used,
  - Evacuate the refrigerant circuit.
  - Purge the refrigerant circuit with nitrogen for 5 min.
  - Evacuate again.
  - Cut out the compressor and drain the oil.
- Evacuate the refrigerant circuit.
- Purge the refrigerant circuit with nitrogen for 5 min.
- Evacuate again.
- Cut out the compressor and drain the oil.

Annex II
(Void)

Annex JJ
(normative)

Allowable opening of relays and similar components to prevent ignition of A2L refrigerants

JJ.1 General

Annex JJ is applicable to electric components or devices of appliances using **A2L refrigerants**.

Annex JJ defines the maximum size of openings in relays and similar components that prevents flame propagation to outside. A relay and similar components that comply with the requirements of this annex are not considered as a **potential ignition source** for **A2L refrigerants**.

JJ.2 Definition of the opening

The effective diameter is the equivalent diameter of a circular opening that has the same quenching effect to an opening of any shape. The effective diameter of the opening of relays and similar components is defined as follows:

$$d_{\text{eff}} = 4 \times \frac{A}{S} \qquad \text{(JJ.1)}$$

where

d_{eff} is the effective diameter in mm;

A is the cross sectional area of opening in mm^2;

S is the length of perimeter of opening in mm.

JJ.3 Determination of maximum allowable opening

Relays and similar components shall not be considered as a **potential ignition source** if the effective diameter of all holes complies with the following equation:

$$d_{\text{eff}} < 22{,}3 \times S_u^{-1{,}09} \text{ (in mm)} \leq 7 \text{ mm} \qquad \text{(JJ.2)}$$

where

d_{eff} is the effective diameter in mm;

S_u is the burning velocity in cm/s.

Alternatively, a type test can be used to determine if relays and similar components are not a **potential ignition source**. This type test shall show that there is no propagation of a flame from any contact inside of the relay to the outside, for the concentration of the refrigerant as used for determining the maximum burning velocity. Where the type test is used, the effective diameter limit is 12 mm.

Compliance is checked by inspection or by the following test: At the position of the contact, the refrigerant shall be ignited. It shall be observed if any propagation to the outside of the relay or similar component enclosure occurs. The test shall be repeated five times on the same sample and no propagation shall occur outside the relay or similar component. The test condition should be at the highest burning velocity as specified in 22.116.

NOTE A type test conducted with a refrigerant with a higher burning velocity can be used as evidence to show compliance for a refrigerant with a lower burning velocity.

Annex KK
(normative)

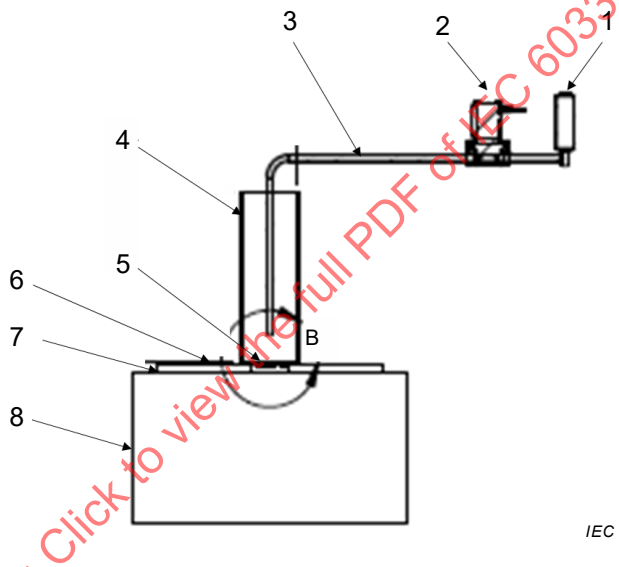
Test method for hot surface ignition temperature for A2L

KK.1 General

The **hot surface ignition temperature** of **A2L refrigerants** shall be determined according to Annex KK. The refrigerants shall be sprayed onto a horizontal flat plate surface which is set at the test temperature.

The test system consists of a hot plate, a spray tube and a chimney. Figure KK.1, Figure KK.2 and Figure KK.3 display the set-up of the test apparatus.

NOTE This method is a modification of the ASTM D6668 "*Standard Test Method for Discrimination Between Flammability Ratings of F = 0 and F = 1*". The ASTM test is designed for automotive fluids as a pass fail test at 815 °C. We are interested in liquefied refrigerants and defining the maximum no ignition temperature.

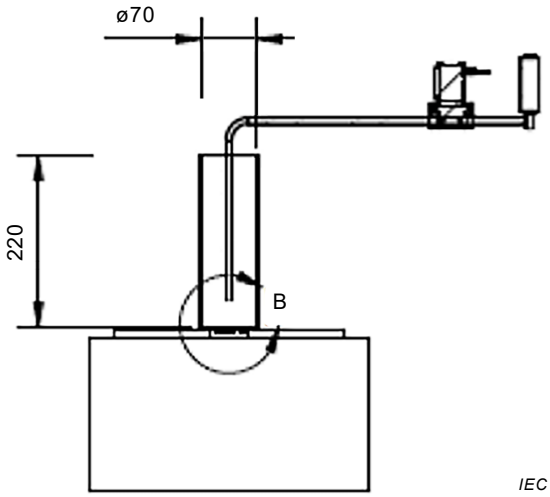


Key

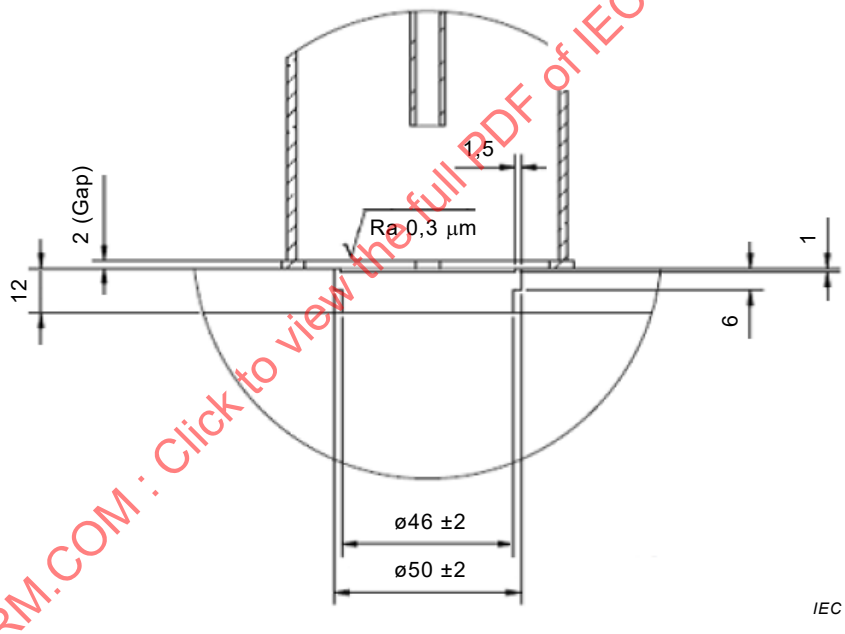
1 refrigerant cylinder with valve
2 valve
3 spray tube
4 glass cylinder
5 planchet
6 thermocouple
7 insulation
8 hot plate

Figure KK.1 – Front view of test apparatus labels

Dimensions in millimetres



a) Front view with dimensions



b) Detail of section B

Figure KK.2 – Test apparatus with dimensions

Dimensions in millimetres

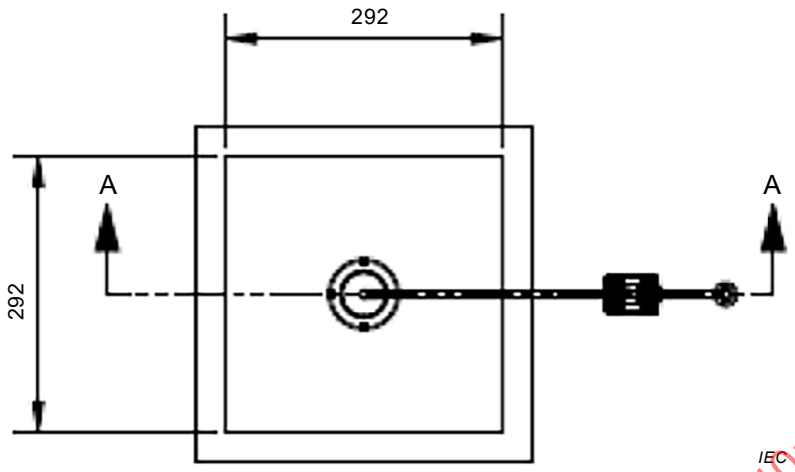


Figure KK.3 – Top view of test apparatus

KK.2 Test equipment requirements

The hot plate shall have the following characteristics. The hot plate shall consist of a flat stainless steel plate with the dimensions:

Diameter: 50 mm ± 2,0 mm

Thickness: 6 mm –0/+2,0 mm

Surface texture: ISO 1302

The hot plate shall be positioned horizontally. The heaters shall provide uniform heating of the plate. All surfaces other than the test surface should be thermally insulated using ceramic fibre board capable to withstand 815 °C. This insulation shall be such that vapours cannot be ignited by other than the hot plate top surface.

Spray system shall consist of a liquid supply, two valves (trap liquid volume of 1,0 cm^3 ± 0,2 cm^3), tubing for directing the spray. The spray tube from valve to the end shall have the following dimensions:

Length: 250 mm ± 5,0 mm

Outer diameter: ≤ 4 mm

Inner diameter: 1,6 mm ± 0,1 mm

Use a type K thermal couple with the individual wires spot welded on opposite sides of the centre of the upper surface of the hot plate.

A borosilicate or quartz glass chimney shall be 230 mm ± 10 mm long and 70 mm ± 10 mm inner diameter . The chimney shall be supported so that it is vertically mounted and has a gap of 2,5 mm ± 0,2 mm between its bottom edge and the top on the insulation.

KK.3 Procedure

The ambient conditions of the test shall be set at 23 °C ± 3 °C and 50 % RH ± 5 % RH. The chimney and hot plate establishes a constant air velocity during the test. This airflow dilutes the vapours so that an optimum (near stoichiometric) concentration for ignition develops over the hot surface.

The test shall be performed in a laboratory fume hood. The test apparatus including the chimney top shall be located in the laminar flow region of the laboratory fume hood so the chimney flow is not disturbed.

The end of the spray refrigerant line shall be placed 40 mm ± 10 mm above the hot plate and shall point at the centre of the hot plate. The tube shall be perpendicular to the horizontal plate.

Operating steps:

1) The hot plate shall be heated until a steady test temperature is maintained for 5 min. The plate temperature shall be kept within ±15 °C of the set-point during the test.
2) Refrigerant used for the test shall be the nominal composition (NC) per ISO 817. Refrigerant from the liquid phase shall be trapped between valve 1 and valve 2. Open valve C to spray the liquid refrigerant onto the centre of the hot plate.
3) Observe and record if ignition (flames) occurs or does not occur within 3 min after release.

   NOTE Ignition is considered as being within the chimney above the plate.

   Care shall be given to avoid vapours getting under the insulation, any ignition outside of the chimney is due to ignition on surfaces hotter than the test surface.
4) A minimum of 5 min of ventilation shall be allowed between runs to clear out reaction products and residual refrigerant.
5) Perform a minimum of 5 repetitions trials at each temperature being tested.
6) The temperature of the hot plate shall be set at 800 °C, if ignition occurs, then the plate temperature is to be reduced in increments of 20 °C until no ignition occurs in five trials. This temperature is to be recorded as the **hot surface ignition temperature** (HSIT).

KK.4 Test report

The results shall be recorded in a test report. The report shall include all the information necessary for the interpretation of the test and all information required by the method used. The report shall include:

- documentation with the sample identity and composition,
- temperature where ignition did not occur and where ignition did occur if applicable.

The reported **hot surface ignition temperature** shall be highest temperature with no ignition in five trials.

Annex LL
(normative)

Refrigerant detection systems for A2L refrigerants

LL.1 General

Refrigerant detection systems shall be set to be activated before the refrigerant concentration reaches 25 % of the ***LFL***. Where ***LFL*** is referenced in this annex, the ***LFL*** shall be taken at WCF – Worst Case Formulation as specified in ISO 817.

LL.2 Function of the refrigerant detection systems

The **refrigerant detection systems** shall be capable of detecting a pre-set level of the refrigerant concentration of the refrigerant that the sensor is designated to be used with and initiate the operation as defined in Annex GG.

LL.3 Refrigerant detection system range, accuracy and response time

Refrigerant detection system shall make output according to the applicable clauses of Annex GG of this standard within 30 s when the sensor is put into refrigerant concentration of 25 % of ***LFL*** or lower.

The **refrigerant detection system**, including the sensors, shall comply with the above requirements over the full range of operating temperature and humidity as specified by the appliance manufacturer.

Compliance is checked by test.

LL.4 Refrigerant detection system calibration

The **refrigerant detection systems** shall be pre-set and calibrated (with an accuracy of ± 20 %) from the factory for the refrigerant used.

LL.5 Electrical outputs for refrigerant detection system

The device shall have an output in accordance with the applicable clauses of Annex GG of this standard.

LL.6 Vibration requirements

A sensor shall withstand vibration without breakage or damage of parts and shall continue to function. The vibration parameters shall be defined based on the intended application and expected transportation. If vibration operating parameters are not established by the manufacturer, then a sample of the sensor shall be subject to the requirements defined below.

To comply with the vibration requirements, two samples shall be secured to the intended mounting and in turn securely fastened to a variable speed vibration test machine having an amplitude and frequency as follows:

- *10 Hz to 31,5 Hz, with 1,0 mm total excursion, and*
- *31,5 Hz to 150 Hz, with 2 g acceleration peak.*

*The samples shall be vibrated over the specified frequency range, displacement and acceleration for a period of 1 h in each of the three mutually perpendicular planes. The change rate shall not exceed 10 Hz/min. After the samples are vibrated, they shall be tested to verify they still sense refrigerant at 25 % of **LFL** or lower.*

LL.7 Refrigerant detection system self-test routine

The detection system shall include a means for self-testing the sensor to determine the output is at proper range. The test shall be run at least every hour and if a failure is detected, an alarm shall be activated.

If the sensor has a defined life and requires replacement after a given period, then the detection system shall initiate an alarm or indication that replacement is required. If sensor becomes more sensitive with aging to generate false alarm, the end of life alarm can be omitted.

Compliance is checked by inspection.

LL.8 Sensor identification

The sensors shall be marked with

- name, trade mark or identification mark of the manufacturer or responsible vendor;
- model or type reference.

Compliance is checked by inspection.

Annex MM
(normative)

Refrigerant sensor location confirmation test

MM.1 General

This test is applicable to appliances with **refrigerant detection systems** other than remote detection.

The purpose of this test is to demonstrate that the sensor(s) of the **refrigerant detection system**(s), where required, will adequately detect refrigerant, in the event of a leak when installed in the location specified by the manufacturer. Compliance will be determined by measurement of the refrigerant concentration in the location of the sensor.

The composition of the refrigerant used for the test shall be taken as the nominal composition as specified in ISO 817. Where ***LFL*** is referenced in this annex, the ***LFL*** shall be taken at the nominal composition as specified in ISO 817.

MM.2 Test methods

MM.2.1 The appliance is modified by introducing a simulated leak through a capillary tube. The leak rate shall be maintained at m_r in g/s. The simulated leak is applied for 1 min.

$$m_r = 12{,}5 \times LFL \times V_{free}, \text{ but not less than } 5 \times LFL \times 1\,000/3\,600 \qquad \text{(MM.1)}$$

where

12,5 is the result of the conversion of kg/min to g/s and 75 % (of *LFL*) 1 000/60 × 0,75 = 12,5;

m_r is the mass flow rate of the simulated leak in g/s, ± 5 %;

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

V_{free} is the free volume of the internal space in the appliance below the simulated leak in m^3.

The free volume (V_{free}) shall be determined by calculating the volume of the appliance bounded by a horizontal plane at the lowest point of the simulated leak, the appliance enclosure walls and the plane of the supply and return openings. The volume shall be reduced by the volume of components or enclosed compartments within the bounded space. Components and enclosed compartments within the bounded space with a volume of less than 0,001 m^3 can be ignored.

A leakage of refrigerant in the **refrigerating system** is simulated at the unfavourable critical points for detection of the leak. A critical point is a joint in the refrigerant system tubing, a bend of more than 90 degrees, or other point judged to be a weak point in the refrigerant containing system due to the thickness of the metal, exposure to damage, sharpness of a bend or the manufacturing process, an unfavourable point is a point where the path between the leakage point and the point of detection location is more distant or more obstructed. The refrigerant is injected at the most critical point and the most unfavourable direction at ambient temperature (15 °C to 35 °C). The capillary tube shall discharge refrigerant into a chamber or similar device which will reduce the refrigerant velocity into the appliance or space.

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

MM.2.2 During this test, following appliance operating modes shall be tested;

– Fan OFF, and

– Fan ON.

If the minimum airflow specified by the manufacturer is not less than the minimum airflow specified in GG.2.2 or Clause GG.9, testing in the fan ON mode is not required.

MM.2.3 The appliance shall be installed according to the instructions. Appliances that can be installed in different positions shall be tested in all positions allowed by the manufacturer. The supply and return openings shall not be covered and the manufacturers recommended air-filters shall be installed per instructions.

MM.2.4 *The test is conducted in a room that is draft free and of sufficient size to conduct the test without influencing the results by accumulation of leaked refrigerant in to the room during the test.*

The minimum room area *A* is:

$$A_t > 1{,}2 \times m_r/(LFL^* h_t), \qquad \text{(MM.2)}$$

where

A_t is the minimum room area for the test;

h_t is the height from the floor to the bottom of the unit in the test set-up in metres (m);

m_r is the refrigerant leak rate in g/s;

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

1,2 is the conversion factor based on limiting the test room concentration to 5 % *LFL* at the end of the 60 s refrigerant release at a release rate of m_r.

MM.2.5 The instrument used for monitoring the refrigerant gas concentration shall have a fast response to the gas concentration, at least 90 % response within 10 s (time constant 4,3 s) and shall be located as close to the intended sensor location as possible, but care should be taken not to unduly influence the results of the test. It shall be calibrated to have an accuracy of ± 1 % of gas concentration between 20 % and 30 % gas concentration.

For small products where an additional sensor cannot be built-in, the evaluation of MM.2.6 shall suffice.

NOTE An oxygen sensor can be used for monitoring.

The refrigerant gas concentrations sampling shall be made at least every 10 s.

MM.2.6 *The measured concentration of refrigerant gas at the location of the **refrigerant detection system** sensor shall exceed the set point of the detection system used within 90 s from the start of the release. Where multiple sensors are applied with the **refrigerant detection system**, if the concentration at any single sensor location exceeds the set point of the detection system used within 90 s from the start of the release, the **refrigerant detection system** sensor location shall be considered in compliance.*

Annex NN
(normative)

Flame arrest enclosure verification test for A2L refrigerants

NN.1 General

Annex NN is applicable to appliances using **A2L refrigerants**.

A flame arrest enclosure is a device or assembly enclosing components with electrical contacts that are made and broken, or similar devices which may become a source of ignition which will withstand an internal ignition of a **A2L refrigerant** vapour which may enter it without suffering damage and without transmission of flame from the internal ignition to an external **A2L refrigerant** vapour of the same refrigerant.

Electrical components enclosed in a flame arrest enclosure in compliance with the test procedures below shall not be considered as a source of ignition.

If all openings in the enclosure comply with Annex JJ, the enclosure is deemed to comply.

The following test requirements are based on consideration of IEC 60079-15:2010, Clause 17, as applicable to the products within the scope of IEC 60335-2-40, and specific to the use of flammable **A2L refrigerants**.

NN.2 Test method

NN.2.1 *The test shall be conducted on a single sample enclosure or the complete appliance. The test shall be conducted one time.*

NN.2.2 *Representative electrical components and related wiring as intended in the final end usage in the appliance shall be installed in the enclosure. The enclosure shall be positioned as it would be in the appliance and all construction critical to ensure non-transmission of flames shall be included.*

NN.2.3 *If panels or similar means of access are intended to be opened or removed for routine service and maintenance, the panels shall be removed or opened ten times prior to conducting the test.*

NN.2.4 *Dielectric strength tests per 16.3 shall be conducted prior to the test.*

NN.2.5 *The ambient test conditions shall be at 32 °C **dry-bulb temperature** and 27 °C **dew point temperature**.*

NN.2.6 *The enclosure shall be filled with and surrounded by a stoichiometric mixture of the intended refrigerant.*

NN.2.7 *The **flammable refrigerant** vapour inside the enclosure shall be ignited in the most unfavorable position. The ignition shall be provided using a 15 kV source producing a 30 mA spark across a 6,4 mm gap for 0,3 ± 0,05 s or equivalent. Ignition of the refrigerant inside the enclosure shall be confirmed visually or by any other method.*

NN.2.8 *Dielectric strength tests per 16.3 shall be conducted after the test.*

NN.2.9 *The enclosure shall be considered in compliance with this annex if all of the following conditions are met.*

- *There shall be no ignition of the refrigerant vapour outside the enclosure.*
- *There shall be no visible signs of damage outside the enclosure.*
- *The dielectric strength after the test shall be in compliance with the requirements of this standard.*
- *The enclosure shall be capable of performing all intended primary safety functions, including protection from hazardous **live parts** and ingress of water, if applicable.*

Annex OO
(normative)

UV radiation conditioning

OO.1 Ten samples of the internal wiring are subjected to ultraviolet light conditioning according to Clause OO.2 or OO.3. When the internal wiring is provided in more than one colour, ten samples of each colour are subjected to this conditioning.

The test samples are mounted on the inside of the cylinder in the ultraviolet light apparatus perpendicular to the light source and in such a way that the samples do not touch each other.

OO.2 The samples are to be exposed for 1 000 h to xenon-arc, method A, in accordance with ISO 4892-2. There shall be continuous exposure to light and intermittent exposure to water spray. The cycle shall consist of 102 min without water spray and 18 min with water spray. The apparatus shall operate with a water-cooled xenon-arc lamp, borosilicate glass inner and outer optical filters, a spectral irradiance of 0,35 W/m^2/nm at 340 nm and a black panel temperature of (65 ± 3) °C. The temperature of the chamber shall be (45 ± 3) °C. The relative humidity in the chamber shall be (50 ± 5) %.

OO.3 The samples are to be exposed for 720 h to open-flame carbon-arc, in accordance with ISO 4892-4. There shall be continuous exposure to light and intermittent exposure to water spray. The cycle shall consist of 102 min without water spray and 18 min with water spray. The apparatus shall operate with an open-flame carbon-arc lamp, borosilicate glass Type 1 inner and outer optical filters, a spectral irradiance of 0,35 W/m^2/nm at 340 nm and a black panel temperature of (63 ± 3) °C. The temperature of the chamber shall be (45 ± 3) °C. The relative humidity in the chamber shall be (50 ± 5) %.

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

IEC 60050-845:1987, *International Electrotechnical Vocabulary – Part 845: Lighting*
IEC 60050-845:1987/AMD1:2016

IEC 60335-2-21, *Household and similar electrical appliances – Safety – Part 2-21: Particular requirements for storage water heaters*

IEC 60335-2-88, *Household and similar electrical appliances – Safety – Part 2-88: Particular requirements for humidifiers intended for use with heating, ventilation, or air-conditioning systems*

ASTM E 659, *Standard Test Method for Autoignition Temperature of Liquid Chemicals "Ignition risk of Hydrocarbon liquids and vapors by hot surface in the open air" API recommended practice 2216 Third Edition, December 2003*

ASTM D6668, *Standard Test Method for Discrimination Between Flammability Ratings of F = 0 and F = 1*

NFPA 921, *Guide for fire and explosion investigations (2004) Section 25.4.3.2 "Hot surface ignition of flammable and combustible liquids" Scott Davis, Dylan Chavez and Harri Kytomaa, Exponent, SAE technical paper series 2006-01-1014*

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

IEC 60335-2-40:2018-01(en)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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.

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

INTRODUCTION

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

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the 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 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.

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 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 refrigerants other than group A1, A2L, A2 and A3 as defined by 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:

- 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, *Refrigerants – Designation 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 5149-1:2014, *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*

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

ASTM 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 **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 **refrigerating system** and the means to circulate air. It also includes a drain arrangement for collecting and storing and/or disposing of the condensate.

3.108
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 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
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 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
flammable refrigerant
refrigerant 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 single package unit
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
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 $\mu W/cm^2$

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.

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**;
– **refrigerant charge** for each **refrigerating system**;
– refrigerant number in accordance with ISO 817;
– permissible excessive operating pressure for the storage tank (for **sanitary hot water heat pumps**);
– **maximum allowable pressure** in the water and/or brine circuit for the **heat exchanger** for **hydronic fan coil units**;
– **maximum allowable pressure** for the refrigerant circuit; if the permissible excessive operating pressure for the suction and discharge side differ, a separate indication is required;
– 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.

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), 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 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' m^2.

The minimum room size X shall be specified on the appliance. The X in the marking shall be determined in m^2 according to Annex GG; the marking shall not be required if the **refrigerant charge** (m_c) of the appliance is up to m_1 according to GG.1.2.

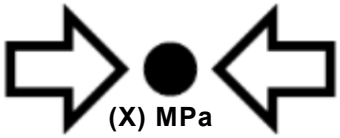
NOTE 101 For the **refrigerating system**, if the **maximum allowable pressure** of the **low-pressure side** and the **high-pressure side** is the same, a single indication is permitted.

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:*

	[symbol ISO 7010-W021 (2011-05)]	warning; 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 μW/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 μW/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 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 instructions except for **hydronic fan coil units** where the flow rates and liquid temperatures shall be the maximum specified in the instructions;*

- *the outlet duct connected to the appliance shall be subjected to the maximum static pressure given in the 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 102a) or Figure 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 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** (± 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** (± 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
Windings of sealed motor-compressors [a]	
– *with synthetic insulation*	*140*
– *with other insulation*	*130*
External enclosure of appliances with or without ***supplementary heaters***	*85*
Windings [b] *if the winding insulation is (other than motor-compressors):*	
– *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*
Terminals, including earthing terminals, for external conductors of ***stationary appliances****, unless they are provided with a* ***supply cord***	*85*
Ambient of switches, and ***thermostats*** *and* ***temperature limiters*** [d]	
– *without T marking*	*55*
– *with T marking*	*T*
Rubber or polyvinyl chloride insulation of internal and external wiring, including ***supply cord****:*	
– *without temperature rating* [e]	*75*
– *with temperature rating (T)*	*T*
Cord sheaths used as ***supplementary insulation***	*60*
Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:	
– *when used as* ***supplementary insulation*** *or* ***reinforced insulation***	*65*
– *in other cases*	*75*
Lampholders with T-marking [j]	
– *B15 and B22 marked T1*	*165*
– *B15 and B22 marked T2*	*210*
– *other lampholders*	*T*
Lampholders without T-marking [j]	
– *E14 and B15*	*135*
– *B22, E26 NS E27*	*165*
– *other lampholders and starter holders for fluorescent lamps*	*80*
Material used as insulation other than that specified for wires and windings:	
– *impregnated or varnished textile, paper or press board*	*95*
– *laminated bonded with:*	
• *melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins*	*110*
• *urea-formaldehyde resin*	*90*
– *printed circuit boards bonded with epoxy resin*	*145*
– *moulding of:*	
• *phenol-formaldehyde with cellulose fillers*	*110*
• *phenol-formaldehyde with mineral fillers*	*90*
• *melamine-formaldehyde*	*110*
• *urea-formaldehyde*	*90*
– *polyester with glass-fibre reinforcement*	*135*
– *silicone rubber*	*170*
– *polytetrafluoroethylene*	*290*
– *pure mica and tightly sintered ceramic material, when such materials are used as* ***supplementary insulation*** *or* ***reinforced insulation***	*425*
– *thermoplastic material* [f]	–
Wood, in general [g]	*90*

Parts	Temperature °C
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*

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

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

[c] *The classification is in accordance with IEC 60085.*

Examples of Class A (class 105) material are:

– impregnated cotton, silk, artificial silk and paper;

– enamels based on oleo or polyamide resins.

Examples of Class B (class 130) materials are:

– glass fibre, melamine-formaldehyde and phenol-formaldehyde resins.

Example of Class E (class 120) material are:

– mouldings with cellulose fillers, cotton fabric laminates and paper laminates, materials bonded with melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins;

– cross-linked polyester resins, cellulose triacetate films, polyethylene terephthalate films;

– varnished polyethylene terephthalate textile bonded with oil-modified alkyd resin varnish;

– enamels based on polyvinyl formalin, polyurethane or epoxy resins.

For totally enclosed motors, the temperature limits for class A (class 105), class E (class 120) and class B (class 130) materials may be increased by 5 °C (5 K).

A totally enclosed motor is a motor so constructed that the circulation of the air between the inside and the outside of the case is prevented, but which is not necessarily sufficiently enclosed to be called airtight.

[d] *T means the maximum operating temperature.*
*The ambient of switches and **thermostats** is the temperature of the air at the hottest point at a distance of 5 mm from the surface of the switch and **thermostat** concerned.*
*For the purpose of this test, switches and **thermostats** marked with the individual ratings may be considered as having no marking for the maximum operating temperature, if this is requested by the manufacturer of the appliance. 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.*

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

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

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

[h] *There is no limit for the temperature rise of capacitors which are short-circuited in 19.11.2 c).*

[i] *Temperature marking for capacitors mounted on printed circuit boards may be given in the technical sheet.*

[j] *Locations for measuring the temperatures are specified in Table 12.1 of IEC 60598-1:2008.*

If these or other materials are used, they shall not be subjected to temperatures in excess of the thermal capabilities as determined by aging tests made on the materials themselves.

NOTE 101 The 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/m^3 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 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 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 cm^3/s per 1 m^3/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 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 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 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 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 °C ± 5 °C.

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

During the test, the temperature of the enclosure shall not exceed 150 °C and the temperature of the windings shall not exceed the values shown in Table 8.

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.*

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

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

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

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

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

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

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

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 °C ± 5 °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 kg/m^2 ± 0,4 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 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 D4728-06. 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 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 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 mm^2 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 **refrigerant charge** (m_c) of all **refrigerating systems** within the appliance employing 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 comply with at least one of the following:

- shall be located in an enclosure which complies with Clause 20 of IEC 60079-15:2010 for restricted breathing enclosures suitable for use with group IIA gases or the refrigerant used;
- shall not be located in an area where a potentially flammable gas mixture will accumulate as demonstrated by the test of 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 °C ± 0,5 C dew point at 101,3 kPa containing 21,0 ± 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 maximum allowable surface temperature 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 operation** shall be protected against mechanical damage.

Compliance is checked according to the 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 ºC 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/cm^2, 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.*

22.129 For **user maintenance** access areas, the **UV-C spectral irradiance** shall not exceed the limit specified in 32.101.2 with the access panels opened or removed as needed to perform the required **user maintenance**. Panels that are opened or removed to perform **user maintenance** shall be required to be closed or put back in place for proper operation of the appliance.

Compliance is checked by inspection and test per Subclause 32.101.

22.130 If the replacement of the **UV-C lamp** is allowed by the user, the appliance shall be constructed so that

– the replacement of the **UV-C lamp** is easily possible;

– if screws or components are omitted or incorrectly positioned or fastened, the appliance is rendered inoperable or manifestly incomplete.

Compliance is checked by inspection.

22.131 Appliances that employ refrigerants in a **transcritical refrigerating system** shall be equipped with a **pressure-limiting device** that operates no greater than the **maximum allowable pressure** plus the tolerance of the **pressure-limiting device**.

Compliance is checked by inspection.

23 Internal wiring

This clause of Part 1 is applicable except as follows.

23.101 Internal wiring that is exposed to direct or reflected **UV-C radiation** shall be UV-C resistant.

Compliance is checked by the following test.

Samples of the internal wiring are conditioned in accordance with Annex OO.

On completion of the conditioning, the cable is wrapped in metal foil and is wound around a conductive mandrel 15 mm in diameter for three turns. A voltage of 2 000 V is applied for 15 min between the conductor and the mandrel. There shall be no breakdown.

24 Components

This clause of Part 1 is applicable except as follows.

24.1 *Addition:*

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

24.1.4 *Modification:*

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

Addition:

- ***thermostats*** *which control the motor-compressor* *100 000*
- *motor-compressor starting relays* *100 000*
- *automatic thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type* *min 2 000 (but not less than the number of operations during the locked rotor test)*
- *manual reset thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type* *50*
- *other automatic thermal motor protectors* *2 000*
- *other manual reset thermal motor protectors* *30*
- ***refrigerant detection systems self resetting*** *300*
- ***refrigerant detection systems non self resetting*** *30*
- *electromechanical proof of airflow control* *100 000*
- *self-resetting electrical* ***pressure-limiting device*** *3 000*
- *non-self-resetting electrical* ***pressure-limiting device*** *300*

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

The replacement part shall be marked accordingly.

Compliance is checked by inspection of the marking.

24.102 The **pressure-limiting devices** used in **transcritical refrigerating systems** shall comply with IEC 60730-2-6 and

– shall be of type 2A or 2B;
– shall have a trip free mechanism of type 2J;
– the deviation and drift shall not exceed + 0 %.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Addition:*

The appliances may be provided with a **supply cord** fitted with a plug

- if they are for indoor use only,
- if they have a marked rating of 25 A or less, and
- if they comply with the applicable code requirements for cord-connected appliances appropriate to the specific country in which they are to be used.

Modification:

Appliances shall not be provided with an appliance inlet.

25.7 *Addition:*

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

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable except as follows:

27.5 *Addition:*

NOTE If the ground continuity between system components meets the minimum values specified in 27.5, it is considered to meet the requirements without dedicated grounding conductors.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is not checked on parts relating to motor-compressors if the motor-compressor complies with IEC 60335-2-34. For motor-compressors not complying with IEC 60335-2-34, the additions and modifications specified in IEC 60335-2-34 are applicable.

29.2 *Addition:*

For insulation located in any airflow, the micro-environment is pollution degree 3 unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution due to normal use of the appliance.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2.2 Not applicable.

31 Resistance to rusting

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is checked by the salt mist test of IEC 60068-2-52, severity 2 being applicable.

Before the test, coatings are scratched by means of a hardened steel pin, the end of which has the form of a cone with an angle of 40°. Its tip is rounded with a radius of 0,25 mm ± 0,02 mm. The pin is loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches are made by drawing the pin along the surface of the coating at a speed of approximately 20 mm/s. Five scratches are made at least 5 mm apart and at least 5 mm from the edges.

After the test, the appliance shall not have deteriorated to such an extent that compliance with this standard, in particular with Clauses 8 and 27, is impaired. The coating shall not be broken and shall not have loosened from the metal surface.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable except as follows.

Addition:

32.101 UV-C irradiance test

32.101.1 For the occupied space outside the unit, a test shall be performed to determine the **UV-C spectral irradiance**. The emissions from the equipment shall not exceed a **UV-C spectral irradiance** limit of 0,2 µW/cm^2.

NOTE The **UV-C spectral irradiance** limit of 0,2 μW/cm^2 is equivalent to 0,1 μW/cm^2 effective irradiance at 254 nm (i.e., 0,2 μW/cm^2 multiplied by the hazard function, S_{UV} = 0,5 at 254 nm as defined in IEC 62471 equals 0,1 μW/cm^2). Effective irradiance of 0,1 μW/cm^2 is classified as exempt in IEC 62471.

32.101.2 For areas inside the unit that are accessible for anticipated **user maintenance** and are not equipped with the interlock required by Subclause 22.128, there shall be no **UV-C spectral irradiance** greater than 1,7 μW/cm^2. The **UV-C spectral irradiance** is measured at any point of accessibility required for **user maintenance**. When determining user accessibility, consideration should be given to the actual degree of exposure that the user would experience in performing his duties.

NOTE The **UV-C spectral irradiance** limit of 1,7 μW/cm^2 is equivalent to 0,85 μW/cm^2 effective irradiance at 254 nm (i.e., 1,7 μW/cm^2 multiplied by the hazard function, S_{UV} = 0,5 at 254 nm as defined in IEC 62471 equals 0,85 μW/cm^2). The exposure limit at 0,85 μW/cm^2 effective irradiance at this level is 60 min/day.

*Compliance is determined by measuring the **UV-C irradiance** per IEC 62471:2006, Clause 5 and Annex B.*

32.101.3 ***UV-C irradiance*** *shall be measured at the location in Table 101.*

Table 101 – UVC irradiance measurement location

	UV-C spectral irradiance limits		For compliance, UV-C irradiance is measured
	μW/cm^2	W/m^2	
Occupied space outside unit	≤ 0,2[a]	≤ 0,002	At 0,3 m from all outside surfaces of appliance[c]
Supply and return air openings	≤ 0,2[a]	≤ 0,002	At 0,3 m from the perpendicular plane of the opening
User maintenance openings[b]	≤ 1,7	≤ 0,017	At 0,3 m from the perpendicular plane of the access opening
UV-C lamp replacement			Not required – all power shall be disconnected

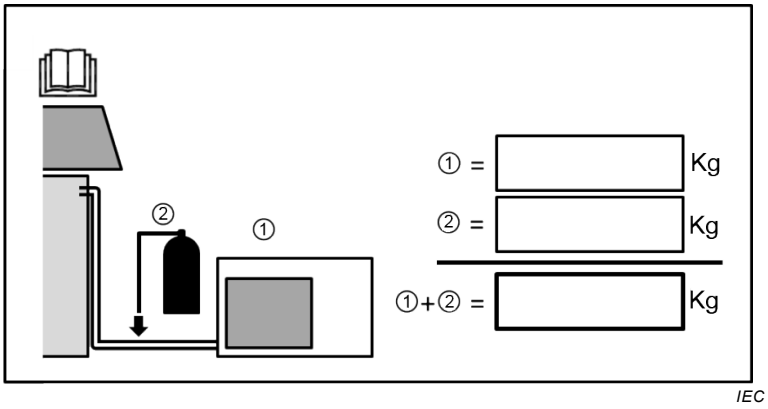
[a] Less than or equal to 0,1 μW/cm^2 effective irradiance is exempt per IEC 62471. This is 0,2 μW/cm^2 spectral irradiance at 254 nm.

[b] Based on maximum exposure time of 60 min.

[c] If the appliance has an inspection window, the measuring distance is reduced to 0,0 m.

32.101.4 *When conducting **UV-C irradiance** tests:*

– *the **UV-C irradiance** measurements shall be conducted with a scanning spectroradiometer, or a narrow band range radiometer;*
– *all panels and components shall be positioned or adjusted in the most severe position;*
– *removable air filters shall be removed;*
– *measurements shall be made at the worst case location and angle of incidence;*
– *the minimum specified duct and configuration, including any duct liners, specified by the manufacturer shall be in place and the measurements taken at the opening at the end of the duct.*

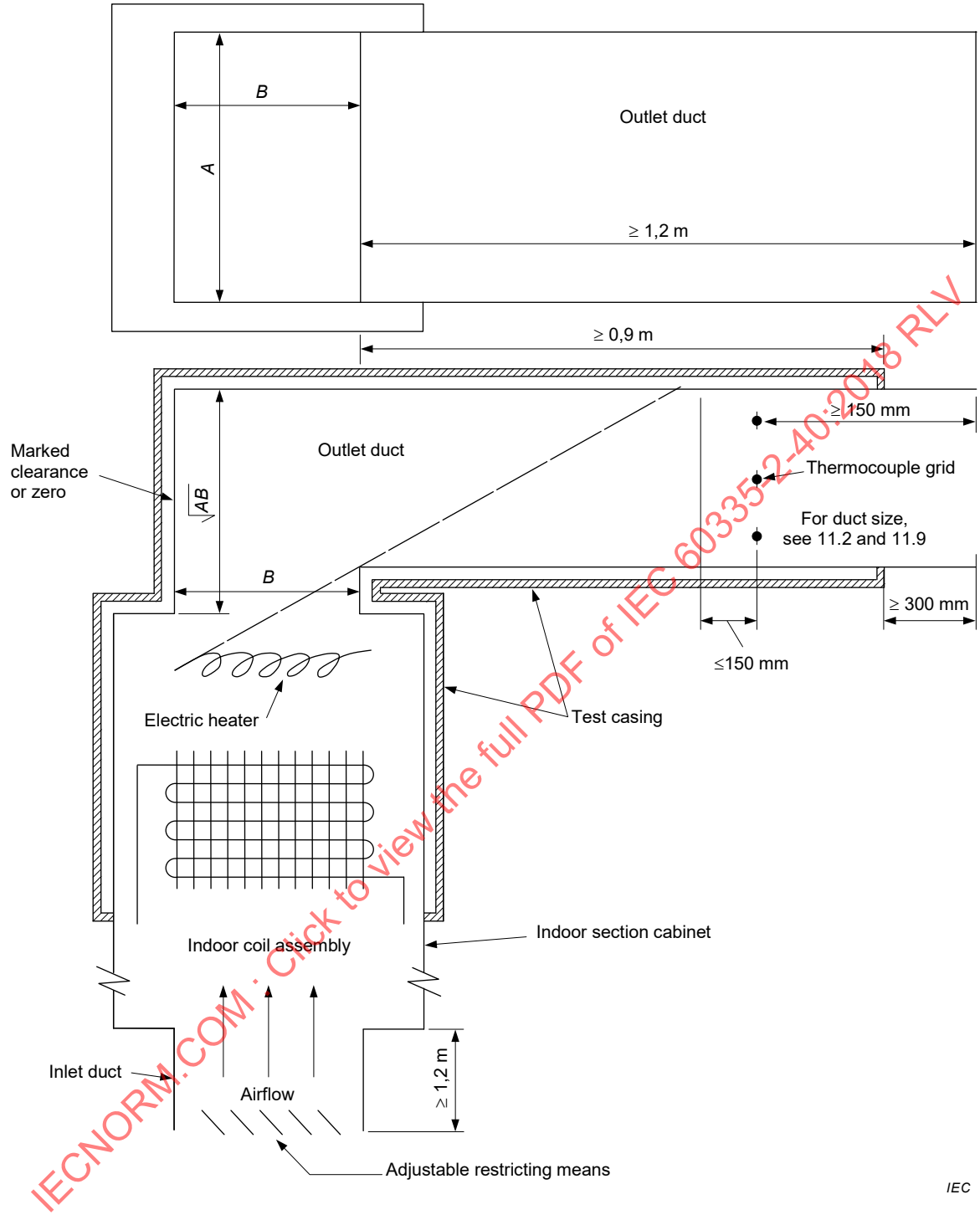


Key

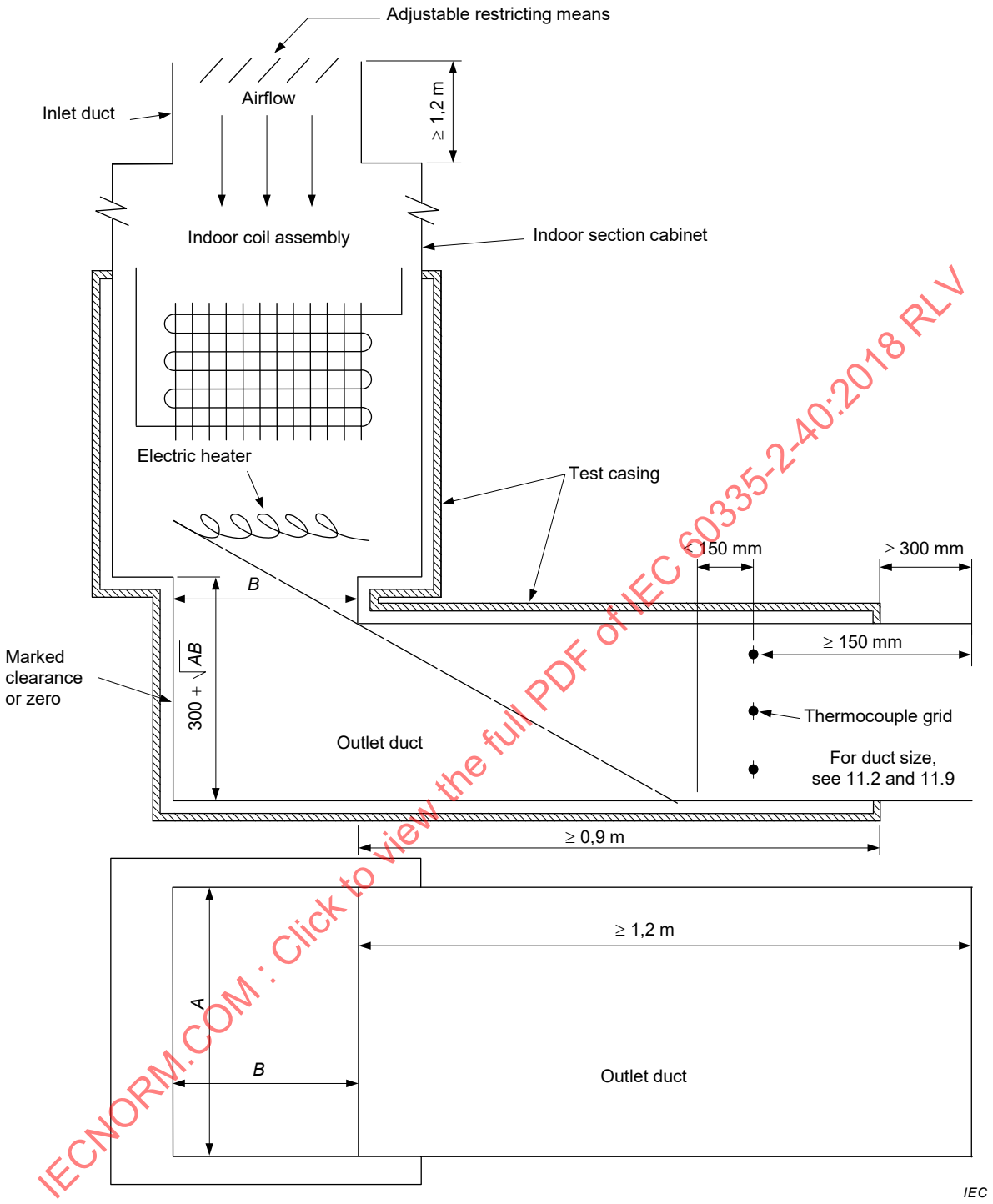
Example 1 **refrigerant charge** of the precharged part of the appliance

Example 2 **refrigerant charge** added during installation

Figure 101 – Example of label for field charged units

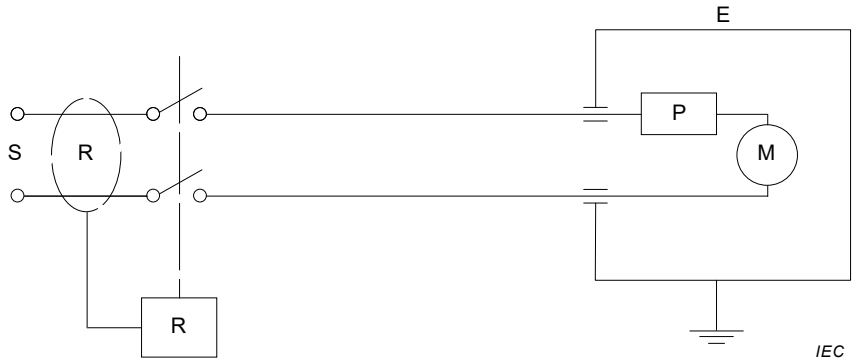


a) Upflow application



b) **Downflow application**

Figure 102 – Arrangement for heating test of appliances with supplementary heater



Key

S supply

E motor enclosure

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

P protective device (external or internal)

M motor

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

Figure 103 – Supply circuit for locked-rotor test of a motor of the single-phase type – Revise as needed for three-phase test

Annexes

The annexes of Part 1 are applicable except as follows.

Annex D
(normative)

Thermal motor protectors

This annex of Part 1 is not applicable.

Annex I
(normative)

Motors having basic insulation that is inadequate for the rated voltage of the appliance

This annex of Part 1 is not applicable.

Annex AA
(informative)

Examples for operating temperatures of the appliance

Table AA.1 – Examples for operating temperatures of the appliance

Function of appliance	Classification		Heating				Cooling			
			Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)		Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)	
			DB [a]	WB [b]	DB [a]	WB [b]	DB [a]	WB [b]	DB [a]	WB [b]
Outside air/ Recycled air	A7	A20	7	6	20	12	35	24	27	19
Exhaust air/ Recycled air	A20	A20	20	12	20	12	–	–	–	–
Exhaust air/ Fresh air	A20	A7	20	12	7	6	–	–	–	–
Outside air/Water	A7	W50	7	6	Water	50	35	24	Water	7
Exhaust air/Water	A20	W50	20	12	Water	50	–	–	–	–
Water/Water	W10	W50	Water	10	Water	50	Water	15	Water	7
Brine/Water	B0	W50	Brine	0	Water	50	Brine	15	Water	7
Brine/Recycled air	B0	A20	Brine	0	20	12	–	–	–	–
Water/Recycled air	W10	A20	Water	10	20	12	–	–	–	–
Water/Recycled air	W20	A20	Water	20	20	12	–	–	–	–
Dehumidification	Comfort		–	–					27	21
	Process								12	9
	Heat recovery (air cooled)						27	21	27	21
	Heat recovery (water cooled)						Water	24	27	21
Sanitary hot water heat pump										
Outside air/Water	A7	W45	7	6	Water	45	–	–	–	–
Ambient air/Water	A15	W45	15	12	Water	45	–	–	–	–
Exhaust air/Water	A20	W45	20	12	Water	45	–	–	–	–
Brine/Water	B0	W45	Brine	0	Water	45	–	–	–	–

NOTE Appliance can be classified according to function and temperature application as noted below:

Source		Sink		Classification		
Outside air		Recycled air		A –	A –	A *
Exhaust air		Recycled air		A –	A –	
Exhaust air		Outside air		A –	A –	
Outside air		Water		A –	W –	
Exhaust air		Water		A –	W –	
Water		Water		W –	W –	
Water		Recycled air		W –	A –	
Brine		Recycled air		B –	A –	
Brine		Water		B –	W –	

* For example, A7 A20 indicates an appliance designed for an outside air operating temperature of 7 °C DB and an inside air operating temperature of 20 °C DB.

[a] DB: dry bulb

[b] WB: wet bulb

Annex BB
(normative)

Selected information about refrigerants

Table BB.1 – Selected information about refrigerants

NOTE This annex is not a complete list of suitable refrigerants. This International Standard applies to any refrigerants as defined in the scope.

Refrigerant designation [a]	Description	Formula (nominal composition mass fraction %)	Safety group [f]	Auto ignition temperature	Hot surface ignition temperature [g]	Maximum allowable surface temperature [g]	Density [b]	Molar mass [c] at nominal composition [h]	Molar mass [c] at worst case formulation [i]	Lower flammability limit [b,d] at nominal composition [h]	Lower flammability limit [b,d] at worst case formulation [i]
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3	kg/m^3
R32	Difluoromethane	CH_2F_2	A2L	648	> 800	700	2,13	52,0	NA	0,307	NA
R50	Methane	CH_4	A3	645		545	0,65	16,0	NA	0,032	NA
R143a	1,1,1 – Trifluoroethane	CF_3CH_3	A2L	750		650	3,43	84,0	NA	0,282	NA
R152a	1, 1 – Difluoroethane	CHF_2CH_3	A2	455		355	2,70	66,0	NA	0,130	NA
R170	Ethane	CH_3CH_3	A3	515		415	1,23	30,1	NA	0,038	NA
R290	Propane	$CH_3CH_2CH_3$	A3	470		370	1,80	44,1	NA	0,038	NA
R600	n-Butane	$CH_3CH_2CH_2CH_3$	A3	365		265	2,37	58,1	NA	0,038	NA
R600a	Isobutane	$CH(CH_3)_3$	A3	460		360	2,37	58,1	NA	0,043	NA
R1150	Ethylene	$CH_2=CH_2$	A3	425			1,15	28,1	NA	0,036	NA
R1270	Propylene	$CH_2=CHCH_3$	A3	455		355	1,72	42,1	NA	0,046	NA
E170	Dimethylether	$(CH_3)_2O$	A3	235		135	1,88	46,1	NA	0,064	NA
R142b	1-chloro-1,1-difluoroethane	CH_3CClF_2	A2L	750[e]		650	4,11	100,5	NA	0,329	NA
R1234yf	2,3,3,3-tetrafluoro-1-propene	$CF_3CF=CH_2$	A2L	405	> 800	700	4,66	114,0	NA	0,289	NA
R1234ze(E)	Trans-1,3,3,3-tetrafluoro-1-propene	$CF_3CF=CHF$	A2L	368	> 800	700	4,66	114.0	NA	0,303	NA

Refrigerant designation [a]	Description	Formula (nominal composition mass fraction %)	Safety group [f]	Auto ignition temperature	Hot surface ignition temperature [g]	Maximum allowable surface temperature [g]	Density [b]	Molar mass [c] at nominal composition [h]	Molar mass [c] at worst case formulation [i]	Lower flammability limit [b,d] at nominal composition [h]	Lower flammability limit [b,d] at worst case formulation [i]
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3	kg/m^3
R-444A	R-32/152a/1234ze(E)	(12/5/83)	A2L	ND	> 800	700	4,03	96,7	95,2	0,324	0,323
R-444B	R-32/152a/1234ze(E)	(41.5/10/48.5)	A2L	ND	> 800	700	3,02	72,8	73,0	0,277	0,277
R-447A	R-32/125/1234ze(E)	(68/3.5/28.5)	A2L	ND			2,61	63,0	63,1	0,304	0,330
R-447B	R-32/125/1234ze(E)	(68/8/24)	A2L	ND	> 800	700	2,58	63,1	63,1	0,312	0,312
R-451A	R-1234yf/134a	(89.8/10.2)	A2L	ND	> 800	700	4,61	112,7	112,7	0,322	0,346
R-451B	R-1234yf/134a	(88.8/11.2)	A2L	ND	> 800	700	4,60	112,6	112,6	0,322	0,341
R-452B	R-32/125/1234yf	(67/7/26)	A2L	ND	> 800	700	2,60	63,5	63,7	0,309	0,310
R-454A	R-32/1234yf	(35/65)	A2L	ND	> 800	700	3,29	80,5	81,8	0,273	0,278
R-454B	R-32/1234yf	(68.9/31.1)	A2L	ND	> 800	700	2,56	62,6	63,0	0,307	0,301
R-454C	R-32/1234yf	(21.5/78.5)	A2L	ND	> 800	700	3,71	90,8	92,5	0,286	0,291
R-457A	R-32/1234yf/152a	(18/70/12)	A2L	ND			3,58	87,6	88,0	0,215	0,216

If any data in this table is missing or in conflict with the data in ISO 817 then the value in ISO 817 shall take precedence.

ND means non-determined. Consult the safety data sheet of the manufacturer.

NA means not applicable.

[a] The refrigerant designations are in accordance with ISO 817.

[b] These values are at 25 °C and at 1 013,2 mbar.

[c] For comparison, the molecular mass of air is taken equal to 28,8 kg/kmol.

[d] Multiply % *v/v* by the corresponding molar mass × 0,000 409 to give the flammability limit in kg/m^3.

[e] Estimated from molecular structure.

[f] Safety group of refrigerants based upon ISO 817.

[g] For **flammable refrigerants**, the maximum allowable surface temperature is determined by AIT reduced by 100 K .
For **A2L refrigerants**, 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.

[h] Nominal composition means design composition as stated in the refrigerant blend application, excluding any tolerances.

[i] Worst case formulation means the composition that results from application of the tolerances to the nominal composition resulting in the most toxic or most flammable formulation.

Annex CC
(informative)

Transportation, marking and storage for units that employ flammable refrigerants

CC.1 General

The following information is provided for units that employ **flammable refrigerants**.

CC.2 Transport of equipment containing flammable refrigerants

Attention is drawn to the fact that additional transportation regulations may exist with respect to equipment containing flammable gas. The maximum number of pieces of equipment or the configuration of the equipment permitted to be transported together will be determined by the applicable transport regulations.

CC.3 Marking of equipment using signs

Signs for similar appliances used in a work area are generally addressed by local regulations and give the minimum requirements for the provision of safety and/or health signs for a work location.

All required signs are to be maintained and employers should ensure that employees receive suitable and sufficient instruction and training on the meaning of appropriate safety signs and the actions that need to be taken in connection with these signs.

The effectiveness of signs should not be diminished by too many signs being placed together.

Any pictograms used should be as simple as possible and contain only essential details.

CC.4 Disposal of equipment using flammable refrigerants

See national regulations.

CC.5 Storage of equipment/appliances

The storage of the appliance should be in accordance with the applicable regulations or instructions, whichever is more stringent.

CC.6 Storage of packed (unsold) equipment

Storage package protection should be constructed in such a way that mechanical damage to the equipment inside the package will not cause a leak of the **refrigerant charge**.

The maximum number of pieces of equipment permitted to be stored together will be determined by local regulations.

Annex DD
(normative)

Requirements for operation, service and installation manuals of appliances using flammable refrigerants

DD.1 General

Each service manual shall include requirements of clauses according to Table DD.1. Different manuals can be combined into one manual.

Table DD.1 – Mandatory clauses in each manual

Clause	Installation	Maintenance and repair	Decommissioning	Note
DD.2	Yes	Yes	Yes	
DD.3.1	Yes	Yes	No	
DD.3.2	Yes	Yes	No	User manual also
DD.3.3	Yes	Yes	Yes	
DD.4	No	Yes	Yes	
DD.4.1	No	Yes	Yes	
DD.4.2	No	Yes	Yes	
DD.4.3	No	Yes	Yes	
DD.4.4	No	Yes	Yes	
DD.4.5	No	Yes	Yes	
DD.4.6	No	Yes	Yes	
DD.4.7	No	Yes	Yes	
DD.4.8	Yes	Yes	No	
DD.4.9	No	Yes	No	
DD.5.1	No	Yes	No	
DD.5.2	No	Yes	No	
DD.6	No	Yes	No	
DD.7	Yes	Yes	No	
DD.8	Yes	Yes	Yes	
DD.9	Yes	Yes	Yes	
DD.10	Yes	Yes	No	
DD.11	No	No	Yes	
DD.12	No	No	Yes	
DD.13	Yes	Yes	Yes	

DD.2 Symbols

The symbols referred to in 7.6 (without colours is permitted) and the information of the warning marking shall be provided as follows:

WARNING

Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.

The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater.

Do not pierce or burn.

Be aware that refrigerants may not contain an odour.

The manufacturer may provide other suitable examples or may provide additional information about the refrigerant odour.

DD.3 Information in manual

DD.3.1 General

The following information shall be specified in the manual where the information is needed for the function of the manual and as applicable to the appliance:

– information for spaces where refrigerant pipes are allowed, including statements
  - that the installation of pipe-work shall be kept to a minimum;
  - that pipe-work shall be protected from physical damage and, in the case of **flammable refrigerants**, shall not be installed in an unventilated space, if that space is smaller than A_{min} in Annex GG, except for **A2L refrigerants** where the installed pipes comply with 22.116. In case of field charge, the effect on **refrigerant charge** caused by the different pipe length has to be quantified;
  - that compliance with national gas regulations shall be observed;
  - that mechanical connections made in accordance with 22.118 shall be accessible for maintenance purposes;
  - that, for appliances containing **flammable refrigerants**, the minimum floor area of the room shall be mentioned in the form of a table or a single figure without reference to a formula;
– the **maximum refrigerant charge** (m_{max});
– instructions how to determine the additional **refrigerant charge** and how to complete the **refrigerant charge** on the label provided by the manufacturer considering the requirements in 7.107;
– the minimum rated airflow, if required by Annex GG;
– information for handling, installation, cleaning, servicing and disposal of refrigerant;
– for appliances using **flammable refrigerants**, instructions shall include the minimum **installed height** h_{inst} (when required to calculate A_{min}), **refrigerant charge** m_c and minimum room area of the space A_{min} or a minimum room area of conditioned space TA_{min} where applicable. Additional minimum room area data may be provided based on other **installed heights** and/or charge levels.
– detailed instructions on how to install the appliance to ensure that the release height h_0 as determined in Clause GG.2 of the installed appliance is not lower than h_0 used for the calculation of A_{min};

– a warning to keep any required ventilation openings clear of obstruction;
– a notice that servicing shall be performed only as recommended by the manufacturer;
– a warning that ducts connected to an appliance shall not contain a **potential ignition source**;
– instructions for wiring to external zoning dampers and/or mechanical ventilation, if required to comply with Clause GG.9, to ensure that upon detection of a leak, the zoning dampers are driven fully open and additional mechanical ventilation is activated;
– for appliances relying on safety measures according to GG.8.3 instructions for wiring to external ventilation;
– when a remote located refrigerant sensor is specified by the manufacturer, the instructions shall state when it is required and how to install and connect the sensor;
– for appliances using **A2L refrigerants**, connected via an air duct system to one or more rooms, the supply and return air shall be directly ducted to the space. Open areas such as false ceilings shall not be used as a return air duct;
– the following information requirements apply **for enhanced tightness refrigerating systems** using **A2L refrigerants**:
  - Equipment piping in the occupied space shall be installed in such a way to protect against accidental damage in operation and service.
  - Precautions shall be taken to avoid excessive vibration or pulsation to refrigerating piping.
  - Protection devices, piping and fittings shall be protected as far as possible against adverse environmental effects, for example the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris.
  - Provision shall be made for expansion and contraction of long runs of piping.
  - Piping in **refrigerating systems** shall be so designed and installed to minimize the likelihood hydraulic shock damaging the system.
  - Solenoid valves shall be correctly positioned in the piping to avoid hydraulic shock.
  - Solenoid valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.
  - Steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation.
  - Flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces. They should be checked for mechanical damage annually.
  - The indoor equipment and pipes shall be securely mounted and guarded such that accidental rupture of equipment cannot occur from such events as moving furniture or reconstruction activities.
  - Where safety shut off valves are specified, the minimum room area may be determined based on the maximum amount of refrigerant that can be leaked as determined in GG.12.2.
  - Where safety shut off valves are specified, the location of the valve in the **refrigerating system** relative to the occupied spaces shall be as described in GG.12.1.
  - Field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of 5 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.
– For mechanical ventilation as specified in GG.8.3, the air extraction opening from the room shall be located equal or below the refrigerant release point. For floor mounted units, it shall be as low as practicable. The air extraction openings shall be located in a sufficient distance from the air intake openings to prevent re-circulation to the space.

DD.3.2 Unventilated areas

For appliances containing more than m_1 for any refrigerating circuit, the manual shall include a statement advising that an unventilated area where the appliance using **flammable refrigerants** is installed shall be so constructed that should any refrigerant leak, it will not stagnate so as to create a fire or explosion hazard. This shall include:

– a warning that the non-**fixed appliance** shall be stored in an area where the room size corresponds to the room area as specified for operation;

– a warning that the non-**fixed appliance** shall be stored in a room without continuously operating open flames (for example an operating gas appliance) or other **potential ignition sources** (for example an operating electric heater, hot surfaces);

– a warning that if appliances with **A2L refrigerants** connected via an air duct system to one or more rooms are installed in a room with an area less than A_{min} as determined in Clause GG.2, that room shall be without continuously operating open flames (for example an operating gas appliance) or other **potential ignition sources** (for example an operating electric heater, hot surfaces). A flame-producing device may be installed in the same space if the device is provided with an effective flame arrest;

– for appliances using **A2L refrigerants** connected via an air duct system to one or more rooms, a warning with the substance of the following: “Auxiliary devices which may be a **potential ignition source** shall not be installed in the duct work. Examples of such **potential ignition sources** are hot surfaces with a temperature exceeding X°C and electric switching devices”;

NOTE X is the maximum allowable surface temperature as defined in 22.117.

– for appliances using **A2L refrigerants** connected via an air duct system to one or more rooms, a warning that only auxiliary devices approved by the appliance manufacturer or declared suitable with the refrigerant shall be installed in connecting ductwork. The manufacturer can list in the instructions all approved auxiliary devices by the manufacturer and model number for use with the specific appliance, if those devices have a potential to become an ignition source.

The manufacturer should specify other potential continuously operating sources known to cause ignition of the refrigerant used.

The appliance shall be stored so as to prevent mechanical damage from occurring.

DD.3.3 Qualification of workers

The manual shall contain specific information about the required qualification of the working personnel for maintenance, service and repair operations. Every working procedure that affects safety means shall only be carried out by competent persons according to Annex HH.

Examples for such working procedures are:

- breaking into the refrigerating circuit;
- opening of sealed components;
- opening of ventilated enclosures.

DD.4 Information on servicing

DD.4.1 General

The manual shall contain specific information for service personnel according to DD.4.2 to DD.4.10.

DD.4.2 Checks to the area

Prior to beginning work on systems containing **flammable refrigerants**, safety checks are necessary to ensure that the risk of ignition is minimised. For repair to the **refrigerating system**, DD.4.3 to DD.4.7 shall be completed prior to conducting work on the system.

DD.4.3 Work procedure

Work shall be undertaken under a controlled procedure so as to minimise the risk of a flammable gas or vapour being present while the work is being performed.

DD.4.4 General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

DD.4.5 Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

DD.4.6 Presence of fire extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO_2 fire extinguisher adjacent to the charging area.

DD.4.7 No ignition sources

No person carrying out work in relation to a **refrigerating system** which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. “No Smoking” signs shall be displayed.

DD.4.8 Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

DD.4.9 Checks to the refrigerating equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer’s maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer’s technical department for assistance.

*The following checks shall be applied to installations using **flammable refrigerants**:*

– *the actual **refrigerant charge** is in accordance with the room size within which the refrigerant containing parts are installed;*

– *the ventilation machinery and outlets are operating adequately and are not obstructed;*

– *if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;*

– *marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;*

– *refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.*

DD.4.10 Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

Initial safety checks shall include:

- that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- that no live electrical components and wiring are exposed while charging, recovering or purging the system;
- that there is continuity of earth bonding.

DD.5 Repairs to sealed components

DD.5.1 During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

DD.5.2 Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatus is mounted securely.

Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications.

DD.6 Repair to intrinsically safe components

Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.

Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating.

Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

NOTE The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

DD.7 Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

DD.8 Detection of flammable refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but in the case of **flammable refrigerants**, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the ***LFL*** of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

NOTE Examples of leak detection fluids are

– bubble method,

– fluorescent method agents.

If a leak is suspected, all naked flames shall be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to Clause DD.9.

DD.9 Removal and evacuation

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for **flammable refrigerants** it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to:

- remove refrigerant;
- purge the circuit with inert gas (optional for A2L);
- evacuate (optional for A2L);
- purge with inert gas (optional for A2L);
- open the circuit by cutting or brazing.

The **refrigerant charge** shall be recovered into the correct recovery cylinders. For appliances containing **flammable refrigerants** other than **A2L refrigerants**, the system shall be purged with oxygen-free nitrogen to render the appliance safe for **flammable refrigerants**. This process may need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing **flammable refrigerants**, other than **A2L refrigerants**, **refrigerants** purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. This operation is absolutely vital if brazing operations on the pipe-work are to take place.

Ensure that the outlet for the vacuum pump is not close to any **potential ignition sources** and that ventilation is available.

DD.10 Charging procedures

In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimise the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the **refrigerating system** is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the **refrigerating system**.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

DD.11 Decommissioning

Before carrying out this procedure it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

a) Become familiar with the equipment and its operation.

b) Isolate system electrically.

c) Before attempting the procedure, ensure that:

   - mechanical handling equipment is available, if required, for handling refrigerant cylinders;
   - all personal protective equipment is available and being used correctly;
   - the recovery process is supervised at all times by a competent person;
   - recovery equipment and cylinders conform to the appropriate standards.

d) Pump down refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with instructions.

h) Do not overfill cylinders (no more than 80 % volume liquid charge).

i) Do not exceed the maximum working pressure of the cylinder, even temporarily.

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another **refrigerating system** unless it has been cleaned and checked.

DD.12 Labelling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing **flammable refrigerants**, ensure that there are labels on the equipment stating the equipment contains **flammable refrigerant**.

DD.13 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, **flammable refrigerants**. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.

The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that **flammable refrigerant** does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the supplier. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Annex EE
(normative)

Pressure tests

EE.1 General

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

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

Compliance is checked by the following tests.

For all tests of Clause 21, if the refrigerant is a blend, the test pressure of EE.4.2 shall be carried out at the highest pressure under the specified temperature.

The test value that is the maximum of Clauses EE.2, EE.3 or EE.4 shall be used for the test of EE.4.2, respectively, for the high side and the low side components.

EE.2 Pressure test value determined under testing carried out in Clause 11

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

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

EE.3 Pressure test value determined under testing carried out in Clause 19

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

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

EE.4 Pressure test value determined under testing carried out under standstill conditions

EE.4.1 In order to determine the standstill pressure, the appliance shall be soaked in the highest operating temperature specified by the manufacturer for 1 h with power off.

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

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

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

EE.4.2 The pressure test shall be carried out on three samples of each component. The test samples are filled with a liquid, such as water, to exclude air and are connected in a hydraulic pump system. The pressure is raised gradually until the required test pressure is reached. The pressure is maintained for at least 1 min, during which time the sample shall not leak.

Where gaskets are employed for sealing parts under pressure, leakage at gaskets is acceptable, provided the leakage only occurs at a value greater than 120 % of the **maximum allowable pressure** and the test pressure is still reached for the specified time. Additional sealing measures, such as an "O" ring, for pressure testing may be provided.

EE.5 Fatigue test option for Clause EE.1 and EE.4.2

EE.5.1 The components shall be subjected to a test at 66,7 % of the test pressure determined by Clauses EE.2, EE.3 or EE.4, provided the components comply with the fatigue test in Clause EE.5. This test is conducted on a separate sample.

EE.5.2 Three samples of each refrigerant-containing part shall be tested at the cyclic pressure values specified in EE.5.7 and EE.5.8 for the number of cycles specified in EE.5.6, as described in EE.5.4.

EE.5.3 The samples shall be considered to comply with EE.5.5 on completion of the test and if they do not rupture, burst, or leak.

EE.5.4 The test samples shall be filled with fluid, and shall be connected to a pressure-driving source. The pressure shall be raised and lowered between the upper and lower cyclic values at a rate specified by the manufacturer. The pressure shall reach the specified upper and lower values during each cycle. The shape of the pressure cycle shall be such that the upper and lower pressure values shall be maintained for at least 0,1 s.

NOTE For safety purposes, it is suggested that a non-compressible fluid is used for the test. The fluid fills the sample completely to prevent any significantly remaining gas.

If the operating temperatures of the appliance under the conditions of steady state operation of Clause 11 are less than or equal to 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the component part or assembly shall be at least 20 °C. If the continuous operating temperature of the component exceeds 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the parts or assemblies that are at these temperatures, and subjected to the pressure, shall be at least 25 °C greater than the temperature of the part measured during the test of Clause 11 for copper or aluminium and 60 °C higher for steel. For other materials, the effects of temperature on the material fatigue characteristics shall be evaluated by conducting the test at the higher temperatures and considering the material characteristics at the higher temperatures.

EE.5.5 The pressure for the first cycle shall be the maximum evaporating pressure for **low-pressure side** components or the maximum condensing pressure for the **high-pressure side** components.

EE.5.6 The total number of cycles shall be 250 000. The test pressures shall be determined by EE.5.7 (except the first and last cycles as noted in EE.5.5 and EE.5.8).

EE.5.7 The pressure for the test cycles shall be as follows:

a) For components subject to high side pressures, the upper pressure value shall not be less than the saturated vapour pressure of the refrigerant at 50 °C and the lower pressure value shall not be greater than the saturated vapour pressure of the refrigerant at 5 °C. For hot water **heat pumps**, the upper pressure shall not be less than 80 % of the **maximum allowable pressure** under the conditions of Clause 11.