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| Ein Bild, das Text, ClipArt enthält.  Automatisch generierte Beschreibung | | | | Test Report issued under the responsibility of: | |
| TEST REPORT **IEC 60335‑2‑40**  **Safety of household and similar electrical appliances**  **Part 2‑40: Particular requirements for electrical heat pumps, air conditioners and dehumidifiers** | | | |
|  | |  | |
| **Report Number. :** | |  | |
| **Date of issue :** | |  | |
| **Total number of pages :** | |  | |
|  | | | |
| **Name of Testing Laboratory preparing the Report :** |  | | |
| **Applicant’s name :** |  | | |
| **Address :** |  | | |
| **Test specification:** |  | | |
| **Standard :** | IEC 60335‑2‑40:2022 in conjunction with IEC 60335‑1:2010, IEC 60335‑1:2010/AMD1:2013, IEC 60335‑1:2010/AMD2:2016 | | |
| **Test procedure :** | CB Scheme | | |
| **Non-standard test method :** | N/A | | |
| **TRF template used :** | IECEE OD-2020-F1:2022, Ed.1.5 | | |
| **Test Report Form No. :** | IEC60335\_2\_40X | | |
| **Test Report Form(s) Originator :** | VDE Prüf- und Zertifizierungsinstitut GmbH | | |
| **Master TRF :** | Dated 2023-11-17 | | |
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| **Test item description :** | |  | | |
| **Trade Mark :** | |  | | |
| **Manufacturer :** | |  | | |
| **Model/Type reference :** | |  | | |
| **Ratings :** | |  | | |
|  | | | | |
| **Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):** | | | | |
|  | **CB Testing Laboratory:** | |  | |
| **Testing location/ address :** | | |  | |
| **Tested by (name, function, signature) :** | | |  |  |
| **Approved by (name, function, signature) :** | | |  |  |
|  | | | | |
|  | **Testing procedure: CTF Stage 1:** | |  | |
| **Testing location/ address :** | | |  | |
| **Tested by (name, function, signature) :** | | |  |  |
| **Approved by (name, function, signature) :** | | |  |  |
|  | | | | |
|  | **Testing procedure: CTF Stage 2:** | |  | |
| **Testing location/ address :** | | |  | |
| **Tested by (name + signature) :** | | |  |  |
| **Witnessed by (name, function, signature) :** | | |  |  |
| **Approved by (name, function, signature) :** | | |  |  |
|  | | | | |
|  | **Testing procedure: CTF Stage 3:** | |  | |
|  | **Testing procedure: CTF Stage 4:** | |  | |
| **Testing location/ address :** | | |  | |
| **Tested by (name, function, signature) :** | | |  |  |
| **Witnessed by (name, function, signature) :** | | |  |  |
| **Approved by (name, function, signature) :** | | |  |  |
| **Supervised by (name, function, signature) :** | | |  |  |
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| **List of Attachments (including a total number of pages in each attachment):** | |
| **Summary of testing:** | |
| **Tests performed (name of test, test clause and date test performed):** | **Testing location: (CBTL, SPTL, CTF, Subcontractor)** |
| **Summary of compliance with National Differences (List of countries addressed):**  **The product fulfils the requirements of** | |
| **Use of uncertainty of measurement for decisions on conformity (decision rule) :**  No decision rule is specified by the IEC standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty (“simple acceptance” decision rule, previously known as “accuracy method”).  Other:… (to be specified, for example when required by the standard or client, or if national accreditation requirements apply)  **Information on uncertainty of measurement:**  The uncertainties of measurement are calculated by the laboratory based on application of criteria given by OD-5014 for test equipment and application of test methods, decision sheets and operational procedures of IECEE.  IEC Guide 115 provides guidance on the application of measurement uncertainty principles and applying the decision rule when reporting test results within IECEE scheme, noting that the reporting of the measurement uncertainty for measurements is not necessary unless required by the test standard or customer.  Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing. | |

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| **Copy of marking plate:** |

|  |  |
| --- | --- |
| **Test item particulars :** |  |
| **Classification of installation and use :** |  |
| **Supply Connection :** |  |
| **:** |  |
| **Possible test case verdicts:** |  |
| **- test case does not apply to the test object :** | N/A |
| **- test object does meet the requirement :** | P (Pass) |
| **- test object does not meet the requirement :** | F (Fail) |
| **Testing :** |  |
| **Date of receipt of test item :** |  |
| **Date (s) of performance of tests :** |  |
|  | |
| **General remarks:** | |
| "(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.  **Throughout this report a  comma /  point is used as the decimal separator.**  **This Test Report Form contains requirements according to IEC/ISO …... Standard dated ….. and includes** Corrigendum dated ……. (Note: The above text maybe removed if not applicable)  This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program. | |
| **Manufacturer’s Declaration per sub-clause 4.2.5 of IECEE 02:** | |
| The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided : | **Yes**  **Not applicable** |
| **When differences exist; they shall be identified in the General product information section.** | |
| **Name and address of factory (ies) :** |  |
| General product information and other remarks: | |

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| **5** | **GENERAL CONDITIONS FOR THE TESTS** | |  |
|  | Tests performed according to clause 5, e.g. nature of supply, sequence of testing, etc. |  |  |
| 5.2 | Tests of clause 21 carried out on separate samples. Tests of clauses 11, 19 and 21 require pressure measurements made at various points in refrigerating system |  |  |
|  | If the tests of Annex FF (Leak simulation tests) and Annex QQ (Methods for determining releasable charge) are carried out, at least one additional specially prepared sample is required. |  |  |
|  | If the tests of Annex LL are carried out, additional refrigerant sensors are needed. |  |  |
|  | If the test of Annex NN has to be carried out, an additional appliance may be used. |  |  |
| 5.6 | Any controls which regulate the temperature or humidity of the conditioned space are rendered inoperative during the test. |  |  |
| 5.7 | 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 | For split units, the refrigerant lines installed in accordance with the installation instructions. The length of pipe between 5 m and 7,5 m. |  |  |
|  | Where the installation instructions specify a maximum pipe length of less than 5 m, the length of pipe the maximum length specified in the installation instructions, and where the installation instructions specify a minimum pipe length of more than 7,5 m, the length of pipe the minimum length specified in the installation instructions. |  |  |
|  | The thermal insulation of the refrigerant lines applied in accordance with the installation instructions. |  |  |
| **6** | **CLASSIFICATION** | |  |
| 6.1 | Class I, II, III |  |  |
| 6.2 | Appliances shall be classified according to degree of protection against harmful ingress of water in accordance with IEC 60529: | |  |
|  | - appliances or parts intended for outdoor use be at least IPX4 |  |  |
|  | - appliances intended only for indoor use (excluding laundry rooms) be IPX0 |  |  |
|  | - appliances intended to be used in laundry rooms 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. |  |  |
| **7** | **MARKING AND INSTRUCTIONS** | |  |
| 7.1 | Rated voltage or voltage range (V) : |  |  |
|  | Symbol for nature of supply including number of phases, unless for single phase operation : |  |  |
|  | Rated frequency (Hz) : |  |  |
|  | Rated power input (W), or : |  |  |
|  | Rated current (A) : |  |  |
|  | Manufacturer's or responsible vendor's name, trademark or identification mark : |  |  |
|  | Model or type reference : |  |  |
|  | Symbol IEC 60417‑5172, for class II appliances |  |  |
|  | IP number, other than IPX0 : |  |  |
|  | Symbol IEC 60417‑5180, for class III appliances, unless |  |  |
|  | the appliance is operated by batteries only, or |  |  |
|  | for appliances powered by rechargeable batteries recharged in the appliance |  |  |
|  | Symbol IEC 60417‑5018, for class II and class III appliances incorporating a functional earth |  |  |
|  | Symbol IEC 60417‑5036, for the enclosure of electrically‑operated water valves in external hose‑sets for connection of an appliance to the water mains, if the working voltage exceeds extra‑low voltage |  |  |
|  | Refrigerant charge for each refrigerating system : |  |  |
|  | Refrigerant designation in accordance with ISO 817 : |  |  |
|  | maximum allowable pressure for the storage : |  |  |
|  | 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 maximum allowable pressures for the suction and discharge side differ, a separate indication is required : |  |  |
|  | for pre-charged pipe sets |  |  |
|  | - refrigerant designation in accordance with ISO 817 |  |  |
|  | - the refrigerant charge in the line set |  |  |
|  | - maximum allowable pressure |  |  |
|  | * if charged with a flammable refrigerant, the flame symbol ISO 7010-W021 (2011-05) including the safety group per ISO 817 |  |  |
|  | Ratings in watts and voltage of a UV-C germicidal lamp system if employed |  |  |
|  | Appliances are marked with all of the designations and the rated inputs of the supplementary heaters for which they are intended to be used, and have provision for identifying the actual heater that is field installed. |  |  |
|  | Unless it is evident from the design, the enclosure of the appliance marked, by words or by symbols, with the direction of the fluid flow. |  |  |
|  | If a flammable refrigerant is used, a warning symbol (flame symbol: ISO 7010-W021 (2011-05)) including the safety group per ISO 817 as described in 7.6 placed within sight of the marking of the refrigerant designation on the appliance. The height of the symbol at least 10 mm, and the symbol need not be in colour. |  |  |
|  | Appliances using flammable refrigerants marked with the flame symbol ISO 7010-W021 (2011-05) including the safety group per ISO 817. The height of the triangle used for the symbol at least 30 mm. The required markings shall be provided on all units which contain compressors. |  |  |
|  | If not already visible when accessing a service port and if a service port is provided, the service port marked to identify the type of refrigerant. If the refrigerant is flammable, symbol ISO 7010-W021 (2011-05) including the safety group per ISO 817 included, without specifying the colour. |  |  |
|  | Appliances employing refrigerating systems with maximum allowable pressures > than 7 MPa be marked with symbol ISO 7000-1701 (2004-01) followed by the text “(X) MPa” and the Operator's manual; ISO 7000-0790 (2004-01). Where: "X" is the maximum allowable pressure. |  |  |
| 7.2 | Warning for stationary appliances for multiple supply |  |  |
|  | Warning placed in vicinity of terminal cover |  |  |
| 7.3 | Range of rated values marked with the lower and upper limits separated by a hyphen |  |  |
|  | Different rated values marked with the values separated by an oblique stroke |  |  |
| 7.4 | Appliances adjustable for different rated voltages or rated frequencies, the voltage or the frequency setting is clearly discernible |  |  |
|  | Requirement met if frequent changes are not required and the rated voltage or rated frequency to which the appliance is to be adjusted is determined from a wiring diagram |  |  |
| 7.5 | Appliances with more than one rated voltage or one or more rated voltage ranges, marked with rated input or rated current for each rated voltage or range, unless |  |  |
|  | the power input or current are related to the arithmetic mean value of the rated voltage range |  |  |
|  | Relation between marking for upper and lower limits of rated power input or rated current and voltage is clear |  |  |
| 7.6 | Correct symbols used |  |  |
|  | IEC 60335-2-40:2022 | service indicator;  read technical  manual |  |
|  | IEC 60335-2-40:2022 | warning; flammable  material |  |
|  | IEC 60335-2-40:2022 | pressure |  |
|  | IEC 60335-2-40:2022 | ultraviolet radiation,  instructional  safeguard |  |
|  | IEC 60335-2-40:2022 | minimum room floor  area |  |
|  | ISO 7000-0790 (2004-01). |  |  |
|  | Symbol for nature of supply placed next to rated voltage |  |  |
|  | Symbol for class II appliances placed unlikely to be confused with other marking |  |  |
|  | Units of physical quantities and their symbols according to international standardized system |  |  |
| 7.7 | Connection diagram fixed to appliances to be connected to more than two supply conductors and appliances for multiple supply, unless |  |  |
|  | correct mode of connection is obvious |  |  |
| 7.8 | Except for type Z attachment, terminals for connection to the supply mains indicated as follows: | |  |
|  | - marking of terminals exclusively for the neutral conductor (letter N) |  |  |
|  | - marking of protective earthing terminals (symbol IEC 60417‑5019) |  |  |
|  | - marking of functional earthing terminals (symbol IEC 60417‑5018) |  |  |
|  | - marking not placed on removable parts |  |  |
| 7.9 | Marking or placing of switches which may cause a hazard |  |  |
| 7.10 | Indications of switches on stationary appliances and controls on all appliances by use of figures, letters or other visual means : |  |  |
|  | This applies also to switches which are part of a control |  |  |
|  | If figures are used, the off position indicated by the figure 0 |  |  |
|  | The figure 0 indicates only OFF position, unless no confusion with the OFF position |  |  |
| 7.11 | Indication for direction of adjustment of controls |  |  |
| 7.12 | Instructions for safe use provided |  |  |
|  | Details concerning precautions during user maintenance |  |  |
|  | The instructions state that: | |  |
|  | - the appliance is not to be used by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction |  |  |
|  | - children being supervised not to play with the appliance |  |  |
|  | For a part of class III construction supplied from a detachable power supply unit, the instructions state that the appliance is only to be used with the unit provided |  |  |
|  | Instructions for class III appliances state that it must only be supplied at SELV, unless |  |  |
|  | it is a battery‑operated appliance, the battery being charged outside the appliance |  |  |
|  | For appliances for altitudes exceeding 2000 m, the maximum altitude is stated : |  |  |
|  | The instructions for appliances incorporating a functional earth states that the appliance incorporates an earth connection for functional purposes only |  |  |
| 7.12.1 | Sufficient details for installation supplied |  |  |
|  | For an appliance intended to be permanently connected to the water mains and not connected by a hose‑set, this is stated |  |  |
|  | If different rated voltages or different rated frequencies are marked, the instructions state what action to be taken to adjust the appliance |  |  |
|  | In particular, the following information supplied: | |  |
|  | a) that the appliance installed in accordance with national wiring regulations; |  |  |
|  | b) the dimensions of the space necessary for correct installation of the appliance including the minimum permissible distances to adjacent structures; |  |  |
|  | c) for appliances with supplementary air heaters, the minimum clearance from the appliance to combustible surfaces; |  |  |
|  | d) a wiring diagram with a clear indication of the connections and wiring to external control devices and supply cord; |  |  |
|  | e) the range of external static pressures at which the appliance was tested (add-on heat pumps and ducted appliances with supplementary air heaters only); |  |  |
|  | f) the method of connection of the appliance to the electrical supply and interconnection of separate components; |  |  |
|  | g) indication of which parts of the appliance are suitable for outdoor use, if applicable; |  |  |
|  | h) details of type and rating of fuses, or rating of circuit breakers; |  |  |
|  | i) 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; |  |  |
|  | j) maximum and minimum water or brine operating temperatures; |  |  |
|  | k) maximum and minimum water or brine operating pressures; |  |  |
|  | l) maximum and minimum operating indoor and outdoor air temperatures |  |  |
|  | m) instructions on charging of refrigerants when addition of charge is required by the manufacturer for completing the refrigerating system. |  |  |
|  | n) when the symbol IEC 60417-6412 (2019-03) is used, a warning that the appliance installed, operated and stored in a room with a floor area not less than the minimum room area. |  |  |
| 7.12.101 | For appliances not accessible to the general public, the classification according to 6.101 included. |  |  |
| 7.12.102 | For appliances using flammable refrigerants, an installation manual, service, maintenance and repair manual, and decommissioning manual, either as separate or combined manuals, made available and include the information given in Annex DD. |  |  |
|  | Additional guidance on transportation, marking and storage for units that employ flammable refrigerants is given in Annex CC. |  |  |
| 7.12.2 | Stationary appliances not fitted with means for disconnection from the supply mains having a contact separation in all poles that provide full disconnection under overvoltage category III, the instructions state that means for disconnection must be incorporated in the fixed wiring in accordance with the wiring rules |  |  |
| 7.12.3 | Insulation of the fixed wiring in contact with parts exceeding 50 K during clause 11; instructions state that the fixed wiring must be protected |  |  |
| 7.12.4 | Instructions for built‑in appliances: | |  |
|  | - dimensions of space |  |  |
|  | - dimensions and position of supporting and fixing |  |  |
|  | - minimum distances between parts and surrounding structure |  |  |
|  | - minimum dimensions of ventilating openings and arrangement |  |  |
|  | - connection to supply mains and interconnection of separate components |  |  |
|  | - allow disconnection of the appliance after installation, by accessible plug or a switch in the fixed wiring, unless |  |  |
|  | a switch complying with 24.3 |  |  |
| 7.12.5 | Replacement cord instructions, type X attachment with a specially prepared cord |  |  |
|  | Replacement cord instructions, type Y attachment |  |  |
|  | Replacement cord instructions, type Z attachment |  |  |
| 7.12.6 | Caution in the instructions for appliances incorporating a non‑self‑resetting thermal cut‑out that is reset by disconnection of the supply mains, if this cut‑out is required to comply with the standard |  |  |
| 7.12.7 | Instructions for fixed appliances stating how the appliance is to be fixed |  |  |
| 7.12.8 | Instructions for appliances connected to the water mains: | |  |
|  | - max. inlet water pressure (Pa) : |  |  |
|  | - min. inlet water pressure, if necessary (Pa) : |  |  |
|  | Instructions concerning new and old hose‑sets for appliances connected to the water mains by detachable hose‑sets |  |  |
| 7.12.9 | Instructions specified in 7.12 and from 7.12.1 to 7.12.8 appear together before any other instructions supplied with the appliance |  |  |
|  | These instructions may be supplied with the appliance separately from any functional use booklet |  |  |
|  | They may follow the description of the appliance that identifies parts, or follow the drawings/sketches |  |  |
|  | In addition, instructions are also available in an alternative format such as on a website or on request from the user in a format such as a DVD |  |  |
| 7.13 | Instructions and other texts in an official language |  |  |
| 7.14 | Markings clearly legible and durable: | |  |
|  | Signal words WARNING, CAUTION, DANGER in uppercase having a height as specified : |  |  |
|  | Uppercase letter of the text explaining the signal word not smaller than 1,6 mm : |  |  |
|  | Moulded in, engraved, or stamped markings either raised above or have a depth below the surface of at least 0,25 mm, unless |  |  |
|  | contrasting colours are used |  |  |
|  | Markings checked by inspection, measurement and rubbing test as specified |  |  |
| 7.15 | Markings on a main part |  |  |
|  | Marking clearly discernible from the outside, if necessary after removal of a cover |  |  |
|  | For portable appliances, cover can be removed or opened without a tool |  |  |
|  | For stationary appliances, name, trademark or identification mark and model or type reference visible after installation |  |  |
|  | For fixed appliances, name, trademark or identification mark and model or type reference visible after installation according to the instructions |  |  |
|  | Indications for switches and controls placed on or near the components. Marking not on parts which can be positioned or repositioned in such a way that the marking is misleading |  |  |
|  | The symbol IEC 60417‑5018 placed next to the symbol IEC 60417‑5172 or IEC 60417‑5180 |  |  |
|  | A marking may be located on a panel that can be removed for installation or service, providing that the panel in place for the intended operation of the appliance. |  |  |
| 7.16 | Marking of a possible replaceable thermal link or fuse link clearly visible with regard to replacing the link |  |  |
| 7.101 | Marking of fuses and overload protective devices, if replaceable | |  |
|  | - fuse rated current in amperes, type and rated voltage or |  |  |
|  | - manufacturer and model of overload protective device |  |  |
| 7.102 | Marking for connection with aluminium wire, if necessary |  |  |
| 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 include the following additional information: | |  |
|  | - For evaporating units and condensing units, the instructions or markings shall include 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 include refrigerant charging instructions. |  |  |
|  | - A warning to assure that partial units 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 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 leak detection system, the instructions or unit markings shall contain the substance of the following: | |  |
|  | “This unit is equipped with a refrigerant leak detection system for safety. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.” |  |  |
|  | If any remote located refrigerant sensor is employed to detect leaked refrigerant, such remote located refrigerant sensor also apply this marking or be accompanied by such instructions. |  |  |
| 7.106 | For appliances using flammable refrigerants that have safety features depending upon the proper function of electrically powered safety measures, the instructions or unit markings shall contain the substance of the following: | |  |
|  | “This unit is equipped with electrically powered safety measures. For the safety measures to be effective, the unit must be electrically powered at all times after installation, other than when servicing.” |  |  |
|  | If any mechanical ventilation unit is employed to dilute leaked refrigerant and is not integrated in the appliance, such unit also apply this marking or be accompanied by such instructions. |  |  |
| 7.107 | For flammable refrigerants, when addition of charge is required by the installation instructions for completing the refrigerating system, the manufacturer provides 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, excluding appliances with A2L refrigerant charge not exceeding m1, the flame symbol ISO 7010-W021 (2011-05) including the safety group per Annex BB described in 7.6 visible on the packaging of the appliance if the appliance is charged with refrigerant. |  |  |
|  | The perpendicular height of the symbol at least 30 mm. |  |  |
| 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/cm2; |  |  |
|  | - user maintenance access panels |  |  |
|  | - UV-C barriers. |  |  |
| 7.110 | For appliances that employ UV-C germicidal lamp systems, the instructions include the substance of the following: (IEC 60335‑2‑40:2018) | |  |
|  | - 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; |  |  |
|  | - 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; |  |  |
|  | - 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 can have UV-C spectral irradiance greater than 1,7 μW/cm2 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 appliance specified in the instructions by the specific model number; |  |  |
|  | - do not operate UV-C lamps outside of the appliance. |  |  |
| 7.111 | For Appliances employing refrigerating systems with maximum allowable pressures greater than 7 MPa, marked within sight of the refrigerant service ports with the following: | |  |
|  | – the symbol ISO 7000-1701 (2004-01) including the text "(X) MPa", where; "X" is not less than the maximum allowable pressure. |  |  |
| **8** | **PROTECTION AGAINST ACCESS TO LIVE PARTS** | |  |
| 8.1 | Adequate protection against accidental contact with live parts |  |  |
| 8.1.1 | Requirement applies for all positions, detachable parts removed |  |  |
|  | Lamps behind a detachable cover not removed, if conditions met |  |  |
|  | Insertion or removal of lamps, protection against contact with live parts of the lamp cap |  |  |
|  | Use of test probe B of IEC 61032, with a force not exceeding 1 N: no contact with live parts |  |  |
|  | Use of test probe B of IEC 61032 through openings, with a force of 20 N: no contact with live parts |  |  |
| 8.1.2 | Use of test probe 13 of IEC 61032, with a force not exceeding 1 N, through openings in class 0 appliances and class II appliances/constructions: no contact with live parts |  |  |
|  | Test probe 13 also applied through openings in earthed metal enclosures having a non‑conductive coating: no contact with live parts |  |  |
| 8.1.3 | For appliances other than class II, use of test probe 41 of IEC 61032, with a force not exceeding 1 N: no contact with live parts of visible glowing heating elements or supporting parts |  |  |
|  | For a single switching action obtained by a switching device, requirements as specified |  |  |
|  | For appliances with a supply cord and without a switching device, the single switching action may be obtained by the withdrawal of the plug |  |  |
| 8.1.4 | Accessible part not considered live if: | |  |
|  | - safety extra‑low a.c. voltage: peak value not exceeding 42,4 V |  |  |
|  | - safety extra‑low d.c. voltage: not exceeding 42,4 V |  |  |
|  | - or separated from live parts by protective impedance |  |  |
|  | If protective impedance: d.c. current not exceeding 2 mA, and |  |  |
|  | a.c. peak value not exceeding 0,7 mA |  |  |
|  | - for peak values over 42,4 V up to and including 450 V, capacitance not exceeding 0,1 μF |  |  |
|  | - for peak values over 450 V up to and including 15 kV, discharge not exceeding 45 μC |  |  |
|  | - for peak values over 15 kV, the energy in the discharge not exceeding 350 mJ |  |  |
| 8.1.5 | Live parts protected at least by basic insulation before installation or assembly: | |  |
|  | - built‑in appliances |  |  |
|  | - fixed appliances |  |  |
|  | - appliances delivered in separate units |  |  |
|  | *For appliances which have a dedicated installation panel or cover and which cannot be installed without them, compliance is checked according to 5.10* | |  |
| 8.2 | Class II appliances and constructions constructed so that there is adequate protection against accidental contact with basic insulation and metal parts separated from live parts by basic insulation only |  |  |
|  | Only possible to touch parts separated from live parts by double or reinforced insulation |  |  |
| **9** | **STARTING OF MOTOR-OPERATED APPLIANCES** | |  |
|  | Requirements and tests are specified in part 2 when necessary |  |  |
| **10** | **POWER INPUT AND CURRENT** | |  |
| 10.1 | Power input at normal operating temperature, rated voltage and normal operation not deviating from rated power input by more than shown in table 1 : | (see appended table) |  |
|  | If the power input varies throughout the operating cycle and the maximum value of the power input exceeds, by a factor greater than two, the arithmetic mean value of the power input occurring during a representative period, the power input is the maximum value that is exceeded for more than 10 % of the representative period |  |  |
|  | Otherwise the power input is the arithmetic mean value |  |  |
|  | Test carried out at upper and lower limits of the ranges for appliances with one or more rated voltage ranges, unless |  |  |
|  | the rated power input is related to the arithmetic mean value |  |  |
| 10.2 | Current at normal operating temperature, rated voltage and normal operation not deviating from rated current by more than shown in table 2 : | (see appended table) |  |
|  | If the current varies throughout the operating cycle and the maximum value of the current exceeds, by a factor greater than two, the arithmetic mean value of the current occurring during a representative period, the current is the maximum value that is exceeded for more than 10 % of the representative period |  |  |
|  | Otherwise the current is the arithmetic mean value |  |  |
|  | Test carried out at upper and lower limits of the ranges for appliances with one or more rated voltage ranges, unless |  |  |
|  | the rated current is related to the arithmetic mean value of the range |  |  |
| **11** | **HEATING** | |  |
| 11.1 | 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. |  |  |
| 11.2.1 | 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; |  |  |
|  | – adjustable limit controls are set at the maximum cut-out setting and the minimum differential permitted by the control adjusting means. |  |  |
|  | Appliances are installed in one or more test rooms in accordance with the installation instructions. In particular, | |  |
|  | – clearances to adjacent surfaces specified by the manufacturer maintained; |  |  |
|  | – 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 air heaters, an additional test casing as described in 11.2.5 is used.* |  |  |
| 11.2.2 | For heating tests of ducted appliances with supplementary air heaters, an inlet duct is connected to the inlet air opening of the appliance. |  |  |
|  | The duct 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. |  |  |
| 11.2.3 | *A ducted appliance which does not include supplementary air 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 hot air outlet duct is provided with a restricting means to obtain the maximum static pressure given in the instructions* |  |  |
| 11.2.4 | 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 operating 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 operating 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. |  |  |
| 11.2.5 | Test casing |  |  |
| 11.3 | Temperature rise determine by thermocouples or resistance method. |  |  |
| 11.4 | Test performed at supply voltage between 0,94 and 1,06 times the rated voltage |  |  |
| 11.5 | This subclause of Part 1 is not applicable. |  |  |
| 11.6 | This subclause of Part 1 is not applicable. | |  |
| 11.7 | *Test conducted in heating mode and cooling mode, if both exist* | |  |
|  | *Additional for defrost tests in most unfavourable conditions* | |  |
|  | *Appliances operated continuously until steady conditions , except for defrost tests* | |  |
|  | *Appliances are operated under normal operation with flow rates which give the most unfavourable result* | |  |
| 11.8 | Temperatures not exceed the temperature limit according to the formula. |  |  |
| **13** | **LEAKAGE CURRENT AND ELECTRIC STRENGTH AT OPERATING TEMPERATURE** | |  |
| 13.1 | Leakage current not excessive and electric strength adequate |  |  |
|  | Heating appliances operated at 1,15 times the rated power input (W) : |  |  |
|  | Motor‑operated appliances and combined appliances supplied at 1,06 times the rated voltage (V) : |  |  |
|  | Protective impedance and radio interference filters disconnected before carrying out the tests |  |  |
| 13.2 | The leakage current is measured by means of the circuit described in figure 4 of IEC 60990:1999 |  |  |
|  | For stationary class I motor-operated appliances, the leakage current not exceed 3,5 mA, or 2 mA per kilowatt rated power input, whichever is higher. 31 The maximum value not exceed 10 mA for appliances accessible to the general public and 30 mA for appliances not accessible to the general public. |  |  |
|  | Leakage current measurements : | (see appended table) |  |
| 13.3 | The appliance is disconnected from the supply |  |  |
|  | Electric strength tests according to table 4 : |  |  |
|  | No breakdown during the tests |  |  |
| **14** | **TRANSIENT OVERVOLTAGES** | |  |
|  | Appliances withstand the transient over‑voltages to which they may be subjected |  |  |
|  | Clearances having a value less than specified in table 16 subjected to an impulse voltage test, the test voltage specified in table 6 : | (see appended table) |  |
|  | No flashover during the test, unless |  |  |
|  | of functional insulation if the appliance complies with clause 19 with the clearance short‑circuited |  |  |
| **15** | **MOISTURE RESISTANCE** | |  |
| 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. |  |  |
| 15.2 | Tests in accordance with IEC 60529 in appliances other than IPX0, as specified: |  |  |
| 15.3 | Drain pan filled to brim and subjected to continuous overflow and fan(s) switched on |  |  |
| 15.101 | Spillage test as specified |  |  |
|  | After spillage completed, appliance withstand test of clause 16 |  |  |
| **16** | **LEAKAGE CURRENT AND ELECTRIC STRENGTH** | |  |
| 16.1 | Leakage current not excessive and electric strength adequate |  |  |
|  | Protective impedance disconnected from live parts before carrying out the tests |  |  |
|  | Tests carried out at room temperature and not connected to the supply |  |  |
| 16.2 | Single‑phase appliances: test voltage 1,06 times rated voltage (V) : |  |  |
|  | Three‑phase appliances: test voltage 1,06 times rated voltage divided by √3 (V) : |  |  |
|  | Leakage current measurements | (see appended table) |  |
|  | Limit values doubled if: | |  |
|  | - all controls have an off position in all poles, or |  |  |
|  | - the appliance has no control other than a thermal cut‑out, or |  |  |
|  | - all thermostats, temperature limiters and energy regulators do not have an off position, or |  |  |
|  | - the appliance has radio interference filters |  |  |
|  | With the radio interference filters disconnected, the leakage current do not exceed limits specified : | (see appended table) |  |
| 16.3 | Electric strength tests according to table 7 : | (see appended table) |  |
|  | Test voltage applied between the supply cord and inlet bushing and cord guard and cord anchorage as specified : | (see appended table) |  |
|  | No breakdown during the tests |  |  |
| **17** | **OVERLOAD PROTECTION OF TRANSFORMERS AND ASSOCIATED CIRCUITS** | |  |
|  | No excessive temperatures in transformer or associated circuits in event of short‑circuits likely to occur in normal use : | (see appended table) |  |
|  | Appliance supplied with 1,06 or 0,94 times rated voltage under the most unfavourable short‑circuit or overload likely to occur in normal use (V) : |  |  |
|  | Basic insulation is not short‑circuited |  |  |
|  | Temperature rise of insulation of the conductors of safety extra‑low voltage circuits not exceeding the relevant value specified in table 3 by more than 15 K |  |  |
|  | Temperature of the winding not exceeding the value specified in table 8 |  |  |
|  | However, limits do not apply to fail‑safe transformers complying with sub‑clause 15.5 of IEC 61558‑1 |  |  |
| **18** | **ENDURANCE** | |  |
|  | Requirements and tests are specified in part 2 when necessary |  |  |
| **19** | **ABNORMAL OPERATION** | |  |
| 19.1 | The risk of fire, mechanical damage or electric shock under abnormal or careless operation obviated |  |  |
|  | Electronic circuits so designed and applied that a fault will not render the appliance unsafe : | (see appended table) |  |
|  | Failure of the transfer medium flow, or of any control devices, shall not result in a hazard. |  |  |
|  | Appliances are subjected to the tests specified in 19.2 to 19.10, 19.101, 19.102, 19.103, and 19.104 as applicable. |  |  |
|  | Appliances incorporating electronic circuits subjected to the tests of 19.11 and 19.12, as applicable |  |  |
|  | Appliances incorporating contactors or relays subjected to the test of 19.14, being carried out before the tests of 19.11 |  |  |
|  | Appliances incorporating voltage selector switches subjected to the test of 19.15 |  |  |
|  | Unless otherwise specified, the tests are continued until a non‑self‑resetting thermal cut‑out operates, or |  |  |
|  | until steady conditions are established |  |  |
|  | If a heating element or intentionally weak part becomes open‑circuited, the relevant test is repeated on a second sample |  |  |
| 19.2 | This subclause of Part 1 is not applicable for appliances with supplementary air heaters. |  |  |
| 19.3 | This subclause of Part 1 is not applicable for appliances with supplementary air heaters. |  |  |
| 19.4 | Test conditions as in clause 11, any control limiting the temperature during tests of clause 11 short‑circuited |  |  |
|  | The appliance is operated under the conditions in Clause 11 and at rated voltage, with any form of operation or any defect that can 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. |  |  |
| 19.5 | Test of 19.4 repeated on class 0I and I appliances with tubular sheathed or embedded heating elements. No short‑circuiting, but one end of the element connected to the sheath |  |  |
|  | The test repeated with reversed polarity and the other end of the heating element connected to the sheath |  |  |
|  | The test is not carried out on appliances intended to be permanently connected to fixed wiring and on appliances where an all‑pole disconnection occurs during the test of 19.4 |  |  |
| 19.6 | Appliances with PTC heating elements tested at rated voltage, establishing steady conditions |  |  |
|  | The working voltage of the PTC heating element is increased by 5 % and the appliance is operated until steady conditions are re‑established. The voltage is then increased in similar steps until 1,5 times working voltage or until the PTC heating element ruptures (V) : |  |  |
| 19.7 | 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. Care shall be taken to complete the earthing system to permit the correct operation of the RCCB/RCBO. |  |  |
|  | 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 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 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. |  |  |
|  | If the motor-compressor has not been type-tested against the requirements of IEC 60335-2-34, then it subject to the following test. |  |  |
|  | A sample 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 lEC 60335-2-34:2021, if applicable, and comply with the requirements in 19.104 of IEC 60335-2-34:2021. |  |  |
| 19.8 | 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 for motor-compressors, stationary circulation pumps in compliance with IEC 60335-2-51, and fans. |  |  |
| 19.10 | Series motor operated at 1,3 times rated voltage for 1 min (V) : |  |  |
|  | During the test, parts not being ejected from the appliance |  |  |
| 19.11 | Electronic circuits, compliance checked by evaluation of the fault conditions specified in 19.11.2 for all circuits or parts of circuits, unless |  |  |
|  | they comply with the conditions specified in 19.11.1 |  |  |
|  | Appliances incorporating an electronic circuit that relies upon a programmable component to function correctly, subjected to the test of 19.11.4.8, unless |  |  |
|  | restarting does not result in a hazard |  |  |
|  | Appliances having a device with an off position obtained by electronic disconnection, or a device placing the appliance in a stand‑by mode, subjected to the tests of 19.11.4 |  |  |
|  | If the safety of the appliance under any of the fault conditions depends on the operation of a miniature fuse‑link complying with IEC 60127, the test of 19.12 is carried out |  |  |
|  | During and after each test the following is checked: | |  |
|  | - the temperature of the windings do not exceed the values specified in table 8 |  |  |
|  | - the appliance complies with the conditions specified in 19.13 |  |  |
|  | - any current flowing through protective impedance not exceeding the limits specified in 8.1.4 |  |  |
|  | If a conductor of a printed board becomes open‑circuited, the appliance is considered to have withstood the particular test, provided both of the following conditions are met: | |  |
|  | - the base material of the printed circuit board withstands the test of annex E |  |  |
|  | - any loosened conductor does not reduce clearance or creepage distances between live parts and accessible metal parts below the values specified in clause 29 |  |  |
| 19.11.1 | Fault conditions a) to g) in 19.11.2 are not applied to circuits or parts of circuits meeting both of the following conditions: | |  |
|  | - the electronic circuit is a low‑power circuit, that is, the maximum power at low‑power points does not exceed 15 W according to the tests specified |  |  |
|  | - the protection against electric shock, fire hazard, mechanical hazard or dangerous malfunction of other parts of the appliance does not rely on the correct functioning of the electronic circuit |  |  |
| 19.11.2 | Fault conditions applied one at a time, the appliance operating under conditions specified in clause 11, but supplied at rated voltage, duration of the tests as specified: | |  |
|  | a) short circuit of functional insulation if clearances or creepage distances are less than the values specified in clause 29 |  |  |
|  | b) open circuit at the terminals of any component |  |  |
|  | c) short circuit of capacitors, unless |  |  |
|  | they comply with IEC 60384‑14 |  |  |
|  | d) short circuit of any two terminals of an electronic component, other than integrated circuits |  |  |
|  | This fault condition is not applied between the two circuits of an optocoupler |  |  |
|  | e) failure of triacs in the diode mode |  |  |
|  | f) failure of microprocessors and integrated circuits |  |  |
|  | g) failure of an electronic power switching device |  |  |
|  | Each low power circuit is short‑circuited by connecting the low‑power point to the pole of the supply source from which the measurements were made |  |  |
| 19.11.3 | If the appliance incorporates a protective electronic circuit that operates to ensure compliance with clause 19, the appliance is tested as specified |  |  |
| 19.11.4 | The first paragraph of Part 1 in not applicable if unintentional operation does not cause any hazards. |  |  |
|  | Appliances having a device with an off position obtained by electronic disconnection, or |  |  |
|  | a device that can be placed in the stand‑by mode, |  |  |
|  | subjected to the tests of 19.11.4.1 to 19.11.4.7, the device being set in the off position or in the stand‑by mode |  |  |
|  | 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 tested individually with the appliance operated under normal operation at any temperature within the working range. |  |  |
|  | Components protected by a protective electronic circuit that has 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. |  |  |
|  | For these tests, it can be necessary to provide specially prepared component samples, e.g. compressors with locked rotor. |  |  |
|  | Surge protective devices disconnected, unless |  |  |
|  | They incorporate spark gaps |  |  |
| 19.11.4.1 | The appliance is subjected to electrostatic discharges in accordance with IEC 61000‑4‑2, test level 4 |  |  |
| 19.11.4.2 | The appliance is subjected to radiated fields in accordance with IEC 61000‑4‑3, at frequency ranges specified |  |  |
| 19.11.4.3 | The appliance is subjected to fast transient bursts in accordance with IEC 61000‑4‑4, test level 3 or 4 as specified |  |  |
| 19.11.4.4 | The power supply terminals of the appliance subjected to voltage surges in accordance with IEC 61000‑4‑5, test level 3 or 4 as specified |  |  |
|  | An open circuit test voltage of 2 kV is applicable for the line‑to‑line coupling mode |  |  |
|  | An open circuit test voltage of 4 kV is applicable for the line‑to‑earth coupling |  |  |
|  | Earthed heating elements in class I appliances disconnected |  |  |
| 19.11.4.5 | The appliance is subjected to injected currents in accordance with IEC 61000‑4‑6, test level 3 |  |  |
| 19.11.4.6 | Appliances having a rated current not exceeding 16 A are subjected to the class 3 voltage dips and interruptions in accordance with IEC 61000‑4‑11 |  |  |
|  | Appliances having a rated current exceeding 16 A are subjected to the class 3 voltage dips and interruptions in accordance with IEC 61000‑4‑34 |  |  |
| 19.11.4.7 | The appliance is subjected to mains signals in accordance with IEC 61000‑4‑13, test level class 2 |  |  |
| 19.11.4.8 | The appliance is supplied at rated voltage and operated under normal operation at any temperature within the working range. After 60 s the power supply is reduced to a level such that the appliance ceases to respond or parts controlled by the programmable component cease to operate at any temperature within the working range. |  |  |
|  | The appliance continues to operate normally, or |  |  |
|  | requires a manual operation to restart |  |  |
| 19.12 | If the safety of the appliance for any of the fault conditions specified in 19.11.2 depends on the operation of a miniature fuse‑link complying with IEC 60127, the test is repeated, measuring the current flowing through the fuse‑link; measured current (A); rated current of the fuse‑link (A) : |  |  |
| 19.13 | During the tests the appliance does not emit flames, molten metal, poisonous or ignitable gas in hazardous amounts |  |  |
|  | Temperature rises not exceeding the values shown in table 9 : | (see appended table) |  |
|  | Compliance with clause 8 not impaired |  |  |
|  | If the appliance can still be operated it complies with 20.2 |  |  |
|  | Insulation, other than of class III appliances or class III constructions that do not contain live parts, withstands the electric strength test of 16.3, the test voltage as specified in table 4: | |  |
|  | - basic insulation (V) : |  |  |
|  | - supplementary insulation (V) : |  |  |
|  | - reinforced insulation (V) : |  |  |
|  | After operation or interruption of a control, clearances and creepage distances across the functional insulation withstand the electric strength test of 16.3, the test voltage being twice the working voltage |  |  |
|  | The appliance does not undergo a dangerous malfunction, and |  |  |
|  | no failure of protective electronic circuits, if the appliance is still operable |  |  |
|  | Appliances tested with an electronic switch in the off position, or in the stand‑by mode: | |  |
|  | - do not become operational, or |  |  |
|  | - if they become operational, do not result in a dangerous malfunction during or after the tests of 19.11.4 |  |  |
|  | If the appliance contains lids or doors that are controlled by one or more interlocks, one of the interlocks may be released provided that: | |  |
|  | - the lid or door does not move automatically to an open position when the interlock is released, and |  |  |
|  | - the appliance does not start after the cycle in which the interlock was released |  |  |
| 19.14 | Appliances operated under the conditions of clause 11, any contactor or relay contact operating under the conditions of clause 11 being short‑circuited |  |  |
|  | For a relay or contactor with more than one contact, all contacts are short‑circuited at the same time |  |  |
|  | A relay or contactor operating only to ensure the appliance is energized for normal use is not short‑circuited |  |  |
|  | If more than one relay or contactor operates in clause 11, they are short‑circuited in turn |  |  |
|  | 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. |  |  |
|  | 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. |  |  |
| 19.15 | For appliances with a mains voltage selector switch, the switch is set to the lowest rated voltage position and the highest value of rated voltage is applied |  |  |
| 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. |  |  |
| 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, but not to exceed 55 °C. |  |  |
|  | The appliances are operated at rated voltage or at the upper limit of the rated voltage range. |  |  |
| 19.104 | Appliances with supplementary air heater | |  |
| 19.104.1 | General | |  |
|  | Appliances provided with supplementary air heaters or provisions for supplementary air heaters are subjected to the test of 19.104.2 through 19.104.8 under the conditions specified in Clause 11 unless otherwise indicated. |  |  |
|  | All appliances with supplementary air heaters configured with inlet and outlet ducts as applicable and instrumented in accordance with the applicable subclauses of Clause 11 |  |  |
|  | Appliances are tested in the operating state and configuration which give the most unfavourable results. |  |  |
|  | Appliances are operated at an ambient temperature of 23 °C ± 5 °C and rated voltage or at the upper limit of the rated voltage range of the supplementary air heaters |  |  |
| 19.104.2 | Restricted inlet – 1st limit cut-out | |  |
|  | To test limit cut-out conditions, the airflow conditions specified are established, the indoor airflow is reduced by restricting the inlet air opening to a rate resulting in not more than 1 K/min outlet air temperature rise until a self-resetting thermal cut-out device operates for the first time as a result of slowly restricting the free area of the inlet. |  |  |
|  | The outlet air temperature, measured by means of the thermocouple grid, not exceed 90 °C. |  |  |
| 19.104.3 | Restricted inlet – minimum airflow | |  |
|  | To test heating operation conditions, after the airflow conditions specified are established, the indoor airflow is reduced by restricting the inlet air opening to such an extent that the temperature of the air in the outlet is 3 K below the temperature obtained after a self-resetting thermal cut-out device operates for the first time as a result of slowly restricting the free area of the inlet. |  |  |
|  | The appliance shall be operated until steady state conditions are established or for 1 h, whichever is longer. During the test, the temperatures are monitored continuously and not exceed the values shown in Table 3 |  |  |
|  | To facilitate this test, the self-resetting thermal cut-out which has operated in 19.104.2 be short-circuited, if necessary. |  |  |
| 19.104.4 | Restricted inlet – restrict inlet to fully blocked | |  |
|  | To test restricted inlet conditions, after the airflow conditions specified are established, the indoor airflow is reduced by restricting the inlet air opening at a rate resulting in not more than 1 K/min outlet air temperature rise until a self-resetting thermal cut-out device operates. |  |  |
|  | The restriction halted after any protective device operates until steady state conditions are established. After steady state conditions are reached, the restriction is resumed. The test continue until the inlet is fully restricted. |  |  |
|  | The temperatures are monitored continuously. Temperatures shall not exceed the values shown in (Table 3 + 30 K) during the first hour and Table 3 thereafter. |  |  |
| 19.104.5 | Fan failure | |  |
|  | To test fan failure conditions, after steady state conditions are attained, heat transfer medium flow of the indoor heat exchanger is restricted or shut off, whichever is the most unfavourable without the appliance being non-operative. |  |  |
|  | Temperatures shall not exceed the values shown in 19.13. |  |  |
| 19.104.6 | Blocked outlet | |  |
|  | To test blocked outlet conditions, when steady conditions are attained, the appliance outlet air opening is totally closed off and operation continued until maximum temperatures are determined. |  |  |
|  | This test with the outlet air opening closed not be conducted on any unit with free air discharge openings located more than 1,2 m above the floor level when the unit is installed as intended. |  |  |
|  | Temperatures not exceed the values in 19.13. |  |  |
| 19.104.7 | All appliances provided with supplementary air heaters and with free air discharge openings are subjected to the following test in each mode of operation. |  |  |
| 19.104.8 | Back up protection test | |  |
|  | If a self-resetting thermal cut-out operates during the tests of 19.104, then the self-resetting thermal cut-out by-passed and the tests of 19.104.4 through 19.104.7 repeated. |  |  |
| 19.105 | For dehumidifiers in which the compressor is enclosed by a non-metallic material which isolates it from the forced air stream providing air to the heat exchanger, the following test apply. |  |  |
| **20** | **STABILITY AND MECHANICAL HAZARDS** | |  |
| 20.1 | Appliances having adequate stability |  |  |
|  | Tilting test through an angle of 10°, appliance placed on an inclined plane/horizontal support, not connected to the supply mains; appliance does not overturn |  |  |
|  | Tilting test repeated on appliances with heating elements, angle of inclination increased to 15° |  |  |
|  | Possible heating test in overturned position; temperature rise does not exceed values shown in table 9 |  |  |
| 20.2 | Moving parts adequately arranged or enclosed as to provide protection against personal injury |  |  |
|  | Protective enclosures, guards and similar parts are non‑detachable, and |  |  |
|  | have adequate mechanical strength |  |  |
|  | Enclosures that can be opened by overriding an interlock are considered to be detachable parts |  |  |
|  | Self‑resetting thermal cut‑outs and overcurrent protective devices not causing a hazard by unexpected closure |  |  |
|  | Not possible to touch dangerous moving parts with the test probe described |  |  |
|  | Fixed appliances that are only fixed into position by water piping, refrigerant piping or other piping are also subjected to this test. |  |  |
| **21** | **MECHANICAL STRENGTH** | |  |
| 21.1 | Appliance has adequate mechanical strength and is constructed as to withstand rough handling |  |  |
|  | Checked by applying 3 blows to every point of the enclosure like to be weak, in accordance with test Ehb of IEC 60068‑2‑75, spring hammer test, with an impact energy of 0,5 J | (see appended table) |  |
|  | The appliance shows no damage impairing compliance with this standard, and |  |  |
|  | compliance with 8.1, 15.1 and clause 29 not impaired |  |  |
|  | If doubt, supplementary or reinforced insulation subjected to the electric strength test of 16.3 |  |  |
|  | If necessary, repetition of groups of three blows on a new sample |  |  |
|  | Pressure vessels comply with the requirements of ISO 5149-2:2014, Subclause 4.4. |  |  |
|  | The pressure test in Annex EE applies to parts other than pressure vessels |  |  |
| 21.2 | Accessible parts of solid insulation having strength to prevent penetration by sharp implements |  |  |
|  | Test not applicable if the thickness of supplementary insulation is at least 1 mm and reinforced insulation at least 2 mm |  |  |
|  | The insulation is tested as specified, and does withstand the electric strength test of 16.3 |  |  |
|  | For accessible parts made of particle foam material used as supplementary insulation or reinforced insulation, the following test is done without any consideration of the insulation thicknes |  |  |
| 21.101 | Appliances using flammable refrigerants shall withstand the effects of vibration during transport.  Vibration test according ISO13555:2016 |  |  |
|  | *Where testing to ISO 13355:2016 is impractical due to limitations of available test*  *facilities/equipment within the industry, the appliance shall be tested by a transport test*  *representative of shipping mode such as truck, rail, air, and/or ocean. Truck transport test is*  *mandatory. Rail, air, and/or ocean transport tests are optional The product shall be transported for a distance of not less than 2 times the longest expected*  *transportation route as determined by the manufacturer in consideration of the product*  *marketplace and distribution. For truck transport, at least 3 categories of roads shall be used,*  *representing the expected transportation route with at least 10 % of the total distance for each*  *road category.* |  |  |
| **22** | **CONSTRUCTION** | |  |
| 22.1 | Appliance marked with the first numeral of the IP system, relevant requirements of IEC 60529 are fulfilled |  |  |
| 22.2 | Stationary appliance: means to ensure all‑pole disconnection from the supply being provided: | |  |
|  | - a supply cord fitted with a plug, or |  |  |
|  | - a switch complying with 24.3, or |  |  |
|  | - a statement in the instruction sheet that a disconnection incorporated in the fixed wiring is to be provided, or |  |  |
|  | - an appliance inlet |  |  |
|  | Singe‑pole switches and single‑pole protective devices for the disconnection of heating elements in single‑phase, permanently connected class 01 and class I appliances, connected to the phase conductor |  |  |
| 22.3 | Appliance provided with pins: no undue strain on socket‑outlets |  |  |
|  | Applied torque not exceeding 0,25 Nm |  |  |
|  | Pull force of 50 N to each pin after the appliance has being placed in the heating cabinet; when cooled to room temperature the pins are not displaced by more than 1 mm |  |  |
|  | Each pin subjected to a torque of 0,4 Nm; the pins are not rotating, unless |  |  |
|  | rotating does not impair compliance with this standard |  |  |
| 22.4 | Appliance for heating liquids and appliance causing undue vibration not provided with pins for insertion into socket‑outlets |  |  |
| 22.5 | No risk of electric shock when touching pins, for appliances having a capacitor with rated capacitance equal to or greater than 0,1 μF, the appliance being disconnected from the supply at the instant of voltage peak |  |  |
|  | Voltage not exceeding 34 V (V) : |  |  |
|  | If compliance relies on the operation of an electronic circuit, the electromagnetic phenomena tests of 19.11.4.3 and 19.11.4.4 are applied |  |  |
|  | The discharge test is then repeated three times, voltage not exceeding 34 V (V) : |  |  |
| 22.6 | Electrical insulation not affected by condensing water or leaking liquid |  |  |
|  | Electrical insulation of class II appliances not affected if a hose ruptures or seal leaks |  |  |
|  | In case of doubt, test as described |  |  |
|  | The electrical insulation shall not be affected by snow which might enter the appliance enclosure. |  |  |
| 22.7 | Adequate safeguards against the risk of excessive pressure in appliances containing liquid or gases or having steam‑producing devices |  |  |
| 22.8 | Electrical connections not subject to pulling during cleaning of compartments to which access can be gained without the aid of a tool, and that are likely to be cleaned in normal use |  |  |
| 22.9 | Insulation, internal wiring, windings, commutators and slip rings not exposed to oil, grease or similar substances, unless |  |  |
|  | the substance has adequate insulating properties |  |  |
| 22.10 | Not possible to reset voltage‑maintained non‑self‑resetting thermal cut‑outs by the operation of an automatic switching device incorporated within the appliance, if: |  |  |
|  | - a non‑self‑resetting thermal cut‑out is required by the standard, and |  |  |
|  | - a voltage maintained non‑self‑resetting thermal cut‑out is used to meet it |  |  |
|  | Non‑self‑resetting thermal motor protectors have a trip‑free action, unless |  |  |
|  | they are voltage maintained |  |  |
|  | Reset buttons of non‑self‑resetting controls so located or protected that accidental resetting is unlikely |  |  |
| 22.11 | Reliable fixing of non‑detachable parts that provide the necessary degree of protection against electric shock, moisture or contact with moving parts |  |  |
|  | Obvious locked position of snap‑in devices used for fixing such parts |  |  |
|  | No deterioration of the fixing properties of snap‑in devices used in parts that are likely to be removed during installation or servicing |  |  |
|  | Tests as described |  |  |
| 22.12 | Handles, knobs etc. fixed in a reliable manner, if loosening result in a hazard |  |  |
|  | Removing or fixing in wrong position of handles, knobs etc. indicating position of switches or similar components not possible, if resulting in a hazard |  |  |
|  | A choking hazard does not apply to appliances for commercial use |  |  |
|  | Axial force 15 N applied to parts, the shape being so that an axial pull is unlikely to be applied |  |  |
|  | Axial force 30 N applied to parts, the shape being so that an axial pull is likely to be applied |  |  |
|  | If the part is removed and can be contained within the small parts cylinder, it is considered to be a choking hazard |  |  |
| 22.13 | Unlikely that handles, when gripped as in normal use, make the operator’s hand touch parts having a temperature rise exceeding the value specified for handles which are held for short periods only |  |  |
| 22.14 | No ragged or sharp edges creating a hazard for the user in normal use, or during user maintenance |  |  |
|  | No exposed pointed ends of self‑tapping screws or other fasteners, likely to be touched by the user in normal use or during user maintenance |  |  |
|  | This requirement does not apply to the metallic fins of heat exchangers. |  |  |
| 22.15 | Storage hooks and the like for flexible cords smooth and well rounded |  |  |
| 22.16 | Automatic cord reels cause no undue abrasion or damage to the sheath of the flexible cord, no breakage of conductors strands and no undue wear of contacts |  |  |
|  | Cord reel tested with 6000 operations, as specified |  |  |
|  | Electric strength test of 16.3, voltage of 1000 V applied |  |  |
| 22.17 | Spacers not removable from the outside by hand or by means of a screwdriver or a spanner |  |  |
| 22.18 | Current‑carrying parts and other metal parts resistant to corrosion |  |  |
| 22.19 | Driving belts not relied upon to provide the required level of insulation, unless |  |  |
|  | constructed to prevent inappropriate replacement |  |  |
| 22.20 | Direct contact between live parts and thermal insulation effectively prevented, unless |  |  |
|  | material used is non‑corrosive, non‑hygroscopic and non‑combustible |  |  |
| 22.21 | Wood, cotton, silk, ordinary paper and fibrous or hygroscopic material not used as insulation, unless |  |  |
|  | impregnated |  |  |
|  | This requirement does not apply to magnesium oxide and mineral ceramic fibres used for the electrical insulation of heating elements |  |  |
| 22.22 | Appliances not containing asbestos |  |  |
| 22.23 | Oils containing polychlorinated biphenyl (PCB) not used |  |  |
| 22.24 | Bare heating elements 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 not be used with wood or wood composite enclosures. |  |  |
| 22.25 | Sagging heating conductors, except in class III appliances or class III constructions that do not contain live parts, cannot come into contact with accessible metal parts |  |  |
| 22.26 | For class III constructions the insulation between parts operating at safety extra‑low voltage and other live parts complies with the requirements for double or reinforced insulation |  |  |
| 22.27 | Parts connected by protective impedance separated by double or reinforced insulation |  |  |
| 22.28 | Metal parts of class II appliances conductively connected to gas pipes or in contact with water, separated from live parts by double or reinforced insulation |  |  |
| 22.29 | Class II appliances permanently connected to fixed wiring so constructed that the required degree of access to live parts is maintained after installation |  |  |
| 22.30 | Parts serving as supplementary or reinforced insulation fixed so that they cannot be removed without being seriously damaged, or |  |  |
|  | so constructed that they cannot be replaced in an incorrect position, and so that if they are omitted, the appliance is rendered inoperable or manifestly incomplete |  |  |
| 22.31 | Neither clearances nor creepage distances over supplementary and reinforced insulation reduced below values specified in clause 29 as a result of wear |  |  |
|  | Neither clearances nor creepage distances between live parts and accessible parts reduced below values for supplementary insulation if wires, screws etc. become loose |  |  |
| 22.32 | Supplementary and reinforced insulation constructed or protected against pollution so that clearances or creepage distances are not reduced below the values in clause 29 |  |  |
|  | Supplementary insulation of natural or synthetic rubber resistant to ageing, or arranged and dimensioned so that creepage distances are not reduced below values specified in 29.2 |  |  |
|  | Ceramic material not tightly sintered, similar materials or beads alone not used as supplementary or reinforced insulation |  |  |
|  | Ceramic and similar porous material in which heating conductors are embedded is considered to be basic insulation, not reinforced insulation |  |  |
|  | Oxygen bomb test at 70 °C for 96 h and 16 h at room temperature |  |  |
| 22.33 | Conductive liquids that are or may become accessible in normal use and conductive liquids that are in contact with unearthed accessible metal parts are not in direct contact with live parts, or |  |  |
|  | unearthed metal parts separated from live parts by basic insulation only |  |  |
|  | Electrodes not used for heating liquids |  |  |
|  | For class II constructions, conductive liquids that are or may become accessible in normal use and conductive liquids that are in contact with unearthed accessible metal parts, not in direct contact with basic or reinforced insulation, unless |  |  |
|  | the reinforced insulation consists of at least 3 layers |  |  |
|  | For class II constructions, conductive liquids which are in contact with live parts, not in direct contact with reinforced insulation, unless |  |  |
|  | the reinforced insulation consists of at least 3 layers |  |  |
|  | An air layer not used as basic or supplementary insulation in a double insulation system if likely to be bridged by leaking liquid |  |  |
| 22.34 | Shafts of operating knobs, handles, levers etc. not live, unless |  |  |
|  | the shaft is not accessible when the part is removed |  |  |
| 22.35 | For other than class III constructions, handles, levers and knobs, held or actuated in normal use, not becoming live in the event of a failure of basic insulation |  |  |
|  | Such parts being of metal, and their shafts or fixings are likely to become live in the event of a failure of basic insulation, are either adequately covered by insulation material or their accessible parts are separated from their shafts or fixings by supplementary insulation |  |  |
|  | This requirement does not apply to handles, levers and knobs on stationary appliances and cordless appliances, other than those of electrical components, provided they are reliably connected to an earthing terminal or earthing contact, or separated from live parts by earthed metal |  |  |
|  | Insulating material covering metal handles, levers and knobs withstand the electric strength test of 16.3 for supplementary insulation |  |  |
| 22.36 | For appliances other than class III, handles continuously held in the hand in normal use so constructed that when gripped as in normal use, the operators hand is not likely to touch metal parts, unless |  |  |
|  | they are separated from live parts by double or reinforced insulation |  |  |
| 22.37 | Capacitors in class II appliances not connected to accessible metal parts and their casings, if of metal, separated from accessible metal parts by supplementary insulation, unless |  |  |
|  | the capacitors comply with 22.42 |  |  |
| 22.38 | Capacitors not connected between the contacts of a thermal cut‑out |  |  |
| 22.39 | Lamp holders used only for the connection of lamps |  |  |
| 22.40 | Motor‑operated appliances and combined appliances intended to be moved while in operation, or having accessible moving parts, fitted with a switch to control the motor. The actuating member of the switch being easily visible and accessible |  |  |
|  | If the appliance cannot operate continuously, automatically or remotely without giving rise to a hazard, appliances for remote operation being fitted with a switch for stopping the operation. The actuating member of the switch being easily visible and accessible |  |  |
| 22.41 | No components, other than lamps, containing mercury |  |  |
| 22.42 | Protective impedance consisting of at least two separate components |  |  |
|  | Values specified in 8.1.4 not exceeded if any one of the components are short‑circuited or open‑circuited |  |  |
|  | Resistors checked by the test of 14.1 a) in IEC 60065 |  |  |
|  | Capacitors checked by the tests for class Y capacitors in IEC 60384‑14 |  |  |
| 22.43 | Appliances adjustable for different voltages, accidental changing of the setting of the voltage unlikely to occur |  |  |
| 22.44 | Appliances not having an enclosure that is shaped or decorated like a toy |  |  |
| 22.45 | When air is used as reinforced insulation, clearances not reduced below the values specified in 29.1.3 due to deformation as a result of an external force applied to the enclosure |  |  |
| 22.46 | For programmable protective electronic circuits used to ensure compliance with the standard, the software contains measures to control the fault/error conditions in table R.1 |  |  |
|  | 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. |  |  |
|  | Software that contains measures to control the fault/error conditions specified in table R.2 is to be specified in parts 2 for particular constructions or to address specific hazards |  |  |
|  | These requirements are not applicable to software used for functional purpose or compliance with clause 11 |  |  |
| 22.47 | Appliances connected to the water mains withstand the water pressure expected in normal use |  |  |
|  | No leakage from any part, including any inlet water hose |  |  |
| 22.48 | Appliances connected to the water mains constructed to prevent backsiphonage of non‑potable water |  |  |
| 22.49 | For remote operation, the duration of operation is to be set before the appliance can be started, unless |  |  |
|  | the appliance switches off automatically or can operate continuously without hazard |  |  |
| 22.50 | Controls incorporated in the appliance take priority over controls actuated by remote operation |  |  |
| 22.51 | There is a control on the appliance manually adjusted to the setting for remote operation before the appliance can be operated in this mode |  |  |
|  | There is a visual indication showing that the appliance is adjusted for remote operation |  |  |
|  | These requirements not necessary on appliances that can operate as follows, without giving rise to a hazard: | |  |
|  | - continuously, or |  |  |
|  | - automatically, or |  |  |
|  | - remotely |  |  |
| 22.52 | Socket‑outlets on appliances accessible to the user in accordance with the socket‑outlet system used in the country in which the appliance is sold |  |  |
| 22.53 | Class II appliances and class III appliances that incorporate functionally earthed parts have at least double insulation or reinforced insulation between live parts and the functionally earthed parts |  |  |
| 22.54 | Button cells and batteries designated R1 not accessible without the aid of a tool, unless |  |  |
|  | the cover of their compartment can only be opened after at least two independent movements have been applied simultaneously |  |  |
| 22.55 | Devices operated to stop the intended function of the appliance, if any, are be distinguished from other manual devices by means of shape, size, surface texture or position : |  |  |
|  | The requirement concerning position does not preclude use of a push on push off switch |  |  |
|  | An indication when the device has been operated is given by: | |  |
|  | - tactile feedback from the actuator or from the appliance, or |  |  |
|  | - reduction in heat output; or |  |  |
|  | - audible and visible feedback |  |  |
| 22.56 | Detachable power supply part provided with the part of class III construction |  |  |
| 22.57 | The properties of non‑metallic materials do not degrade from exposure to UV-C radiation, as specified in annex T |  |  |
|  | This requirement does not apply to glass, ceramics or similar materials |  |  |
| 22.101 | Appliances intended to be fixed so designed that they can be securely fixed and maintained in position. |  |  |
| 22.102.1 | Appliances provided with supplementary air heaters provided with at least two thermal cut-outs. The thermal cut-out intended to operate first 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. |  |  |
| 22.102.2 | Appliances provided with supplementary water heaters 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. |  |  |
| 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. |  |  |
| 22.103 | The sensing and switching elements of electromechanical non-self-resetting cut-outs 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 also be operated by other control devices. Protective electronic circuits are covered by Clause 19. |  |  |
| 22.104 | Containers of sanitary hot water heat pumps withstand the water pressure occurring in normal use. |  |  |
|  | 0,15 MPa in open containers |  |  |
|  | twice the permissible excessive operating maximum allowable pressure for closed containers; |  |  |
| 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, provided. |  |  |
| 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 maximum allowable pressure by more than 0,1 MPa. |  |  |
| 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 maximum allowable pressure. |  |  |
|  | Vented containers of sanitary hot water heat pumps constructed that the container is always open to the atmosphere through an aperture of at least 5 mm in diameter or 20 mm2 in area, with a width of at least 3 mm. |  |  |
| 22.108 | Storage tanks of sanitary hot water heat pumps shall be resistant to vacuum pressure impulses which can occur in normal use. |  |  |
| 22.109 | Wiring connected to a non-self-resetting thermal cut-out designed to be replaced after its operation 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. |  |  |
| 22.110 | Non-self-resetting thermal cut-outs designed to be replaced after their operation 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. |  |  |
| 22.112 | The construction of the refrigerating system shall comply with the requirements of ISO 5149-2:2014, Subclauses 4.2, 4.3, 5.2.1, 5.2.2, 5.2.4, 5.2.5, 5.2.15, 5.2.6.1, 5.2.6.3, 5.2.7, 5.2.8, 5.2.9.1, 5.2.9.3, and 5.2.9.4.and ISO 5149-2:2014/AMD1:2020, Subclauses 4.1, 5.2.3, 5.2.9.2 |  |  |
| 22.113 | When a flammable refrigerant is used, refrigerant tubing piping protected or enclosed to avoid mechanical damage. |  |  |
|  | The refrigerant piping protected to the extent that it will not be handled or used for carrying during moving of the appliance. |  |  |
|  | Refrigerant piping located within the appliance enclosure is considered to be protected from mechanical damage. |  |  |
| 22.114 | When a flammable refrigerant is used, low temperature solder alloys, such as lead/tin alloys, not be used for pipe connections or any other refrigerant pressure containing purposes. |  |  |
| 22.115 | The refrigerant charge (mc) in each refrigerating system employing flammable refrigerant shall not exceed m3 as defined in Annex GG. |  |  |
|  | The construction of the refrigerating system using flammable refrigerants comply with the requirements in Annex GG. |  |  |
| 22.116 | Arcs and sparks from electric components | |  |
| 22.116.1 | 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 or connected ducts where electrical components, which could be a source of ignition and which could function during normal operation or as a result of a leak, are located. |  |  |
|  | 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. |  |  |
|  | Electrical components, which are potential ignition sources that could function under normal operation or as a result of a leak, are not considered a source of ignition if they comply with at least one of the following requirements: | |  |
|  | a) not be located in an area where a potentially flammable gas mixture will accumulate as demonstrated by the test of Annex FF; |  |  |
|  | b) have equipment protection level according to 22.116.2; |  |  |
|  | c) are sealed components in compliance with the tests of 22.116.3, and protected from impact by the appliance enclosure; |  |  |
|  | d) are located in an enclosure which complies with IEC 60079-15:2017, Clauses 7 through 10, for restricted breathing enclosures suitable for use with group IIA gases or the refrigerant used; |  |  |
|  | e) are located in an enclosure which complies with Annex NN. Applicable to appliances with A2L refrigerants only; |  |  |
|  | f) are in compliance with Annex JJ. Applicable to appliance with A2L refrigerants only |  |  |
|  | g) are in compliance with 22.116.4. Applicable to appliance with A2L refrigerants only; |  |  |
|  | h) electrostatic air cleaners or similar devices tested and found to comply with 22.116.5. Applicable to appliance with A2L refrigerants only; |  |  |
|  | i) refrigerant sensors tested and found to comply with Clause LL.11. |  |  |
| 22.116.2 | Components are not considered to be ignition sources if they comply with the requirements for equipment protection level Ga, Gb, or Gc as defined in IEC 60079-14 for the refrigerant used in the appliance or the relevant gas group (IIA, IIB, or IIC) to which the refrigerant belongs. However, the following requirements do not apply: | |  |
|  | – marking requirements of the applicable standard in IEC 60079 (all parts) |  |  |
|  | – the impact tests of IEC 60079-0 |  |  |
|  | – the IP test of IEC 60079-0; |  |  |
|  | – the drop test of IEC 60079-0; |  |  |
|  | – the creepage and clearance requirements in IEC 60079-7. |  |  |
| 22.116.3 | Three samples of the component conditioned in a climate chamber for 168 h at the maximum operating temperature during the test of Clause 11 plus 12 K, but not less than 75 °C. This conditioning is followed by 24 h at the minimum operating temperature during the test of Clause 11 reduced by at least 5 K. |  |  |
|  | The test temperature in the climate chamber maintained within 2 K for the duration of the test. |  |  |
|  | The components shall be stabilized at a temperature of 25 °C. The entire components then be rapidly immersed in water at a temperature of (50 ± 2) °C to a depth of at least 25 mm below the surface for at least 60 s. |  |  |
|  | No bubbles emerge from the inside of the samples during this test |  |  |
| 22.116.4 | For A2L refrigerants, devices capable of 100 000 cycles per Clause 24, switching devices AC loads in compliance with all one of the following are not considered a potential ignition source: | |  |
|  | – for resistive loads where the impedance has a power factor higher than 0,99: Breaking current per contact is not more than 48A during normal operation; |  |  |
|  | – for inductive loads where the power factor is not more than 0,99, the apparent power (S) of the switched inductive electrical load (Le) per phase in kVA is less than or equal to: | |  |
|  | • Le = 5 × (6,7/Su)4 when breaking all phases of a 3 phase load; |  |  |
|  | • Le = 2,5 × (6,7/Su)4 all others. |  |  |
| 22.116.5 | For appliances with A2L refrigerants, electrostatic air cleaners and similar devices which can 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 Clause GG.9. |  |  |
| 22.116.6 | For the purpose of determining the maximum quenching diameter (dq) in Annex JJ and the maximum allowable switched inductive electrical load Le (see 22.116.4), the effect of humidity on burning velocity (Su) taken into consideration. |  |  |
|  | The burning velocity (Su) 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 % O2 excluding water vapour determined at the nominal composition as specified in ISO 817. |  |  |
|  | The burning velocity (Su) at 27 °C dew point may be determined by extrapolation of the measurement at 23 °C and 50 % relative humidity and the burning velocity (Su) as provided by ISO 817. |  |  |
|  | The extrapolation based on the measured value increased by the measurement uncertainty to the burning velocity (Su) at 23 °C and 50 % relative humidity. |  |  |
|  | If the burning velocity (Su) is not measurable at dry condition, the burning velocity shall be measured at 27 °C dew point. |  |  |
| 22.117 | Hot surfaces | |  |
| 22.117.1 | Temperatures on surfaces that can be exposed to leakage of flammable refrigerants in excess of 25 % of LFL as determined in Annex FF not exceed the maximum allowable surface temperature given in Annex BB. |  |  |
|  | For A2 and A3 refrigerants not listed in Annex BB, the maximum allowable surface temperature is the AIT. | Measured surface temperature: \_\_\_\_\_ (°C) |  |
|  | For A2L refrigerants not listed in Annex BB, the maximum allowable surface temperature is determined by the higher of AIT or, if tested per Annex KK, the hot surface ignition temperature reduced by 100 K | Measured surface temperature: \_\_\_\_\_ (°C) |  |
|  | Surfaces in compliance with 22.117 not be considered a potential ignition source. |  |  |
|  | Refrigerant sensors tested and found to comply with Clause LL.11 are considered to comply with 22.117. |  |  |
| 22.117.2 | Temperatures on surfaces that can 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. |  |  |
| 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 can 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. |  |  |
| 22.118 | Joints made in installation between parts of refrigerating system, with at least one part charged, made in accordance with following: | |  |
|  | - A brazed, welded, or mechanical connection be made before opening the valves to permit refrigerant to flow between the refrigerating system parts. A vacuum valve provided to evacuate the interconnecting pipe and/or any uncharged refrigerating system part |  |  |
|  | - Mechanical connectors used indoors comply with ISO 14903. When mechanical connectors are reused indoors, sealing parts renewed. When flared joints are reused indoors, the flare part re-fabricated. |  |  |
|  | - Refrigerant tubing protected or enclosed to avoid damage |  |  |
|  | Flexible refrigerant connectors (such as connecting lines between the indoor and outdoor unit) that can be displaced during normal operations protected against mechanical damage. |  |  |
| 22.119 | Condensing units and evaporating units are equipped with a pressure limiting device or equivalent to assure that the equipment does not exceed the maximum allowable pressure. |  |  |
|  | For partial units, the interconnection circuits for signal communication between each unit be of the same type. |  |  |
|  | SELV level connection is recommended. |  |  |
| 22.120 | Partial units provided with a means of connection to the supply mains and not be powered by an electrical circuit from another appliance. |  |  |
| 22.121 | Leak detection system sensor location | |  |
| 22.121.1 | For the installation condition of appliances using an A2L refrigerant and where a leak detection system is applied to fulfil the requirements of Annex GGor for the purpose of limiting releasable charge, the refrigerant sensor: | |  |
|  | - within the unit for appliances connected via an air duct system to one or more rooms, |  |  |
|  | - within the ventilated enclosure if in compliance with Clause GG.4, |  |  |
|  | – within the unit where release height h0 as determined in Clause GG.2 is not more than 1,5 m, |  |  |
|  | – where the release height h0 as determined in Clause GG.2 is more than 1,5 m, the refrigerant 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 refrigerant sensor is specified by the manufacturer, the instructions shall state that the refrigerant sensor 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 |  |  |
|  | 1. 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 refrigerant sensor. |  |  |
|  | For installations with field applied mechanical joints which are exposed in the occupied space, the instructions state that a refrigerant sensor 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 h0 is not more than 300 mm from the floor; or |  |  |
|  | - 300 mm above the floor where h0 is greater than 300 mm from the floor. |  |  |
|  | The following mechanical joints not require that sensor: | |  |
|  | - mechanical joints in compliance with ISO 14903; |  |  |
|  | - joints in enclosures which vent to the unit or to the outside |  |  |
|  | – joints in enclosures which vent to a room with a minimum room area as specified in GG.2.1 |  |  |
| 22.121.2 | For the installation condition of appliances using an A2 or A3 refrigerant and where a leak detection system is applied to fulfil the requirements of Annex GG or for the purpose of limiting releasable charge, the refrigerant sensor within or part of the unit. |  |  |
|  | For appliances with ventilated enclosure in compliance with Clause GG.4, the refrigerant sensor within the ventilated enclosure. |  |  |
|  | For installations with field applied joints which are exposed in the occupied space, these joints fulfil at least one of the following: | |  |
|  | – mechanical joints in compliance with ISO 14903; |  |  |
|  | – welded or brazed joints; |  |  |
|  | – joints in enclosures which vent to the unit or to the outside. |  |  |
| 22.122 | For refrigerant detection systems that are required by this standard for flammable refrigerants, the following applies: | |  |
|  | – the output signal of the refrigerant detection system activate the actions required to comply with Annex GG in the event of a leak; |  |  |
|  | – where a refrigerant detection system refrigerant sensor is used to activate safety measures in multiple units in the same room, all of the detection system activated safety measures applied to those units in the room which rely on that refrigerant detection system; |  |  |
|  | – If a refrigerant detection system provides notification to the user that replacement of the refrigerant sensor is required, then resetting this notification only be possible when the refrigerant sensor has been replaced. |  |  |
|  | Refrigerant detection system comply with Annex LL. |  |  |
| 22.123 | For appliances using a flammable refrigerant according to Clause GG.9, which include a separate section with refrigerant containing components except pipes (e.g. compressors, condensers), and is located in a room smaller than Amin per Clause GG.2, that section: | |  |
|  | – not be isolated from the indoor air stream, where a leak will be detected, or |  |  |
|  | – be ventilated to the outdoors in compliance with Clause GG.4, or |  |  |
|  | – be naturally ventilated to outdoors. |  |  |
| 22.124 | Void | |  |
| 22.125 | Refrigerating systems that fulfil all of the following conditions be considered enhanced tightness refrigerating systems: (IEC 60335‑2‑40:2018) | |  |
|  | a) compressors, pressure relief devices and pressure vessels of the refrigerating system located in locations other than the occupied space, |  |  |
|  | b) refrigerant distribution assemblies 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 protected from damage in the event of catastrophic failure of moving parts, e.g. fans, belts, |  |  |
|  | e) systems where the equipment refrigerant containing pipes in the occupied space in question are installed in such a way that they are protected against accidental damage, |  |  |
|  | f) the refrigerating system of each indoor unit tightness tested at the factory with detection equipment with a capability of 3 grams per year of refrigerant or better less under a pressure of at least 0,25 times the maximum allowable pressure. No leak detected, |  |  |
|  | 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. |  |  |
|  | h) indoor heat exchangers protected from damage in the event of freezing. |  |  |
|  | i) the maximum speed of the indoor fan, in normal operation, 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 tested as follows: | |  |
|  | The maximum allowable fan speed 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 ISO 2578, 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 1) to 4) below | |  |
|  | 1) tensile strength in accordance with ISO 527-3, |  |  |
|  | 2) flexural strength in accordance with ISO 178, |  |  |
|  | 3) Izod impact in accordance with ISO 180 |  |  |
|  | 4) tensile impact in accordance with ISO 8256 |  |  |
| 22.126 | Germicidal lamps are limited to low pressure mercury lamps with a quartz envelope having a continuous spectral irradiance at 254 nm. |  |  |
| 22.127 | Appliance enclosure, UV-C lamps and UV-C barriers 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. |  |  |
|  | Appliance indoor airflow inlet and outlet be considered as possible radiation paths. The unit filters are not considered UV-C barriers. |  |  |
| 22.128 | For appliances that employ UV-C germicidal lamp systems and which have doors and/or panels that provide direct access to an area within the appliance where the measured UV-C spectral irradiance is greater than 1,7 µW/cm2, the doors and/or panels be equipped with an interlock device that terminates the power to the lamps when opened. |  |  |
|  | If a switch is used to de-energize the UV-C lamps so as to meet the requirement, it is not possible to operate the switch with test probe B of IEC 61032. |  |  |
| 22.129 | For user maintenance access areas, the UV-C spectral irradiance 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 are required to be closed or put back in place for proper operation of the appliance. |  |  |
| 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. |  |  |
| 22.131 | Appliances that employ refrigerants in a transcritical refrigerating system are equipped with a pressure-limiting device that operates no greater than the maximum allowable pressure taking into account the tolerance of the pressure-limiting device. |  |  |
| 22.132 | Safety shut-off valves for flammable refrigerants for the purposes of limiting the releasable charge | |  |
|  | Safety shut-off valves shall default to fully closed position when the appliance is de-energised for any reason other than failure of the supply mains |  |  |
|  | Safety shut-off valves that are activated by a leak detection system shall have either | |  |
|  | – manual operation for resetting which requires the aid of a tool, or |  |  |
|  | – automatically reset after the leak detection system has not detected refrigerant for at least 2 hours. |  |  |
|  | For refrigerating systems using A2 or A3 refrigerants, safety shut-off valves shall be factory fitted in the appliance. |  |  |
|  | The total seat leak rate for the refrigerant used for all the safety shut-off valves that reduce the leak into the same space no more than msv. |  |  |
|  | The safety shut-off valves marked with information for the identification of the valve in case of replacement: | |  |
|  | – means for identification of the safety shut-off valves for facilitating correct replacement, and |  |  |
|  | – arrow indicating the direction of flow, when applicable. |  |  |
|  | The closing of safety shut-off valves in liquid refrigerant lines not result in pressures exceeding the maximum allowable pressure. |  |  |
| 22.133 | Particle foam material not be used outdoors without protective cover of metal or rigid plastic material if the appliance is accessible to the general public. |  |  |
| 22.134 | Appliances constructed so that particle foam material expanded polypropylene is separated from metallic parts containing cobalt, manganese or copper if operating at a temperature higher than 80 °C. |  |  |
|  | However, this requirement is not applicable for particle foam material parts when a deterioration of 3 mm at the contact point will not cause the appliance to fail to comply with this standard. If the separation is provided by an air gap, it at least 3 mm. |  |  |
| **23** | **INTERNAL WIRING** | |  |
| 23.1 | Wireways smooth and free from sharp edges |  |  |
|  | Wires protected against contact with burrs, cooling fins etc. |  |  |
|  | Wire holes in metal well‑rounded or provided with bushings |  |  |
|  | Wiring effectively prevented from coming into contact with moving parts |  |  |
| 23.2 | Beads etc. on live wires cannot change their position, and are not resting on sharp edges |  |  |
|  | Beads inside flexible metal conduits contained within an insulating sleeve |  |  |
| 23.3 | Electrical connections and internal conductors movable relatively to each other not exposed to undue stress |  |  |
|  | Flexible metallic tubes not causing damage to insulation of conductors |  |  |
|  | Open‑coil springs not used |  |  |
|  | Adequate insulating lining provided inside a coiled spring, the turns of which touch one another |  |  |
|  | No damage after 10 000 flexings for conductors flexed during normal use, or |  |  |
|  | 100 flexings for conductors flexed during user maintenance |  |  |
|  | Electric strength test of 16.3, 1000 V between live parts and accessible metal parts |  |  |
|  | Not more than 10 % of the strands of any conductor broken, and |  |  |
|  | not more than 30 % for wiring supplying circuits that consume no more than 15 W |  |  |
| 23.4 | Bare internal wiring sufficiently rigid and fixed |  |  |
| 23.5 | The insulation of internal wiring subjected to the supply mains voltage withstanding the electrical stress likely to occur in normal use |  |  |
|  | Basic insulation electrically equivalent to the basic insulation of cords complying with IEC 60227 or IEC 60245, or |  |  |
|  | no breakdown when a voltage of 2000 V is applied for 15 min between the conductor and metal foil wrapped around the insulation |  |  |
|  | For class II construction, the requirements for supplementary insulation and reinforced insulation apply, |  |  |
|  | except that the sheath of a cord complying with IEC 60227 or IEC 60245 may provide supplementary insulation. |  |  |
|  | A single layer of internal wiring insulation does not provide reinforced insulation |  |  |
| 23.6 | Sleeving used as supplementary insulation on internal wiring retained in position by clamping at both ends, or |  |  |
|  | be such that it can only be removed by breaking or cutting |  |  |
| 23.7 | The colour combination green/yellow only used for earthing conductors |  |  |
| 23.8 | Aluminium wires not used for internal wiring |  |  |
| 23.9 | Stranded conductors not consolidated by soldering where they are subjected to contact pressure, unless |  |  |
|  | the contact pressure is provided by spring terminals |  |  |
| 23.10 | The insulation and sheath of internal wiring, incorporated in external hoses for the connection of an appliance to the water mains, at least equivalent to that of light polyvinyl chloride sheathed flexible cord (60227 IEC 52) |  |  |
| 23.101 | Wires protected if they can be damaged by contact with refrigerant piping. |  |  |
| **24** | **COMPONENTS** | |  |
| 24.1 | Components comply with safety requirements in relevant IEC standards |  |  |
|  | List of components : | (see appended table) |  |
|  | Motors not required to comply with IEC 60034‑1, they are tested as part of the appliance |  |  |
|  | Relays tested as part of the appliance, or |  |  |
|  | alternatively acc. to IEC 60730‑1, and meeting the additional requirements in IEC 60335‑1 |  |  |
|  | The requirements of clause 29 apply between live parts of components and accessible parts of the appliance |  |  |
|  | Components can comply with the requirements for clearances and creepage distances for functional insulation in the relevant component standard |  |  |
|  | 30.2 of this standard apply to parts of non‑metallic material in components including parts of non‑metallic material supporting current‑carrying connections |  |  |
|  | Components that have not been previously tested to comply with the IEC standard for the relevant component are tested according to the requirements of 30.2 |  |  |
|  | Components that have been previously tested to comply with the resistance to fire requirements in the IEC standard for the relevant component need not be retested provided the specified conditions are met |  |  |
|  | If these conditions are not satisfied, the component is tested as part of the appliance. |  |  |
|  | Power electronic converter circuits not required to comply with IEC 62477‑1, they are tested as part of the appliance |  |  |
|  | If components have not been tested and found to comply with relevant IEC standard for the number of cycles specified, they are tested in accordance with 24.1.1 to 24.1.9 |  |  |
|  | For components mentioned in 24.1.1 to 24.1.9 no additional tests specified in the relevant component standard are necessary other than those specified in 24.1.1 to 24.1.9 |  |  |
|  | Components not tested and found to comply with relevant IEC standard and components not marked or not used in accordance with its marking, tested under the conditions occurring in the appliance |  |  |
|  | Lampholders and starterholders that have not being tested and found to comply with the relevant IEC standard, tested as a part of the appliance and additionally according to the gauging and interchangeability requirements of the relevant IEC standard |  |  |
|  | No additional tests specified for nationally standardized plugs such as those detailed in IEC/TR 60083 or connectors complying with the standard sheets of IEC 60320‑1 and IEC 60309 |  |  |
|  | Motor-compressors | |  |
|  | – comply with IEC 60335-2-34 (including its Annex AA), or |  |  |
|  | – comply with IEC 60335-2-34 (without Annex AA) and comply with Clause 11 of this standard, or |  |  |
|  | – comply with this standard and in addition shall comply with IEC 60335-2-34:2021, 22.9 |  |  |
| 24.1.1 | Capacitors likely to be permanently subjected to the supply voltage and used for radio interference suppression or for voltage dividing, comply with IEC 60384‑14 |  |  |
|  | If the capacitors have to be tested, they are tested according to annex F |  |  |
| 24.1.2 | Transformers in associated switch mode power supplies comply with annex BB of IEC 61558‑2‑16 |  |  |
|  | Safety isolating transformers comply with IEC 61558‑2‑6 |  |  |
|  | If they have to be tested, they are tested according to annex G |  |  |
| 24.1.3 | Switches comply with IEC 61058‑1, the number of cycles of operation being at least 10 000 |  |  |
|  | If they have to be tested, they are tested according to annex H |  |  |
|  | If the switch operates a relay or contactor, the complete switching system is subjected to the test |  |  |
|  | If the switch only operates a motor staring relay complying with IEC 60730‑2‑10 with the number of cycles of a least 10 000 as specified, the complete switching system need not be tested |  |  |
| 24.1.4 | Automatic controls comply with IEC 60730‑1 with the relevant part 2. The number of cycles of operation being at least: | |  |
|  | - thermostats: 10 000 |  |  |
|  | - temperature limiters: 1 000 |  |  |
|  | - self‑resetting thermal cut‑outs: 3000 |  |  |
|  | - voltage maintained non‑self‑resetting thermal cut‑outs: 1 000 |  |  |
|  | - other non‑self‑resetting thermal cut‑outs: 300 |  |  |
|  | - timers: 3 000 |  |  |
|  | - energy regulators: 10 000 |  |  |
|  | - thermostats which control motor‑compressor 100 000 |  |  |
|  | - motor‑compressor starting relays 100 000 |  |  |
|  | - automatic thermal motor‑protectors for hermetic and semi‑hermetic type motor‑compressors (not less than number of operations during locked rotor test) min 2000 |  |  |
|  | - manual reset thermal motor‑protectors for hermetic and semi‑hermetic type motor‑compressors 50 |  |  |
|  | - other automatic thermal motor‑protectors 2000 |  |  |
|  | - 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 |  |  |
|  | The number of cycles for controls operating during clause 11 need not be declared, if the appliance meets the requirements of this standard when they are short‑circuited |  |  |
|  | Thermal motor protectors are tested in combination with their motor under the conditions specified in annex D |  |  |
|  | For water valves containing live parts and that are incorporated in external hoses for connection of an appliance to the water mains, the degree of protection declared for subclause 6.5.2 of IEC 60730‑2‑8 is IPX7 |  |  |
|  | Thermal cut‑outs of the capillary type comply with the requirements for type 2.K controls in IEC 60730‑2‑9 |  |  |
| 24.1.5 | Appliance couplers comply with IEC 60320‑1 |  |  |
|  | However, for class II appliances classified higher than IPX0, the appliance couplers comply with IEC 60320‑2‑3 |  |  |
|  | Interconnection couplers comply with IEC 60320‑2‑2 |  |  |
| 24.1.6 | Small lamp holders similar to E10 lampholders comply with IEC 60238, the requirements for E10 lampholders being applicable |  |  |
| 24.1.7 | For remote operation of the appliance via a telecommunication network, the relevant standard for the telecommunication interface circuitry in the appliance is IEC 62151 |  |  |
| 24.1.8 | The relevant standard for thermal links is IEC 60691 |  |  |
|  | Thermal links not complying with IEC 60691 are considered to be an intentionally weak part for the purposes of clause 19 |  |  |
| 24.1.9 | Contactors and relays, other than motor starting relays, tested as part of the appliance |  |  |
|  | They are also tested in accordance with clause 17 of IEC 60730‑1, the number of cycles of operations in 24.1.4 selected according to the contactor or relay function in the appliance : |  |  |
| 24.2 | Appliances not fitted with: | |  |
|  | - switches, automatic controls or power supplies in flexible cords |  |  |
|  | - devices causing the protective device in the fixed wiring to operate in the event of a fault in the appliance |  |  |
|  | - thermal cut‑outs that can be reset by soldering, unless |  |  |
|  | the solder has a melding point of at least 230 °C |  |  |
| 24.3 | Switches intended for all‑pole disconnection of stationary appliances are directly connected to the supply terminals and have a contact separation in all poles, providing full disconnection under overvoltage category III conditions |  |  |
| 24.4 | Plugs and socket‑outlets for extra‑low voltage circuits and heating elements, not interchangeable with plugs and socket‑outlets listed in IEC/TR 60083 or IEC 60906‑1 or with connectors and appliance inlets complying with the standard sheets of IEC 60320‑1 |  |  |
| 24.5 | Capacitors in auxiliary windings of motors marked with their rated voltage and capacitance, and used accordingly |  |  |
|  | Voltage across capacitors in series with a motor winding does not exceed 1,1 times rated voltage, when the appliance is supplied at 1,1 times rated voltage under minimum load |  |  |
| 24.6 | Working voltage of motors connected to the supply mains and having basic insulation that is inadequate for the rated voltage of the appliance, not exceeding 42 V |  |  |
|  | In addition, the motors comply with the requirements of annex I |  |  |
| 24.7 | Detachable hose‑sets for connection of appliances to the water mains comply with IEC 61770 |  |  |
|  | They are supplied with the appliance |  |  |
|  | Appliances intended to be permanently connected to the water mains not connected by a detachable hose‑set |  |  |
| 24.8 | Motor running capacitors in appliances for which 30.2.3 is applicable and that are permanently connected in series with a motor winding, not causing a hazard in event of a failure |  |  |
|  | One or more of the following conditions are to be met: | |  |
|  | - the capacitors are of class S2 or S3 according to IEC 60252‑1 |  |  |
|  | - the capacitors are housed within a metallic or ceramic enclosure |  |  |
|  | - the distance of separation of the outer surface to adjacent non‑metallic parts exceeds 50 mm |  |  |
|  | - adjacent non‑metallic parts within 50 mm withstand the needle‑flame test of annex E |  |  |
|  | - adjacent non‑metallic parts within 50 mm classified as at least V‑1 according to IEC 60695‑11‑10 |  |  |
| 24.101 | Replaceable parts of thermal control devices identified by marking |  |  |
| 24.102 | Pressure-limiting devices used in transcritical refrigerating systems complies with IEC 60730-2-6 and | |  |
|  | - be of type 2A or 2B; |  |  |
|  | - have a trip free mechanism of type 2 J |  |  |
|  | - the deviation and drift not exceed + 0 %. |  |  |
| **25** | **SUPPLY CONNECTION AND EXTERNAL FLEXIBLE CORDS** | |  |
| 25.1 | Appliance not intended for permanent connection to fixed wiring, means for connection to the supply: | |  |
|  | - supply cord fitted with a plug, the current rating and voltage rating of the plug being not less than the corresponding ratings of its associated appliance |  |  |
|  | - an appliance inlet having at least the same degree of protection against moisture as required for the appliance, or |  |  |
|  | - pins for insertion into socket‑outlets |  |  |
|  | Supply cord fitted with plug provided, if: | |  |
|  | - supply cord with a plug is for indoor use only |  |  |
|  | - marked with rating of 25 A or less and |  |  |
|  | - complies with code requirements of country where it will be used |  |  |
|  | Appliance inlet not allowed |  |  |
| 25.2 | Appliance not provided with more than one means of connection to the supply mains |  |  |
|  | Stationary appliance for multiple supply may be provided with more than one means of connection, provided electric strength test of 1250 V for 1 min between each means of connection causes no breakdown |  |  |
| 25.3 | Appliance intended to be permanently connected to fixed wiring provided with one of the following means for connection to the supply mains: | |  |
|  | - a set of terminals allowing the connection of a flexible cord |  |  |
|  | - a fitted supply cord |  |  |
|  | - a set of supply leads accommodated in a suitable compartment |  |  |
|  | - a set of terminals for the connection of cables of fixed wiring, cross‑sectional areas specified in 26.6, and the appliance allows the connection of the supply conductors after the appliance has been fixed to its support |  |  |
|  | - a set of terminals and cable entries, conduit entries, knock‑outs or glands, allowing connection of appropriate types of cable or conduit, and the appliance allows the connection of the supply conductors after the appliance has been fixed to its support |  |  |
|  | For a fixed appliance constructed so that parts can be removed to facilitate easy installation, this requirement is met if it is possible to connect the fixed wiring without difficulty after a part of the appliance has been fixed to its support |  |  |
| 25.4 | Cable and conduit entries, rated current of appliance not exceeding 16 A, dimension according to table 10 (mm) : |  |  |
|  | Introduction of conduit or cable does not reduce clearances or creepage distances below values specified in clause 29 |  |  |
| 25.5 | Method for assembling the supply cord to the appliance: | |  |
|  | - type X attachment |  |  |
|  | - type Y attachment |  |  |
|  | - type Z attachment, if allowed in relevant part 2 |  |  |
|  | Type X attachment, other than those with a specially prepared cord, not used for flat twin tinsel cords |  |  |
|  | For multi‑phase appliances supplied with a supply cord and that are intended to be permanently connected to fixed wiring, the supply cord is assembled to the appliance by type Y attachment |  |  |
| 25.6 | Plugs fitted with only one flexible cord |  |  |
| 25.7 | Supply cords, other than for class III appliances, being one of the following types: | |  |
|  | - rubber sheathed (at least 60245 IEC 53) |  |  |
|  | - polychloroprene sheathed (at least 60245 IEC 57) |  |  |
|  | - polyvinyl chloride sheathed. Not used if they are likely to touch metal parts having a temperature rise exceeding 75 K during the test of clause 11 | |  |
|  | - light polyvinyl chloride sheathed cord (60227 IEC 52), for appliances not exceeding 3 kg |  |  |
|  | - ordinary polyvinyl chloride sheathed cord (60227 IEC 53), for other appliances |  |  |
|  | - heat resistant polyvinyl chloride sheathed. Not used for type X attachment other than specially prepared cords | |  |
|  | - heat‑resistant light polyvinyl chloride sheathed cord (60227 IEC 56), for appliances not exceeding 3 kg |  |  |
|  | - heat‑resistant polyvinyl chloride sheathed cord (60227 IEC 57), for other appliances |  |  |
|  | - halogen‑free, low smoke, thermoplastic insulated and sheathed | |  |
|  | - light duty halogen‑free low smoke flexible cable (62821 IEC 101) for circular cable and (62821 IEC 101f) for flat cable |  |  |
|  | - Ordinary duty halogen‑free low smoke flexible cable (62821 IEC 102) for circular cable and (62821 IEC 102f( for flat cable |  |  |
|  | Supply cords for class III appliances adequately insulated |  |  |
|  | Test with 500 V for 2 min for supply cords of class III appliances that contain live parts |  |  |
|  | Supply cords for outdoor use not lighter than polychloroprene sheathed flexible cord (60245 IEC 57) |  |  |
| 25.8 | Nominal cross‑sectional area of supply cords not less than table 11; rated current (A); cross‑sectional area (mm²) : |  |  |
| 25.9 | Supply cords not in contact with sharp points or edges |  |  |
| 25.10 | Supply cord of class I appliances have a green/yellow core for earthing |  |  |
|  | In multi‑phase appliances, the colour of the neutral conductor of the supply cord is blue |  |  |
|  | Where additional neutral conductors are provided in the supply cord: | |  |
|  | - other colours may be used for these additional neutral conductors; |  |  |
|  | - all of the neutral conductors and line conductors are identified by marking using the alpha numeric notation specified in IEC 60445 |  |  |
|  | - the supply cord is fitted to the appliance |  |  |
| 25.11 | Conductors of supply cords not consolidated by soldering where they are subject to contact pressure, unless |  |  |
|  | the contact pressure is provided by spring terminals |  |  |
| 25.12 | Insulation of the supply cord not damaged when moulding the cord to part of the enclosure |  |  |
| 25.13 | Inlet openings so constructed as to prevent damage to the supply cord |  |  |
|  | If it is not evident that the supply cord can be introduced without risk of damage, a non‑detachable lining or bushing complying with 29.3 for supplementary insulation provided |  |  |
|  | If unsheathed supply cord, a similar additional bushing or lining is required, unless the appliance is |  |  |
|  | class 0, or |  |  |
|  | a class III appliance not containing live parts |  |  |
| 25.14 | Supply cords moved while in operation adequately protected against excessive flexing |  |  |
|  | Flexing test, as described: | |  |
|  | - applied force (N) : |  |  |
|  | - number of flexings : |  |  |
|  | The test does not result in: | |  |
|  | - short‑circuit between the conductors, such that the current exceeds a value of twice the rated current |  |  |
|  | - breakage of more than 10% of the strands of any conductor |  |  |
|  | - separation of the conductor from its terminal |  |  |
|  | - loosening of any cord guard |  |  |
|  | - damage to the cord or the cord guard |  |  |
|  | - broken strands piercing the insulation and becoming accessible |  |  |
| 25.15 | For appliances with supply cord and appliances to be permanently connected to fixed wiring by a flexible cord, conductors of the supply cord relieved from strain, twisting and abrasion by use of cord anchorage |  |  |
|  | The cord cannot be pushed into the appliance to such an extent that the cord or internal parts of the appliance can be damaged |  |  |
|  | Pull and torque test of supply cord: | |  |
|  | - fixed appliances: pull 100 N; torque (not on automatic cord reel) (Nm) : |  |  |
|  | - other appliances: values shown in table 12: mass (kg); pull (N); torque (not on automatic cord reel) (Nm) : |  |  |
|  | Cord not damaged and max. 2 mm displacement of the cord |  |  |
| 25.16 | Cord anchorages for type X attachments constructed and located so that: | |  |
|  | - replacement of the cord is easily possible |  |  |
|  | - it is clear how the relief from strain and the prevention of twisting are obtained |  |  |
|  | - they are suitable for different types of supply cord |  |  |
|  | - cord cannot touch the clamping screws of cord anchorage if these screws are accessible, unless |  |  |
|  | they are separated from accessible metal parts by supplementary insulation |  |  |
|  | - the cord is not clamped by a metal screw which bears directly on the cord |  |  |
|  | - at least one part of the cord anchorage securely fixed to the appliance, unless |  |  |
|  | it is part of a specially prepared cord |  |  |
|  | - screws which have to be operated when replacing the cord do not fix any other component, unless |  |  |
|  | the appliance becomes inoperative or incomplete or the parts cannot be removed without a tool |  |  |
|  | - if labyrinths can be bypassed the test of 25.15 is nevertheless withstood |  |  |
|  | - for class 0, 0I and I appliances they are of insulating material or are provided with an insulating lining, unless |  |  |
|  | failure of the insulation of the cord does not make accessible metal parts live |  |  |
|  | - for class II appliances they are of insulating material, or |  |  |
|  | if of metal, they are insulated from accessible metal parts by supplementary insulation |  |  |
|  | After the test of 25.15, under the conditions specified, the conductors have not moved by more than 1 mm in the terminals |  |  |
| 25.17 | Adequate cord anchorages for type Y and Z attachment, test with the cord supplied with the appliance |  |  |
| 25.18 | Cord anchorages only accessible with the aid of a tool, or |  |  |
|  | Constructed so that the cord can only be fitted with the aid of a tool |  |  |
| 25.19 | Type X attachment, glands not used as cord anchorage in portable appliances |  |  |
|  | Tying the cord into a knot or tying the cord with string not used |  |  |
| 25.20 | The conductors of the supply cord for type Y and Z attachment insulated from accessible metal parts |  |  |
| 25.21 | Space for supply cord for type X attachment or for connection of fixed wiring constructed: | |  |
|  | - to permit checking of conductors with respect to correct positioning and connection before fitting any cover |  |  |
|  | - so there is no risk of damage to the conductors or their insulation when fitting the cover |  |  |
|  | - for portable appliances, so that the uninsulated end of a conductor, if it becomes free from the terminal, prevented from contact with accessible metal parts |  |  |
|  | 2 N test to the conductor for portable appliances; no contact with accessible metal parts |  |  |
| 25.22 | Appliance inlets: | |  |
|  | - live parts not accessible during insertion or removal |  |  |
|  | Requirement not applicable to appliance inlets complying with IEC 60320‑1 |  |  |
|  | - connector can be inserted without difficulty |  |  |
|  | - the appliance is not supported by the connector |  |  |
|  | - not for cold conditions if temp. rise of external metal parts exceeds 75 K during clause 11, unless |  |  |
|  | the supply cord is unlikely to touch such metal parts |  |  |
| 25.23 | Interconnection cords comply with the requirements for the supply cord, except that: | |  |
|  | - the cross‑sectional area of the conductors is determined on the basis of the maximum current during clause 11 |  |  |
|  | - the thickness of the insulation may be reduced |  |  |
|  | - for class I or class II appliance with class III construction, the cross sectional areas of the conductors need not comply with 25.8 if specified conditions are met |  |  |
|  | If necessary, electric strength test of 16.3 |  |  |
| 25.24 | Interconnection cords not detachable without the aid of a tool if compliance with this standard is impaired when they are disconnected |  |  |
| 25.25 | Dimensions of pins that are inserted into socket‑outlets compatible with the dimensions of the relevant socket‑outlet. |  |  |
|  | Dimensions of pins and engagement face in accordance with the dimensions of the relevant plug in IEC/TR 60083 |  |  |
| **26** | **TERMINALS FOR EXTERNAL CONDUCTORS** | |  |
| 26.1 | Appliances provided with terminals or equally effective devices for connection of external conductors |  |  |
|  | Terminals only accessible after removal of a non‑detachable cover, except |  |  |
|  | for class III appliances that do not contain live parts |  |  |
|  | Earthing terminals may be accessible if a tool is required to make the connections and means are provided to clamp the wire independently from its connection |  |  |
| 26.2 | Appliances with type X attachment and appliances for the connection of cables of fixed wiring provided with terminals in which connections are made by means of screws, nuts or similar devices, unless |  |  |
|  | the connections are soldered |  |  |
|  | Screws and nuts not used to fix any other component, except |  |  |
|  | internal conductors, if so arranged that they are unlikely to be displaced when fitting the supply conductors |  |  |
|  | If soldered connections used, the conductor so positioned or fixed that reliance is not placed on soldering alone, unless |  |  |
|  | barriers provided so that neither clearances nor creepage distances between live parts and other metal parts reduced below the values for supplementary insulation if the conductor becomes free at the soldered joint |  |  |
| 26.3 | Terminals for type X attachment and for connection of cables of fixed wiring so constructed that the conductor is clamped between metal surfaces with sufficient contact pressure but without damaging the conductor |  |  |
|  | Terminals fixed so that when the clamping means is tightened or loosened: | |  |
|  | - the terminal does not become loose |  |  |
|  | - internal wiring is not subjected to stress |  |  |
|  | - neither clearances nor creepage distances are reduced below the values in clause 29 |  |  |
|  | Compliance checked by inspection and by the test of subclause 9.6 of IEC 60999‑1, the torque applied being equal to two‑thirds of the torque specified (Nm) : |  |  |
|  | No deep or sharp indentations of the conductors |  |  |
| 26.4 | Terminals for type X attachment, except those having a specially prepared cord and those for the connection of cables of fixed wiring, no special preparation of conductors such as by soldering, use of cable lugs, eyelets or similar, and |  |  |
|  | so constructed or placed that conductors prevented from slipping out when clamping screws or nuts are tightened |  |  |
| 26.5 | Terminals for type X attachment so located or shielded that if a wire of a stranded conductor escapes, no risk of accidental connection to other parts that result in a hazard |  |  |
|  | Stranded conductor test, 8 mm insulation removed |  |  |
|  | No contact between live parts and accessible metal parts and, |  |  |
|  | for class II constructions, between live parts and metal parts separated from accessible metal parts by supplementary insulation only |  |  |
| 26.6 | Terminals for type X attachment and for connection of cables of fixed wiring suitable for connection of conductors with cross‑sectional area according to table 13; rated current (A); nominal cross‑sectional area (mm²) : |  |  |
|  | If a specially prepared cord is used, terminals need only be suitable for that cord |  |  |
| 26.7 | Terminals for type X attachment, except in class III appliances not containing live parts, accessible after removal of a cover or part of the enclosure |  |  |
| 26.8 | Terminals for the connection of fixed wiring, including the earthing terminal, located close to each other |  |  |
| 26.9 | Terminals of the pillar type constructed and located as specified |  |  |
| 26.10 | Terminals with screw clamping and screwless terminals not used for flat twin tinsel cords, unless |  |  |
|  | conductors ends fitted with means suitable for screw terminals |  |  |
|  | Pull test of 5 N to the connection |  |  |
| 26.11 | For type Y and Z attachment, soldered, welded, crimped or similar connections may be used |  |  |
|  | For class II appliances, the conductor so positioned or fixed that reliance is not placed on soldering, welding or crimping alone |  |  |
|  | If soldering, welding or crimping alone used, barriers provided so that clearances and creepage distances between live parts and other metal parts are not reduced below the values for supplementary insulation if the conductor becomes free |  |  |
| **27** | **PROVISION FOR EARTHING** | |  |
| 27.1 | Accessible metal parts of class 0I and I appliances permanently and reliably connected to an earthing terminal or earthing contact of the appliance inlet |  |  |
|  | Earthing terminals and earthing contacts not connected to the neutral terminal |  |  |
|  | Class 0, II and III appliances have no provision for protective earthing |  |  |
|  | Class II appliances and class III appliances can incorporate an earth for functional purposes |  |  |
|  | Safety extra‑low voltage circuits not earthed, unless |  |  |
|  | protective extra‑low voltage circuits |  |  |
| 27.2 | Clamping means of earthing terminals adequately secured against accidental loosening |  |  |
|  | Terminals for the connection of external equipotential bonding conductors allow connection of conductors of 2,5 to 6 mm², and |  |  |
|  | - do not provide earthing continuity between different parts of the appliance, and |  |  |
|  | - conductors cannot be loosened without the aid of a tool |  |  |
|  | Requirements not applicable to class II appliances and class III appliances that incorporate an earth for functional purposes |  |  |
| 27.3 | For a detachable part having an earth connection and being plugged into another part of the appliance, the earth connection is made before and separated after current‑carrying connections when removing the part |  |  |
|  | For appliances with supply cords, current‑carrying conductors become taut before earthing conductor, if the cord slips out of the cord anchorage |  |  |
|  | Requirements not applicable to class II appliances and class III appliances that incorporate an earth for functional purposes |  |  |
| 27.4 | No risk of corrosion resulting from contact between parts of the earthing terminal and the copper of the earthing conductor or other metal |  |  |
|  | Parts providing earthing continuity, other than parts of a metal frame or enclosure, have adequate resistance to corrosion |  |  |
|  | If of steel, these parts provided with an electroplated coating with a thickness at least 5 µm |  |  |
|  | Adequate protection against rusting of parts of coated or uncoated steel, only intended to provide or transmit contact pressure |  |  |
|  | In the body of the earthing terminal is a part of a frame or enclosure of aluminium or aluminium alloys, precautions taken to avoid risk of corrosion |  |  |
|  | Requirements not applicable to class II appliances and class III appliances that incorporate an earth for functional purposes |  |  |
| 27.5 | Low resistance of connection between earthing terminal and earthed metal parts |  |  |
|  | This requirement does not apply to connections providing earthing continuity in the protective extra‑low voltage circuit, provided the clearances of basic insulation are based on the rated voltage of the appliance |  |  |
|  | Requirements not applicable to class II appliances and class III appliances that incorporate an earth for functional purposes |  |  |
|  | Resistance not exceeding 0,1 Ω at the specified low‑resistance test (Ω ) : |  |  |
|  | 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. (IEC 60335‑2‑40:2018) |  |  |
| 27.6 | The printed conductors of printed circuit boards not used to provide earthing continuity in hand‑held appliances. |  |  |
|  | They may be used to provide earthing continuity in other appliances if at least two tracks are used with independent soldering points and the appliance complies with 27.5 for each circuit |  |  |
|  | Requirements not applicable to class II appliances and class III appliances that incorporate an earth for functional purposes |  |  |
| **28** | **SCREWS AND CONNECTIONS** | |  |
| 28.1 | Fixings, electrical connections and connections providing earthing continuity withstand mechanical stresses |  |  |
|  | Screws not of soft metal liable to creep, such as zinc or aluminium |  |  |
|  | Diameter of screws of insulating material min. 3 mm |  |  |
|  | Screws of insulating material not used for any electrical connections or connections providing earthing continuity |  |  |
|  | Screws used for electrical connections or connections providing earthing continuity screwed into metal |  |  |
|  | Screws not of insulating material if their replacement by a metal screw can impair supplementary or reinforced insulation |  |  |
|  | For type X attachment, screws to be removed for replacement of supply cord or for user maintenance, not of insulating material if their replacement by a metal screw impairs basic insulation |  |  |
|  | For screws and nuts; torque‑test as specified in table 14 : | (see appended table) |  |
| 28.2 | Electrical connections and connections providing earthing continuity constructed so that contact pressure is not transmitted through non‑ceramic insulating material liable to shrink or distort, unless |  |  |
|  | there is resiliency in the metallic parts to compensate for shrinkage or distortion of the insulating material |  |  |
|  | This requirement does not apply to electrical connections in circuits of appliances for which: | |  |
|  | - 30.2.2 is applicable and that carry a current not exceeding 0,5 A |  |  |
|  | - 30.2.3 is applicable and that carry a current not exceeding 0,2 A |  |  |
| 28.3 | Space‑threaded (sheet metal) screws only used for electrical connections if they clamp the parts together |  |  |
|  | Thread‑cutting (self‑tapping) screws and thread rolling screws only used for electrical connections if they generate a full form standard machine screw thread |  |  |
|  | Thread‑cutting (self‑tapping) screws not used if they are likely to be operated by the user or installer |  |  |
|  | Thread‑cutting, thread rolling and space threaded screws may be used in connections providing earthing continuity provided it is not necessary to disturb the connection: | |  |
|  | - in normal use, |  |  |
|  | - during user maintenance, |  |  |
|  | - when replacing a supply cord having a type X attachment, or |  |  |
|  | - during installation |  |  |
|  | At least two screws being used for each connection providing earthing continuity, unless |  |  |
|  | the screw forms a thread having a length of at least half the diameter of the screw |  |  |
| 28.4 | Screws and nuts that make mechanical connection secured against loosening if they also make electrical connections or connections providing earthing continuity |  |  |
|  | This requirement does not apply to screws in the earthing circuit if at least two screws are used, or |  |  |
|  | if an alternative earthing circuit is provided |  |  |
|  | Rivets for electrical connections or connections providing earthing continuity secured against loosening if the connections are subjected to torsion |  |  |
| **29** | **CLEARANCES, CREEPAGE DISTANCES AND SOLID INSULATION** | |  |
|  | Clearances, creepage distances and solid insulation withstand electrical stress |  |  |
|  | For coatings used on printed circuits boards to protect the microenvironment (Type 1) or to provide basic insulation (Type 2), annex J applies : |  |  |
|  | The microenvironment is pollution degree 1 under type 1 protection |  |  |
|  | For type 2 protection, the spacing between the conductors before the protection is applied is not less than the values specified in Table 1 of IEC 60664‑3 |  |  |
|  | These values apply to functional, basic, supplementary and reinforced insulation : |  |  |
|  | For motor‑compressor not complying with IEC 60335‑2‑34, additions and modifications as specified (IEC 60335‑2‑40:2018) |  |  |
| 29.1 | Clearances not less than the values specified in table 16, taking into account the rated impulse voltage for the overvoltage categories of table 15, unless : | (see appended table) |  |
|  | for basic insulation and functional insulation they comply with the impulse voltage test of clause 14 |  |  |
|  | However, if the distances are affected by wear, distortion, movement of the parts or during assembly, the clearances for rated impulse voltages of 1500 V and above are increased by 0,5 mm and the impulse voltage test is not applicable |  |  |
|  | For appliances intended for use at altitudes exceeding 2 000 m, the clearances in Table 16 is increased according to the relevant multiplier values in Table A.2 of IEC 60664‑1 |  |  |
|  | Impulse voltage test is not applicable: | |  |
|  | - when the microenvironment is pollution degree 3, or |  |  |
|  | - for basic insulation of class 0 and class 01 appliances, or |  |  |
|  | - to appliances intended for use at altitudes exceeding 2 000 m |  |  |
|  | Appliances are in overvoltage category II |  |  |
|  | A force of 2 N is applied to bare conductors, other than heating elements |  |  |
|  | A force of 30 N is applied to accessible surfaces |  |  |
| 29.1.1 | Clearances of basic insulation withstand the overvoltages, taking into account the rated impulse voltage |  |  |
|  | The values of table 16 or the impulse voltage test of clause 14 are applicable : | (see appended table) |  |
|  | Clearance at the terminals of tubular sheathed heating elements may be reduced to 1,0 mm if the microenvironment is pollution degree 1 |  |  |
|  | Lacquered conductors of windings considered to be bare conductors |  |  |
| 29.1.2 | Clearances of supplementary insulation not less than those specified for basic insulation in table 16 : | (see appended table) |  |
| 29.1.3 | Clearances of reinforced insulation not less than those specified for basic insulation in table 16, using the next higher step for rated impulse voltage : | (see appended table) |  |
|  | For double insulation, with no intermediate conductive part between basic and supplementary insulation, clearances are measured between live parts and the accessible surface, and the insulation system is treated as reinforced insulation |  |  |
| 29.1.4 | Clearances for functional insulation are the largest values determined from: | |  |
|  | - table 16 based on the rated impulse voltage : | (see appended table) |  |
|  | - table F.7a in IEC 60664‑1, frequency not exceeding 30 kHz |  |  |
|  | - clause 4 of IEC 60664‑4, frequency exceeding 30 kHz |  |  |
|  | If values of table 16 are largest, the impulse voltage test of clause 14 may be applied instead, unless |  |  |
|  | the microenvironment is pollution degree 3, or |  |  |
|  | the distances can be affected by wear, distortion, movement of the parts or during assembly |  |  |
|  | However, clearances are not specified if the appliance complies with clause 19 with the functional insulation short‑circuited |  |  |
|  | Lacquered conductors of windings considered to be bare conductors |  |  |
|  | However, clearances at crossover points are not measured |  |  |
|  | Clearance between surfaces of PTC heating elements may be reduced to 1 mm |  |  |
| 29.1.5 | Appliances having higher working voltages than rated voltage, clearances for basic insulation are the largest values determined from: | |  |
|  | - table 16 based on the rated impulse voltage : |  |  |
|  | - table F.7a in IEC 60664‑1, frequency not exceeding 30 kHz |  |  |
|  | - clause 4 of IEC 60664‑4, frequency exceeding 30 kHz |  |  |
|  | If clearances for basic insulation are selected from Table F.7a of IEC 60664‑1 or clause 4 of IEC 60664‑4, the clearances of supplementary insulation are not less than those specified for basic insulation |  |  |
|  | If clearances for basic insulation are selected from Table F.7a of IEC 60664‑1, the clearances of reinforced insulation dimensioned as specified in Table F.7a are to withstand 160 % of the withstand voltage required for basic insulation |  |  |
|  | If clearances for basic insulation are selected from clause 4 of IEC 60664‑4, the clearances of reinforced insulation are twice the value required for basic insulation |  |  |
|  | If the secondary winding of a step‑down transformer is earthed, or if there is an earthed screen between the primary and secondary windings, clearances of basic insulation on the secondary side not less than those specified in table 16, but using the next lower step for rated impulse voltage |  |  |
|  | Circuits supplied with a voltage lower than rated voltage, clearances of functional insulation are based on the working voltage used as the rated voltage in table 15 |  |  |
| 29.2 | Creepage distances not less than those appropriate for the working voltage, taking into account the material group and the pollution degree : | (see appended table) |  |
|  | Pollution degree 2 applies, unless |  |  |
|  | - precautions taken to protect the insulation; pollution degree 1 |  |  |
|  | - insulation subjected to conductive pollution; pollution degree 3 |  |  |
|  | A force of 2 N is applied to bare conductors, other than heating elements |  |  |
|  | A force of 30 N is applied to accessible surfaces |  |  |
|  | In a double insulation system, the working voltage for both the basic and supplementary insulation is taken as the working voltage across the complete double insulation system |  |  |
|  | Insulation located in airflow, pollution degree 3 unless |  |  |
|  | insulation enclosed or located so that unlikely to be exposed to pollution due to normal use |  |  |
| 29.2.1 | Creepage distances of basic insulation not less than specified in table 17 : | (see appended table) |  |
|  | However, if the working voltage is periodic and has a frequency exceeding 30 kHz, the creepage distances are also determined from table 2 of IEC 60664‑4, these values being used if exceeding the values in table 17 : |  |  |
|  | Except for pollution degree 1, corresponding creepage distance not less than the minimum specified for the clearance in table 16, if the clearance has been checked according to the test of clause 14 : |  |  |
| 29.2.2 | Creepage distances of supplementary insulation at least those specified for basic insulation in table 17, or : | (see appended table) |  |
|  | Table 2 of IEC 60664‑4, as applicable : |  |  |
| 29.2.3 | Creepage distances of reinforced insulation at least double those specified for basic insulation in table 17, or : | (see appended table) |  |
|  | Table 2 of IEC 60664‑4, as applicable : |  |  |
| 29.2.4 | Creepage distances of functional insulation not less than specified in table 18 : | (see appended table) |  |
|  | However, if the working voltage is periodic and has a frequency exceeding 30 kHz, the creepage distances are also determined from table 2 of IEC 60664‑4, these values being used if exceeding the values in table 18 : |  |  |
|  | Creepage distances may be reduced if the appliance complies with clause 19 with the functional insulation short‑circuited |  |  |
| 29.3 | Supplementary and reinforced insulation have adequate thickness, or a sufficient number of layers, to withstand the electrical stresses |  |  |
|  | Compliance checked: | |  |
|  | - by measurement, in accordance with 29.3.1, or |  |  |
|  | - by an electric strength test in accordance with 29.3.2, or |  |  |
|  | - for insulation, other than single layer internal wiring insulation, by an assessment of the thermal quality of the material combined with an electric strength test, in accordance with 29.3.3, and |  |  |
|  | for accessible parts of reinforced insulation consisting of a single layer, by measurement in accordance with 29.3.4, or |  |  |
|  | - by an assessment of the thermal quality of the material according to 29.3.3 combined with an electric strength test in accordance with 23.5, for each single layer internal wiring insulation touching each other, or |  |  |
|  | - as specified in subclause 6.3 of IEC 60664‑4 for insulation that is subjected to any periodic voltage having a frequency exceeding 30 kHz |  |  |
| 29.3.1 | Supplementary insulation have a thickness of at least 1 mm |  |  |
|  | Reinforced insulation have a thickness of at least 2 mm |  |  |
| 29.3.2 | Each layer of material withstand the electric strength test of 16.3 for supplementary insulation |  |  |
|  | Supplementary insulation consist of at least 2 layers |  |  |
|  | Reinforced insulation consist of at least 3 layers |  |  |
| 29.3.3 | The insulation is subjected to the dry heat test Bb of IEC 60068‑2‑2, followed by |  |  |
|  | the electric strength test of 16.3 |  |  |
|  | If the temperature rise during the tests of clause 19 does not exceed the value specified in table 3, the test of IEC 60068‑2‑2 is not carried out |  |  |
| 29.3.4 | Thickness of accessible parts of reinforced insulation consisting of a single layer not less than specified in table 19 : |  |  |
| **30** | **RESISTANCE TO HEAT AND FIRE** | |  |
| 30.1 | External parts of non‑metallic material, |  |  |
|  | parts supporting live parts, and |  |  |
|  | parts of thermoplastic material providing supplementary or reinforced insulation |  |  |
|  | sufficiently resistant to heat |  |  |
|  | Ball‑pressure test according to IEC 60695‑10‑2 |  |  |
|  | External parts tested at 40 °C plus the maximum temperature rise determined during the test of clause 11, or at 75 °C, whichever is the higher; temperature (°C) : | (see appended table 30.1) |  |
|  | Parts supporting live parts tested at 40 °C plus the maximum temperature rise determined during the test of clause 11, or at 125 °C, whichever is the higher; temperature (°C) : | (see appended table 30.1) |  |
|  | Parts of thermoplastic material providing supplementary or reinforced insulation tested at 25 °C plus the maximum temperature rise determined during clause 19, if higher; temperature (°C) : | (see appended table 30.1) |  |
| 30.2 | Parts of non‑metallic material resistant to ignition and spread of fire |  |  |
|  | This requirement does not apply to: | |  |
|  | parts having a mass not exceeding 0,5 g, provided the cumulative effect is unlikely to propagate flames that originate inside the appliance by propagating flames from one part to another, or |  |  |
|  | decorative trims, knobs and other parts unlikely to be ignited or to propagate flames that originate inside the appliance |  |  |
|  | Compliance checked by the test of 30.2.1, and in addition: |  |  |
|  | - for attended appliances, 30.2.2 applies |  |  |
|  | - for unattended appliances, 30.2.3 applies |  |  |
|  | For appliances for remote operation, 30.2.3 applies |  |  |
|  | For base material of printed circuit boards, 30.2.4 applies |  |  |
| 30.2.1 | Parts of non‑metallic material subjected to the glow‑wire test of IEC 60695‑2‑11 at 550 °C | (see appended table 30.2) |  |
|  | However, test not carried out if the material is classified as having a glow‑wire flammability index according to IEC 60695‑2‑12 of at least 550 °C, or |  |  |
|  | the material is classified at least HB40 according to IEC 60695‑11‑10 |  |  |
|  | Parts for which the glow‑wire test cannot be carried out need to meet the requirements in ISO 9772 for material classified HBF |  |  |
| 30.2.3 | Appliances operated while unattended, tested as specified in 30.2.3.1 and 30.2.3.2 |  |  |
|  | The tests are not applicable to conditions as specified : |  |  |
| 30.2.3.1 | Parts of non‑metallic material supporting connections carrying a current exceeding 0,2 A during normal operation, and |  |  |
|  | parts of non‑metallic material, other than small parts, within a distance of 3 mm, |  |  |
|  | subjected to the glow‑wire test of IEC 60695‑2‑11 with a test severity of 850 °C | (see appended table 30.2) |  |
|  | Glow‑wire applied to an interposed shielding material, if relevant |  |  |
|  | The glow‑wire test is not carried out on parts of material classified as having a glow‑wire flammability index according to IEC 60695‑2‑12 of at least 850 °C |  |  |
| 30.2.3.2 | Parts of non‑metallic material supporting connections, and |  |  |
|  | parts of non‑metallic material within a distance of 3 mm, |  |  |
|  | subjected to the glow‑wire test of IEC 60695‑2‑11 with appropriate severity level: | (see appended table 30.2) |  |
|  | - 750 °C, for connections carrying a current exceeding 0,2 A during normal operation |  |  |
|  | - 650 °C, for other connections |  |  |
|  | Glow‑wire applied to an interposed shielding material, if relevant |  |  |
|  | However, the glow‑wire test of 750 °C or 650 °C as appropriate, is not carried out on parts of material fulfilling both or either of the following classifications: | |  |
|  | - a glow‑wire ignition temperature according to IEC 60695‑2‑13 of at least: |  |  |
|  | - 775 °C, for connections carrying a current exceeding 0,2 A during normal operation |  |  |
|  | - 675 °C, for other connections |  |  |
|  | - a glow‑wire flammability index according to IEC 60695‑2‑12 of at least: |  |  |
|  | - 750 °C, for connections carrying a current exceeding 0,2 A during normal operation |  |  |
|  | - 650 °C, for other connections |  |  |
|  | The glow‑wire test is also not carried out on small parts. These parts are to: | |  |
|  | - comprise material having a glow‑wire ignition temperature of at least 775 °C or 675 °C as appropriate, or |  |  |
|  | - comprise material having a glow‑wire flammability index of at least 750 °C or 650 °C as appropriate, or |  |  |
|  | - comply with the needle‑flame test of annex E, or |  |  |
|  | - comprise material classified as V‑0 or V‑1 according to IEC 60695‑11‑10 |  |  |
|  | The consequential needle‑flame test of annex E applied to non‑metallic parts that encroach within the vertical cylinder placed above the centre of the connection zone and on top of the non‑metallic parts supporting current‑carrying connections, and parts of non‑metallic material within a distance of 3 mm of such connections if these parts are those: | |  |
|  | - parts that withstood the glow‑wire test of IEC 60695‑2‑11 of 750 °C or 650 °C as appropriate, but produce a flame that persist longer than 2 s, or |  |  |
|  | - parts that comprised material having a glow‑wire flammability index of at least 750 °C or 650 °C as appropriate, or |  |  |
|  | - small parts, that comprised material having a glow‑wire flammability index of at least 750 °C or 650 °C as appropriate, or |  |  |
|  | - small parts for which the needle‑flame test of annex E was applied, or |  |  |
|  | - small parts for which a material classification of V‑0 or V‑1 was applied |  |  |
|  | However, the consequential needle‑flame test is not carried out on non‑metallic parts, including small parts, within the cylinder that are: | |  |
|  | - parts having a glow‑wire ignition temperature of at least 775 °C or 675 °C as appropriate, or |  |  |
|  | - parts comprising material classified as V‑0 or V‑1 according to IEC 60695‑11‑10, or |  |  |
|  | - parts shielded by a flame barrier that meets the needle‑flame test of annex E or that comprises material classified as V‑0 or V‑1 according to IEC 60695‑11‑10 |  |  |
| 30.2.4 | Base material of printed circuit boards subjected to the needle‑flame test of annex E | (see appended table 30.2/30.2.4) |  |
|  | Test not applicable to conditions as specified : |  |  |
| 30.101 | The ball pressure test for particle foam material is carried out using the apparatus specified in IEC 60695-10-2:2014, Clause 5 using the loading device shown in Figure 1a with additional dimensions and shape as shown in Figure 105. |  |  |
|  | The size of test specimen at least 60 mm × 60 mm. |  |  |
|  | The weight applied to the outer surface of the part, and not to a cut-away exposing an interior substrate for the purposes of sample preparation. |  |  |
|  | The test specimen stored for at least 24 h before the test in an atmosphere having a temperature between 15 °C and 35 °C and a relative humidity between 45 % and 75 %. |  |  |
|  | Place the test specimen in the approximate centre of the test specimen support ensuring that its upper surface is horizontal. |  |  |
|  | Gently lower the pressure ball of the loading device on to the approximate centre of the test specimen. |  |  |
|  | Ensure that no conditions exist that will cause the pressure ball to move other than in a downward direction during the test. |  |  |
|  | The installation of the test specimen and application of the weight performed within 30 s. |  |  |
|  | The test chamber return to the specified temperature (± 2 °C) within 5 min and without any overshoot exceeding 5 °C. |  |  |
|  | The test specimen with the loading device remain for a period of 60 +20 min in the test chamber. |  |  |
|  | The thickness of the sample at the point of contact with the loading device shall be measured before and immediately after the conditioning in the chamber according to Figure 106. |  |  |
|  | The test performed at a temperature (40 ± 2) K above the maximum temperature rise measured at accessible surface during the test in Clause 11, but not less than 75 °C. |  |  |
|  | However, for parts providing supplementary insulation or reinforced insulation, the test performed at a temperature, which is (25 ± 2) K above the maximum temperature rise measured during the test in Clause 19, if this is higher. |  |  |
|  | The temperature rises of Clause 19 are not considered, provided the tests of Clause 19 are terminated by a non-self-resetting protective device. The resetting of the non-self-resetting protective device shall require removal of a cover or the using of a tool. |  |  |
|  | After the test, the thickness of the material not less than 50 % of the original material thickness but not less than 4 mm. |  |  |
| **31** | **RESISTANCE TO RUSTING** | |  |
|  | Relevant ferrous parts adequately protected against rusting |  |  |
|  | Tests specified in part 2 when necessary |  |  |
|  | Salt mist test of IEC 60068‑2‑52, severity 2 |  |  |
|  | Before test, coatings are scratched by means of a harden steel pin as specified |  |  |
|  | Five scratches made at least 5 mm apart and at least 5 mm from the edges |  |  |
|  | Appliance not deteriorated to such an extent that compliance with clause 8 and 27 is impaired |  |  |
|  | Coating not be broken and not loosened from the metal surface |  |  |
| **32** | **RADIATION, TOXICITY AND SIMILAR HAZARDS** | |  |
|  | Appliance does not emit harmful radiation or present a toxic or similar hazard due to their operation in normal use |  |  |
|  | Compliance is checked by the limits or tests specified in part 2, if relevant |  |  |
| 32.101 | UV-C irradiance test |  |  |
| 32.101.1 | For the occupied space outside the unit, a test be performed to determine the UV-C spectral irradiance. |  |  |
|  | Emissions from the equipment not exceed a UV-C spectral irradiance limit of 0,2 µW/cm2 |  |  |
| 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 be no UV-C spectral irradiance greater than 1,7 µW/cm2 |  |  |
|  | 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 maximum exposure time of 60 min/day at 1,7 µW/cm2 spectral irradiance that the user would experience in performing his duties. |  |  |
|  | Compliance is determined by measuring the UV-C irradiance per IEC 62471:2006, Clause 5 and Annex B. |  |  |
| 32.101.3 | UV-C irradiance is measured at the location in Table 102 |  |  |
| 32.101.4 | When conducting UV-C spectral irradiance tests: | |  |
|  | - the UV-C spectral irradiance measurements are conducted with a scanning spectroradiometer, or a narrow band range radiometer; |  |  |
|  | - all panels and components are positioned or adjusted in the most severe position |  |  |
|  | - removable air filters are removed; |  |  |
|  | - measurements are made at the worst case location and angle of incidence; |  |  |
|  | - the minimum specified duct and configuration, including any duct liners, specified by the manufacturer be in place and the measurements taken at the opening at the end of the duct. |  |  |
| **B** | **ANNEX B - APPLIANCES POWERED BY RECHARGEABLE BATTERIES THAT ARE RECHARGED IN THE APPLIANCE** | |  |
|  | The following modifications to this standard are applicable for appliances powered by batteries that are recharged in the appliance |  |  |
|  | Three forms of construction covered: | |  |
|  | a) Appliance supplied directly from the supply mains or a renewable energy source, the battery charging circuitry and other supply unit circuitry incorporated within the appliance |  |  |
|  | b) The part of the appliance incorporating the battery is supplied from the supply mains or a renewable energy source, via a detachable supply unit. The battery charging circuitry is incorporated within the part of the appliance containing the battery |  |  |
|  | c) The part of the appliance incorporating the battery is supplied from the supply mains or a renewable energy source, via a detachable supply unit. The battery charging circuitry is incorporated within the detachable supply unit |  |  |
| 3.1.9 | Appliance operated under the following conditions: | |  |
|  | - the appliance, supplied by its fully charged battery, operated as specified in relevant part 2 |  |  |
|  | - the battery is charged, the battery being initially discharged to such an extent that the appliance cannot operate |  |  |
|  | - if possible, the appliance is supplied from the supply mains through its battery charger, the battery being initially discharged to such an extent that the appliance cannot operate. The appliance is operated as specified in relevant part 2 |  |  |
|  | - if the appliance incorporates inductive coupling between two parts that are detachable from each other, the appliance is supplied from the supply mains with the detachable part removed |  |  |
| 3.6.2 | Part to be removed in order to discard the battery is not considered to be detachable |  |  |
| 5.B.101 | Appliances supplied from the supply mains tested as specified for motor‑operated appliances |  |  |
| 7.1 | Battery compartment for batteries intended to be replaced by the user, marked with battery voltage (V) and polarity of the terminals : |  |  |
|  | The positive terminal indicated by symbol IEC 60417‑5005 and the negative terminal by symbol IEC 60417‑5006 |  |  |
|  | Appliances intending to be supplied from a detachable supply unit marked with symbol IEC 60417‑6181 and its type reference along with symbol ISO 7000‑0790 (2004‑01), or |  |  |
|  | use only with <model designation> supply unit : |  |  |
| 7.6 | Additional symbols |  |  |
| 7.12 | The instructions give information regarding charging |  |  |
|  | Instructions for appliances incorporating batteries intended to be replaced by the user include required information |  |  |
|  | Instructions for appliances containing non user‑replaceable batteries state the substance of the following: | |  |
|  | This appliance contains batteries that are only replaceable by skilled persons |  |  |
|  | Instructions for appliances containing non‑replaceable batteries shall state the substance of the following: | |  |
|  | This appliance contains batteries that are non‑replaceable |  |  |
|  | For appliances intending to be supplied from a detachable supply unit for the purposes of recharging the battery, the type reference of the detachable supply unit is stated along with the following: | |  |
|  | WARNING: For the purposes of recharging the battery, only use the detachable supply unit provided with this appliance |  |  |
|  | If the symbol for detachable supply unit is used, its meaning is explained |  |  |
| 7.15 | Markings placed on the part of the appliance connected to the supply mains |  |  |
|  | The type reference of the detachable supply unit is placed in close proximity to the symbol |  |  |
| 8.2 | Appliances having batteries that according to the instruction may be replaced by the user need only have basic insulation between live parts and the inner surface of the battery compartment |  |  |
|  | If the appliance can be operated without batteries, double or reinforced insulation required |  |  |
| 11.7 | The battery is charged for the period stated in the instructions or 24 h : |  |  |
| 11.8 | Temperature rise of the battery surface does not exceed the limit in the battery manufacturer’s specification; measured (K); limit (K) : |  |  |
|  | If no limit specified, the temperature rise does not exceed 20 K; measured (K) : |  |  |
| 19.1 | Appliances subjected to tests of 19.B.101, 19.B.102 and 19.B.103 |  |  |
| 19.10 | Not applicable |  |  |
| 19.B.101 | Appliances supplied at rated voltage for 168 h, the battery being continually charged |  |  |
| 19.B.102 | For appliances having batteries that can be removed without the aid of a tool, short‑circuit of the terminals of the battery, the battery being fully charged, |  |  |
| 19.B.103 | Appliances having batteries replaceable by the user supplied at rated voltage under normal operation with the battery removed or in any position allowed by the construction |  |  |
| 19.13 | The battery does not rupture or ignite |  |  |
| 21.B.101 | Appliances having pins for insertion into socket‑outlets have adequate mechanical strength |  |  |
|  | Part of the appliance incorporating the pins subjected to the free fall test, procedure 2, of IEC 60068‑2‑31, the number of falls being: | |  |
|  | - 100, if the mass of the part does not exceed 250  g (g) : |  |  |
|  | - 50, if the mass of the part exceeds 250 g : |  |  |
|  | After the test, the requirements of 8.1, 15.1.1, 16.3 and clause 29 are met |  |  |
| 22.3 | Appliances having pins for insertion into socket‑outlets tested as fully assembled as possible |  |  |
| 25.13 | An additional lining or bushing not required for interconnection cords in class III appliances or class III constructions operating at safety extra‑low voltage not containing live parts |  |  |
| 30.2 | For parts of the appliance connected to the supply mains during the charging period, 30.2.3 applies |  |  |
|  | For other parts, 30.2.2 applies |  |  |
| **C** | **ANNEX C - AGEING TEST ON MOTORS** | |  |
|  | Tests, as described, carried out when doubt with regard to the temperature classification of the insulation of a motor winding |  |  |
|  | Test conditions as specified |  |  |
| **E** | **ANNEX E - NEEDLE-FLAME TEST** | |  |
|  | Needle‑flame test carried out in accordance with IEC 60695‑11‑5, with the following modifications: | |  |
| 7 | Severities | |  |
|  | The duration of application of the test flame is  30 s ± 1 s |  |  |
| 9 | Test procedure | |  |
| 9.1 | The specimen so arranged that the flame can be applied to a vertical or horizontal edge as shown in the examples of figure 1 |  |  |
| 9.2 | The first paragraph does not apply |  |  |
|  | If possible, the flame is applied at least 10 mm from a corner |  |  |
| 9.3 | The test is carried out on one specimen |  |  |
|  | If the specimen does not withstand the test, the test may be repeated on two additional specimens, both withstanding the test |  |  |
| 11 | Evaluation of test results | |  |
|  | The duration of burning not exceeding 30 s |  |  |
|  | However, for printed circuit boards, the duration of burning not exceeding 15 s |  |  |
| **F** | **ANNEX F - CAPACITORS** | |  |
|  | Capacitors likely to be permanently subjected to the supply voltage, and used for radio interference suppression or voltage dividing, comply with the following clauses of IEC 60384‑14, with the following modifications: | |  |
| 1.5 | Terms and definitions | |  |
| 1.5.3 | Class X capacitors tested according to subclass X2 |  |  |
| 1.5.4 | This subclause is applicable |  |  |
| 1.6 | Marking | |  |
|  | Items a) and b) are applicable |  |  |
| 3.4 | Approval testing | |  |
| 3.4.3.2 | Table 3 is applicable as described |  |  |
| 4.1 | Visual examination and check of dimensions | |  |
|  | This subclause is applicable |  |  |
| 4.2 | Electrical tests | |  |
| 4.2.1 | This subclause is applicable |  |  |
| 4.2.5 | This subclause is applicable |  |  |
| 4.2.5.2 | Only table 11 is applicable |  |  |
|  | Values for test A apply |  |  |
|  | However, for capacitors in heating appliances the values for test B or C apply |  |  |
| 4.12 | Damp heat, steady state | |  |
|  | This subclause is applicable |  |  |
|  | Only insulation resistance and voltage proof are checked |  |  |
| 4.13 | Impulse voltage | |  |
|  | This subclause is applicable |  |  |
| 4.14 | Endurance | |  |
|  | Subclauses 4.14.1, 4.14.3, 4.14.4 and 4.14.7 are applicable |  |  |
| 4.14.7 | Only insulation resistance and voltage proof are checked |  |  |
|  | No visible damage |  |  |
| 4.17 | Passive flammability test | |  |
|  | This subclause is applicable |  |  |
| 4.18 | Active flammability test | |  |
|  | This subclause is applicable |  |  |
| **G** | **ANNEX G - SAFETY ISOLATING TRANSFORMERS** | |  |
|  | The following modifications to this standard are applicable for safety isolating transformers: | |  |
| 7 | Marking and instructions | |  |
| 7.1 | Transformers for specific use marked with: | |  |
|  | - name, trademark or identification mark of the manufacturer or responsible vendor : |  |  |
|  | - model or type reference : |  |  |
| 17 | Overload protection of transformers and associated circuits | |  |
|  | Fail‑safe transformers comply with subclause 15.5 of IEC 61558‑1 |  |  |
| 22 | Construction | |  |
|  | Subclauses 19.1 and 19.1.2 of IEC 61558‑2‑6 are applicable |  |  |
| 29 | Clearances, creepage distances and solid insulation | |  |
| 29.1, 29.2, 29.3 | The distances specified in items 2a, 2c and 3 in table 13 of IEC 61558‑1 apply |  |  |
|  | For insulated winding wires complying with subclause 19.12.3 of IEC 61558‑1 there are no requirements for clearances or creepage distances |  |  |
|  | For windings providing reinforced insulation, the distance specified in item 2c of table 13 of IEC 61558‑1 is not assessed |  |  |
|  | For safety isolating transformers subjected to periodic voltages with a frequency exceeding 30 kHz, the clearances, creepage distances and solid insulation values specified in IEC 60664‑4 are applicable, if greater than the values specified in items 2a, 2c and 3 in table 13 of IEC 61558‑1 |  |  |
| **H** | **ANNEX H - SWITCHES** | |  |
|  | Switches comply with the following clauses of IEC 61058‑1, as modified below: | |  |
|  | The tests of IEC 61058‑1 carried out under the conditions occurring in the appliance |  |  |
|  | Before being tested, switches are operated 20 times without load |  |  |
| 8 | Marking and documentation | |  |
|  | Switches are not required to be marked |  |  |
|  | However, a switch that can be tested separately from the appliance marked with the manufacturer’s name or trade mark and the type reference |  |  |
| 13 | Mechanism | |  |
|  | The tests may be carried out on a separate sample |  |  |
| 15 | Insulation resistance and dielectric strength | |  |
| 15.1 | Not applicable |  |  |
| 15.2 | Not applicable |  |  |
| 15.3 | Applicable for full disconnection and micro‑disconnection |  |  |
| 17 | Endurance | |  |
|  | Compliance is checked on three separate appliances or switches |  |  |
|  | For 17.2.4.4, the number of cycles declared according to 7.1.4 is 10 000, unless |  |  |
|  | otherwise specified in 24.1.3 of the relevant part 2 of IEC 60335 : |  |  |
|  | Switches for operation under no load and which can be operated only by a tool, and |  |  |
|  | switches operated by hand that are interlocked so that they cannot be operated under load, |  |  |
|  | are not subjected to the tests |  |  |
|  | However, switches without this interlock are subjected to the test of 17.2.4.4 for 100 cycles of operation |  |  |
|  | Subclauses 17.2.2 and 17.2.5.2 not applicable |  |  |
|  | The ambient temperature during the test is that occurring in the appliance during the test of clause 11 in IEC 60335‑1 |  |  |
|  | The temperature rise of the terminals not more than 30 K above the temperature rise measured in clause 11 of IEC 60335‑1 (K) : |  |  |
| 20 | Clearances, creepage distances, solid insulation and coatings of rigid printed board assemblies | |  |
|  | Clause 20 is applicable to clearances across full disconnection and micro‑disconnection |  |  |
|  | It is also applicable to creepage distances for functional insulation, across full disconnection and micro‑disconnection, as stated in Table 24 |  |  |
| **J** | **ANNEX J - COATED PRINTED CIRCUIT BOARDS** | |  |
|  | Testing of protective coatings of printed circuit boards carried out in accordance with IEC 60664‑3 with the following modifications: | |  |
| 5.7 | Conditioning of the test specimens | |  |
|  | When production samples are used, three samples of the printed circuit board are tested |  |  |
| 5.7.1 | Cold | |  |
|  | The test is carried out at -25 °C |  |  |
| 5.7.3 | Rapid change of temperature | |  |
|  | Severity 1 is specified |  |  |
| 5.9 | Additional tests | |  |
|  | This subclause is not applicable |  |  |
| **K** | **ANNEX K - OVERVOLTAGE CATEGORIES** | |  |
|  | The information on overvoltage categories is extracted from IEC 60664‑1 |  |  |
|  | Overvoltage category is a numeral defining a transient overvoltage condition |  |  |
|  | Equipment of overvoltage category IV is for use at the origin of the installation |  |  |
|  | Equipment of overvoltage category III is equipment in fixed installations and for cases where the reliability and the availability of the equipment is subject to special requirements |  |  |
|  | Equipment of overvoltage category II is energy consuming equipment to be supplied from the fixed installation |  |  |
|  | If such equipment is subjected to special requirements with regard to reliability and availability, overvoltage category III applies |  |  |
|  | Equipment of overvoltage category I is equipment for connection to circuits in which measures are taken to limit transient overvoltages to an appropriate low level |  |  |
| **M** | **ANNEX M - POLLUTION DEGREE** | |  |
|  | The information on pollution degrees is extracted from IEC 60664‑1 |  |  |
|  | Pollution | |  |
|  | The microenvironment determines the effect of pollution on the insulation, taking into account the macroenvironment |  |  |
|  | Means may be provided to reduce pollution at the insulation by effective enclosures or similar |  |  |
|  | Minimum clearances specified where pollution may be present in the microenvironment |  |  |
|  | Degrees of pollution in the microenvironment | |  |
|  | For evaluating creepage distances, the following degrees of pollution in the microenvironment are established: | |  |
|  | - pollution degree 1: no pollution or only dry, non‑conductive pollution occurs. The pollution has no influence |  |  |
|  | - pollution degree 2: only non‑conductive pollution occurs, except that occasionally a temporary conductivity caused by condensation is to be expected |  |  |
|  | - pollution degree 3: conductive pollution occurs or dry non‑conductive pollution occurs that becomes conductive due to condensation that is to be expected |  |  |
|  | - pollution degree 4: the pollution generates persistent conductivity caused by conductive dust or by rain or snow |  |  |
| **N** | **ANNEX N - PROOF TRACKING TEST** | |  |
|  | The proof tracking test is carried out in accordance with IEC 60112 with the following modifications: | |  |
| 7 | Test apparatus | |  |
| 7.3 | Test solutions | |  |
|  | Test solution A is used |  |  |
| 10 | Determination of proof tracking index (PTI) | |  |
| 10.1 | Procedure | |  |
|  | The proof voltage is 100 V, 175 V, 400 V or 600 V : |  |  |
|  | The test is carried out on five specimens |  |  |
|  | In case of doubt, additional test with proof voltage reduced by 25 V, the number of drops increased to 100 |  |  |
| 10.2 | Report | |  |
|  | The report states if the PTI value was based on a test using 100 drops with a test voltage of (PTI-25) V |  |  |
| **R** | **ANNEX R - SOFTWARE EVALUATION** | |  |
|  | Programmable electronic circuits requiring software incorporating measures to control the fault/error conditions specified in table R.1 or R.2 validated in accordance with the requirements of this annex |  |  |
| R.1 | Programmable electronic circuits using software | |  |
|  | Programmable electronic circuits requiring software incorporating measures to control the fault/error conditions specified in table R.1 or R.2 constructed so that the software does not impair compliance with the requirements of this standard |  |  |
| R.2 | Requirements for the architecture | |  |
|  | Programmable electronic circuits requiring software incorporating measures to control the fault/error conditions specified in table R.1 or R.2 use measures to control and avoid software‑related faults/errors in safety‑related data and safety‑related segments of the software |  |  |
| R.2.1.1 | Programmable electronic circuits requiring software incorporating measures to control the fault/error conditions specified in table R.2 have one of the following structures: | |  |
|  | - single channel with periodic self‑test and monitoring |  |  |
|  | - dual channel (homogenous) with comparison |  |  |
|  | - dual channel (diverse) with comparison |  |  |
|  | Programmable electronic circuits requiring software incorporating measures to control the fault/error conditions specified in table R.1 have one of the following structures: | |  |
|  | - single channel with functional test |  |  |
|  | - single channel with periodic self‑test |  |  |
|  | - dual channel without comparison |  |  |
| R.2.2 | Measures to control faults/errors | |  |
| R.2.2.1 | When redundant memory with comparison is provided on two areas of the same component, the data in one area is stored in a different format from that in the other area |  |  |
| R.2.2.2 | Programmable electronic circuits with functions requiring software incorporating measures to control the fault/error conditions specified in table R.2 and that use dual channel structures with comparison, have additional fault/error detection means for any fault/errors not detected by the comparison |  |  |
| R.2.2.3 | For programmable electronic circuits with functions requiring software incorporating measures to control the fault/error conditions specified in table R.1 or R.2, means are provided for the recognition and control of errors in transmissions to external safety‑related data paths |  |  |
| R.2.2.4 | For programmable electronic circuits with functions requiring software incorporating measures to control the fault/error conditions specified in table R.1 or R.2, the programmable electronic circuits incorporate measures to address the fault/errors in safety‑related segments and data indicated in table R.1 and R.2 as appropriate |  |  |
| R.2.2.5 | For programmable electronic circuits with functions requiring software incorporating measures to control the fault/error conditions specified in table R.1 or R.2, detection of a fault/error occur before compliance with clause 19 is impaired |  |  |
| R.2.2.6 | The software is referenced to relevant parts of the operating sequence and the associated hardware functions |  |  |
| R.2.2.7 | Labels used for memory locations are unique |  |  |
| R.2.2.8 | The software is protected from user alteration of safety‑related segments and data |  |  |
| R.2.2.9 | Software and safety‑related hardware under its control is initialized and terminates before compliance with clause 19 is impaired |  |  |
| R.3 | Measures to avoid errors | |  |
| R.3.1 | General | |  |
|  | For programmable electronic circuits with functions requiring software incorporating measures to control the fault/error conditions specified in table R.1 or R.2, the following measures to avoid systematic fault in the software are applied | |  |
|  | Software that incorporates measures used to control the fault/error conditions specified in table R.2 is inherently acceptable for software required to control the fault/error conditions specified in table R.1 |  |  |
| R.3.2 | Specification | |  |
| R.3.2.1 | Software safety requirements: | Software Id: |  |
|  | The specification of the software safety requirements includes the descriptions listed |  |  |
| R.3.2.2 | Software architecture | |  |
| R.3.2.2.1 | The specification of the software architecture includes the aspects listed  - techniques and measures to control software faults/errors (refer to R.2.2);  - interactions between hardware and software;  - partitioning into modules and their allocation to the specified safety functions;  - hierarchy and call structure of the modules (control flow);  - interrupt handling;  - data flow and restrictions on data access;  - architecture and storage of data;  - time‑based dependencies of sequences and data | Document ref. No: |  |
| R.3.2.2.2 | The architecture specification is validated against the specification of the software safety requirements by static analysis |  |  |
| R.3.2.3 | Module design and coding | |  |
| R.3.2.3.1 | Based on the architecture design, software is suitably refined into modules |  |  |
|  | Software module design and coding is implemented in a way that is traceable to the software architecture and requirements |  |  |
| R.3.2.3.2 | Software code is structured |  |  |
| R.3.2.3.3 | Coded software is validated against the module specification by static analysis |  |  |
|  | The module specification is validated against the architecture specification by static analysis |  |  |
| R.3.3.3 | Software validation | |  |
|  | The software is validated with reference to the requirements of the software safety requirements specification |  |  |
|  | Compliance is checked by simulation of: | |  |
|  | - input signals present during normal operation |  |  |
|  | - anticipated occurrences |  |  |
|  | - undesired conditions requiring system action |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **TABLE R.1** e **– GENERAL FAULT/ERROR CONDITIONS** | | | | | | |
| Component a | Fault/error | Acceptable measures b, c | Definitions | Document reference for applied measure | Document reference for applied test | Ver‑dict |
| 1 CPU  1.1 Registers | Stuck at | Functional test, or  periodic self‑test using either:   * static memory test, or * word protection with single bit redundancy | H.2.16.5  H.2.16.6  H.2.19.6  H.2.19.8.2 |  |  |  |
| 1.2 VOID |  |  |  |  |  |  |
| 1.3 Programme counter | Stuck at | Functional test, or  Periodic self‑test, or  Independent time‑slot monitoring, or  Logical monitoring of the programme sequence | H.2.16.5  H.2.16.6  H.2.18.10.4  H.2.18.10.2 |  |  |  |
| 2 Interrupt handling and execution | No interrupt or too frequent interrupt | Functional test, or  time‑slot monitoring | H.2.16.5  H.2.18.10.4 |  |  |  |
| 3 Clock | Wrong frequency (for quartz synchronized clock: harmonics/ sub‑harmonics only) | Frequency monitoring, or  time slot monitoring | H.2.18.10.1  H.2.18.10.4 |  |  |  |
| 4. Memory  4.1 Invariable memory | All single bit faults | Periodic modified checksum, or  multiple checksum, or  word protection with single bit redundancy | H.2.19.3.1  H.2.19.3.2  H.2.19.8.2 |  |  |  |
| 4.2 Variable memory | DC fault | Periodic static memory test, or  word protection with single bit redundancy | H.2.19.6  H.2.19.8.2 |  |  |  |
| 4.3 Addressing (relevant to variable and invariable memory) | Stuck at | Word protection with single bit redundancy including the address | H.2.19.8.2 |  |  |  |
| 5 Internal data path | Stuck at | Word protection with single bit redundancy | H.2.19.8.2 |  |  |  |
| 5.1 VOID |  |  |  |  |  |  |
| 5.2 Addressing | Wrong address | Word protection with single bit redundancy including the address | H.2.19.8.2 |  |  |  |
| 6 External communication | Hamming distance 3 | Word protection with multi‑bit redundancy, or  CRC – single work, or  Transfer redundancy, or  Protocol test | H.2.19.8.1  H.2.19.4.1  H.2.18.2.2  H.2.18.14 |  |  |  |
| 6.1 VOID |  |  |  |  |  |  |
| 6.2 VOID |  |  |  |  |  |  |
| 6.3 Timing | Wrong point in time  Wrong sequence | Time‑slot monitoring, or  scheduled transmission  Time‑slot and logical monitoring, or  comparison of redundant communication channels by either:   * reciprocal comparison * independent hardware comparator   Logical monitoring, or  time‑slot monitoring, or  Scheduled transmission | H.2.18.10.4  H.2.18.18  H.2.18.10.3    H.2.18.15  H.2.18.3  H.2.18.10.2  H.2.18.10.4  H.2.18.18 |  |  |  |
| 7 Input/output periphery | Fault conditions specified in 19.11.2 | Plausibility check | H.2.18.13 |  |  |  |
| 7.1 VOID |  |  |  |  |  |  |
| 7.2 Analog I/O  7.2.1 A/D and D/A-converter | Fault conditions specified in 19.11.2 | Plausibility check | H.2.18.13 |  |  |  |
| 7.2.2 Analog multiplexer | Wrong addressing | Plausibility check | H.2.18.13 |  |  |  |
| 8 VOID |  |  |  |  |  |  |
| 9 Custom chips d e.g. ASIC, GAL, gate array | Any output outside the static and dynamic functional specification | Periodic self‑test | H.2.16.6 |  |  |  |
| NOTE A Stuck‑at fault model denotes a fault model representing an open circuit or a non‑varying signal level. A DC fault model denotes a stuck‑at fault model incorporating short circuit between signal lines. | | | | | | |
| a) For fault/error assessment, some components are divided into their sub‑functions. b) For each sub‑function in the table, the Table R.2 measure will cover the software fault/error. c) Where more than one measure is given for a sub‑function, these are alternatives. d) To be divided as necessary by the manufacturer into sub‑functions. e) Table R.1 is applied according to the requirements of R.1 to R.2.2.9 inclusive. | | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| **S** | **ANNEX S - BATTERY OPERATED APPLIANCES POWERED BY BATTERIES THAT ARE NON-RECHARGEABLE OR NOT RECHARGED IN THE APPLIANCE** | |  |
|  | The following modifications to this standard are applicable for battery‑operated appliances where the batteries are either non‑rechargeable (primary batteries), or |  |  |
|  | rechargeable batteries (secondary batteries) that are not recharged in the appliance |  |  |
| 5.8.1 | If the supply terminals for the connection of the battery have no indication of polarity, the more unfavourable polarity is applied |  |  |
| 5.S.101 | Appliances intended for use with a battery box are tested with the battery box supplied with the appliance or with the battery box recommended in the instructions |  |  |
| 5.S.102 | Appliances are tested as motor‑operated appliances. |  |  |
| 7.1 | Appliances marked with the battery voltage (V) and the polarity of the terminals, unless : |  |  |
|  | the polarity is irrelevant |  |  |
|  | Appliances also marked with: | |  |
|  | - name, trade mark or identification mark of the manufacturer or responsible vendor : |  |  |
|  | - model or type reference : |  |  |
|  | - IP number according to degree of protection against ingress of water, other than IPX0 : |  |  |
|  | - type reference of battery or batteries : |  |  |
|  | If relevant, the positive terminal is indicated by the symbol IEC 60417‑5005 and the negative terminal by the symbol IEC 60417‑5006 |  |  |
|  | If appliances use more than one battery, they are marked to indicate correct polarity connection of the batteries |  |  |
| 7.6 | Additional symbols |  |  |
| 7.12 | The instructions contain the following, as applicable: | |  |
|  | - the types of batteries that may be used : |  |  |
|  | - how to remove and insert the batteries |  |  |
|  | - non‑rechargeable batteries are not to be recharged |  |  |
|  | - rechargeable batteries are to be removed from the appliance before being charged |  |  |
|  | - different types of batteries or new and used batteries are not to be mixed |  |  |
|  | - batteries are to be inserted with the correct polarity |  |  |
|  | - exhausted batteries are to be removed from the appliance and safely disposed of |  |  |
|  | - if the appliance is to be stored unused for a long period, the batteries are removed |  |  |
|  | - the supply terminals are not to be short‑circuited |  |  |
| 11.5 | Appliances are supplied with the most unfavourable supply voltage between | |  |
|  | - 0,55 and 1,0 times the battery voltage, if the appliance can be used with non‑rechargeable batteries |  |  |
|  | - 0,75 and 1,0 times battery voltage, if the appliance is designed for use with rechargeable batteries only |  |  |
|  | The values specified in Table S.101 for the internal resistance per cell of the battery is taken into account |  |  |
| 19.1 | The tests are carried out with the battery fully charged unless otherwise specified |  |  |
| 19.13 | The battery does not rupture or ignite |  |  |
| 19.S.101 | Appliances are supplied with the voltage specified in 11.5. The supply terminals having an indication of polarity are connected to the opposite polarity, unless |  |  |
|  | such a connection is unlikely to occur due to the construction of the appliance |  |  |
| 19.S.102 | For appliances with provision for multiple batteries, one or more of the batteries are reversed and the appliance is operated, if reversal of batteries is allowed by the construction |  |  |
| 25.5 | The flexible leads or flexible cord used to connect an external battery or battery box in is connected to the appliance by a type X attachment |  |  |
| 25.13 | This requirement is not applicable to the flexible leads or flexible cord connecting external batteries or a battery box with an appliance |  |  |
| 25.S.101 | Appliances have suitable means for connection of the battery. If the type of battery is marked on the appliance, the means of connection is suitable for this type of battery |  |  |
| 26.5 | Terminal devices in an appliance for the connection of the flexible leads or flexible cord connecting an external battery or battery box are so located or shielded that there is no risk of accidental connection between supply terminals |  |  |
| 30.2.3.2 | There is no battery in the area of the vertical cylinder used for the consequential needle flame test, unless |  |  |
|  | the battery is shielded by a barrier that meets the needle flame test of annex E, or |  |  |
|  | that comprises material classified as V‑0 or V‑1 according to IEC 60695‑11‑10 |  |  |
| **T** | **ANNEX T - UV-C RADIATION EFFECT ON NON-METALLIC MATERIALS** | |  |
|  | Requirements for non‑metallic materials subject to direct or reflected UV-C radiation exposure and whose mechanical and electrical properties are relied upon for compliance with the |  |  |
|  | Does not apply to glass, ceramic and similar materials |  |  |
|  | Tested as specified in ISO 4892‑1 and ISO 4892‑2, with the following modifications: | |  |
|  | Modifications to ISO 4892‑1: | |  |
| 5.1.6 | The UV-C emitter is a low pressure mercury lamp with a quartz envelope having a continuous spectral irradiance of 10 W/m2 at 254 nm |  |  |
|  | Subclause 5.1.6.1 and Table 1 are not applicable |  |  |
| 5.2.4 | The black‑panel temperature be 63 °C +/- 3 °C |  |  |
| 5.3.1 | Humidification of the chamber air is specified in part 2 when necessary |  |  |
| 9 | This clause is not applicable |  |  |
|  | Modifications to ISO 4892‑2: | |  |
| 7.1 | At least three test specimens are tested |  |  |
|  | Ten samples of internal wiring is tested |  |  |
| 7.2 | The specimens are attached to the specimen holders such that they are not subject to any stress |  |  |
| 7.3 | Apparatus prepared as specified |  |  |
|  | The test specimens and, if used, the irradiance‑measuring instrument are exposed for 1 000 h |  |  |
| 7.4 | If used, a radiometer is mounted and calibrated such that it measures the irradiance at the exposed surface of the test specimen |  |  |
| 7.5 | Material properties and test methods for parts providing mechanical support or impact resistance as specified in Table T.1 |  |  |
|  | Material properties and test method for electrical insulation of internal wiring as specified in Table T.2 |  |  |
| 8 | This clause is not applicable |  |  |
| **DD** | **ANNEX DD - REQUIREMENTS FOR INSTALLATION, service, maintenance and repair, and decommissioning MANUALS OF APPLIANCES USING FLAMMABLE REFRIGERANTS** | |  |
| **DD.1** | **General** | |  |
|  | Each manual include requirements of clauses according to Table DD.1. Different manuals can be combined into one manual. |  |  |
|  | Numerical values needed for proper installation, service, maintenance, and repair, and decommissioning in the form of a single figure or a table without reference to a formula. |  |  |
|  | For factory sealed single package units, the installation manual does not need to include material from DD.4.8 and Clause DD.9. |  |  |
| **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 specified in the manual where the information is needed for the function of the manual and as applicable to the appliance: | |  |
|  | 1) information for spaces where field-installed refrigerant pipes are allowed, including statements | |  |
|  | a) that the installation of pipe-work shall be kept to a minimum; |  |  |
|  | b) that pipe-work securely mounted and guarded from physical damage; |  |  |
|  | c) that pipe-work not be installed in an unventilated space, if that space is smaller than Amin in Annex GG, except for A2L refrigerants where installed pipe-work has no connecting joints or is connected with at least one of the following: | |  |
|  | i) joints in compliance with ISO 14903, |  |  |
|  | ii) joints in enclosures which vent to the unit or to the outside, |  |  |
|  | iii) joints in enclosures which vent to a room with a room area of at least Amin as specified in GG.2.1; |  |  |
|  | d) that compliance with national gas regulations observed; |  |  |
|  | e) that mechanical connections made in accordance with 22.118 accessible for maintenance purposes; |  |  |
|  | 2) where addition of charge is required to complete installation, instructions on 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. Interconnecting refrigerant piping length and diameter taken into consideration; |  |  |
|  | 3) where safety shut-off valves are installed, instructions on how to determine the releasable charge, mrl. Safety shut-off valve location and refrigerant piping volume between safety shut-off valve and the indoor unit taken into consideration; |  |  |
|  | 4) detailed instructions on how to correctly install the appliance including piping and safety shut-off valves for every space in which refrigerant can leak into, where applicable. |  |  |
|  | a) minimum room area, Amin, or minimum room area of conditioned space TAmin, as a function of the refrigerant charge, mc, or as a function of the releasable charge, mrl. If the releasable charge, mrl, has been used, a warning that the minimum room area or minimum room area of conditioned space is based on releasable charge and is not related to total system refrigerant charge; |  |  |
|  | b) refrigerant charge, mc, and, if the releasable charge, mrl, has been determined, the releasable charge, mrl. The effect on refrigerant charge shall be considered from field-installed piping, field charging, or both, if applicable; |  |  |
|  | c) required installed height, hinst; |  |  |
|  | d) minimum ventilation airflow volume Qmin; |  |  |
|  | e) minimum opening area for natural ventilation Anv,min |  |  |
|  | Additional minimum room area data may be provided based on other installed heights and/or charge levels; | |  |
|  | 5) information for handling, installation, cleaning, servicing and disposal; |  |  |
|  | 6) for appliances intended for use at altitudes 2 000 m and above, the instructions shall include how to adjust minimum room area, Amin, and minimum room area of conditioned space, TAmin, as applicable from Annex GG, based on the building site ground level altitude; |  |  |
|  | 7) a warning to keep any required ventilation openings clear of obstruction |  |  |
|  | 8) a notice that servicing performed only as recommended by the manufacturer; |  |  |
|  | 9) a warning that ducts connected to an appliance not contain a potential ignition source; |  |  |
|  | 10) 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; |  |  |
|  | 11) for mechanical ventilation as specified in GG.8.3 or for enhanced tightness refrigerating systems GG.11.3, information on installation of the mechanical ventilation air extracted and air intake openings per GG.8.3.3 or for enhanced tightness refrigerating systems GG.11.3.3; |  |  |
|  | 12) for appliances relying on safety measures according to GG.8.3 or for enhanced tightness refrigerating systems GG.11.3, instructions for wiring to mechanical ventilation; |  |  |
|  | 13) for appliances using a remote located refrigerant sensor, how and where to install and connect the refrigerant sensor in compli |  |  |
|  | 14) when a remote located refrigerant sensor is specified by the manufacturer, the instructions state the recommended periodic service and maintenance procedures; |  |  |
|  | 15) when a limited life refrigerant sensor is employed, the life of the refrigerant sensor and instruction on how to replace it; |  |  |
|  | 16) for appliances using A2L refrigerants, connected via an air duct system to one or more rooms, the supply and return air directly ducted to the space. Open areas such as false ceilings not be used as a return air duct; |  |  |
|  | 17) a warning that precautions taken to avoid excessive vibration or pulsation to refrigerating piping; |  |  |
|  | 18) a warning that 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; |  |  |
|  | 19) a warning that provision made for expansion and contraction of long runs of piping; |  |  |
|  | 20) a warning that piping in refrigerating systems so designed and installed as to minimize the likelihood of hydraulic shock damaging the system; |  |  |
|  | 21) a warning that solenoid valves correctly positioned in the piping to avoid hydraulic shock and not block in liquid refrigerant unless adequate relief is provided; |  |  |
|  | 22) a warning that steel pipes and components protected against corrosion with a rustproof coating before applying any insulation; |  |  |
|  | 23) where field installed safety shut-off valves are specified for refrigerating systems, a warning that only safety shut-off valves specified by the appliance manufacturer used; |  |  |
|  | 24) where safety shut-off valves are to be field installed, information on where and how the safety shut-off valves shall be installed; |  |  |
|  | 25) information that safety shut-off valves only be replaced with valves specified by the appliance manufacturer; |  |  |
|  | 26) field-made refrigerant joints indoors shall be tightness tested. The test method 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 detected; |  |  |
|  | 27) where remote refrigerant detection systems are specified, a warning that only refrigerant sensors specified by the appliance manufacturer used; |  |  |
|  | 28) information that the refrigerant detection system refrigerant sensorsl only be replaced with refrigerant sensors specified by the appliance manufacturer; |  |  |
|  | 29) for appliances with a leak detection system, safety shut-off valves not be reset until the room has been ventilated, because resetting can result in additional flammable refrigerant released into the space; |  |  |
|  | 30) electrical components that can arc or spark, which are not considered ignition sources due to compliance with 22.116.1 points b), c), d), or f) only be replaced with parts specified by the appliance manufacturer. Replacement with other parts may result in the ignition of refrigerant in the event of a leak; |  |  |
|  | 31) Where openings according to GG.1.4 are applied, information that these openings not be blocked. |  |  |
| **DD.3.2** | **Unventilated areas** | |  |
|  | For appliances containing more than m1 for any refrigerating circuit, the manual shall include a statement advising that an unventilated area where the appliance is installed so constructed that should any refrigerant leak, it will not stagnate so as to create a fire or explosion hazard. This shall include: |  |  |
|  | - for appliances which are not fixed appliances, a warning that the appliance stored in an well-ventilated area where the room size corresponds to the room area as specified for operation; |  |  |
|  | - for appliances which are not fixed appliances, a warning that the appliance 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 connected via an air duct system to one or more rooms are installed in a room with an area less than Amin as determined in Clause GG.2, that 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 flame-producing device may be installed in the same space if the device is provided with an effective flame arrest; |  |  |
|  | - for appliances 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”; |  |  |
|  | - for appliances 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 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. |  |  |
|  | The manufacturer should specify other potential continuously operating sources known to cause ignition of the refrigerant used. |  |  |
| **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. |  |  |
|  | 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 CO2 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 use any sources of ignition in such a manner that it can 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 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 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. |  |  |
| **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 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** | |  |
|  | Sealed electrical components not be repaired |  |  |
| **DD.6** | **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.7** | **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. |  |  |
|  | Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity can be inadequate, or can need re-calibration. |  |  |
|  | 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 avoided as the chlorine can react with the refrigerant and corrode the copper pipe-work. |  |  |
|  | 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 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.8. |  |  |
| **DD.8** | **Removal and evacuation** | |  |
|  | When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures used. |  |  |
|  | However, for flammable refrigerants it is important that best practice is followed since flammability is a consideration. |  |  |
|  | The following procedure adhered to: | |  |
|  | -safely remove refrigerant following local and national regulations |  |  |
|  | -evacuate; |  |  |
|  | -purge the circuit with inert gas |  |  |
|  | -evacuate (optional for A2L); |  |  |
|  | -continuously flush with inert gas when using flame to open circuit; |  |  |
|  | -open the circuit |  |  |
|  | The refrigerant charge recovered into the correct recovery cylinders. |  |  |
|  | The manufacturer specify the inert gases that can be used. Compressed air or oxygen not be used for purging refrigerant systems. |  |  |
|  | Purging of the refrigerant circuit achieved by breaking the vacuum in the system with inert gas 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. |  |  |
|  | This process repeated until no refrigerant is within the system. |  |  |
|  | The system vented down to atmospheric pressure to enable work to take place |  |  |
|  | Ensure that the outlet of the vacuum pump is not close to any potential ignition sources and that ventilation is available. |  |  |
| **DD.9** | **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.10** | **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 not be charged into another refrigerating system unless it has been cleaned and checked. |  |  |
| **DD.11** | **Labelling** | |  |
|  | Equipment 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.12** | **Recovery** |  |  |
|  | When removing refrigerant from a system, either for servicing or decommissioning, it is required to follow 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 in good working order with a set of instructions concerning the equipment that is at hand and suitable for the recovery of the flammable refrigerant. Consult manufacturer if in doubt. In addition, a set of calibrated weighing scales available and in good working order. Hoses complete with leak-free disconnect couplings and in good condition |  |  |
|  | The recovered refrigerant processed according to local legislation 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 compressor body not be heated by an open flame or other ignition sources to accelerate this process |  |  |
|  | Draining of oil from a system, it carried out safely. |  |  |
| **EE** | **ANNEX EE - PRESSURE TESTS** | |  |
| **EE.1** | **General** | |  |
|  | All refrigerating system parts shall withstand the maximum pressure in normal operation, abnormal operation, and standstill. |  |  |
|  | The maximum allowable pressure marked on the system not less than the maximum pressure developed during operation under Clause 11, under Clause 19 and during standstill, see Clause EE.2. |  |  |
|  | A compressor tested and found to comply with IEC 60335-2-34 need not be additionally tested. |  |  |
| **EE.2** | **Determination of standstill pressure** | |  |
|  | 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 can be exposed to a higher pressure under the condition of standstill than under normal operation. |  |  |
| **EE.3** | The test pressure at least three times the marked maximum allowable pressure. |  |  |
| **EE.4** | **Fatigue test** | |  |
|  | The components 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. |  |  |
|  | Three samples of each refrigerant-containing part shall be tested. The total number of cycles 250 000. |  |  |
|  | The test samples 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. |  |  |
|  | 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 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 evaluated by conducting the test at the higher temperatures and considering the material characteristics at the higher temperatures. |  |  |
|  | The pressure for the test cycles as follows: | |  |
|  | a) For components subject to high side pressures, the upper pressure value not be less than the saturated vapour pressure of the refrigerant at 50 °C and the lower pressure value not be greater than the saturated vapour pressure of the refrigerant at 5 °C. For sanitary hot water heat pumps, the upper pressure not be less than 80 % of the marked maximum allowable pressure under the conditions of Clause 11. |  |  |
|  | b) For components subjected to only low side pressures, the upper pressure value 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. |  |  |
|  | For the final test cycle, the test pressure to two times the pressure determined in a) or b). |  |  |
| **FF** | **ANNEX FF - LEAK SIMULATION TESTS** | |  |
| **FF.1** | **General** | |  |
|  | A leakage of refrigerant is simulated in the refrigerating system at the potential leak points. |  |  |
|  | The method to simulate a leakage at the potential leak points is to inject refrigerant vapour through a suitable capillary tube at that point |  |  |
|  | Where LFL is referenced in this annex, the LFL shall be taken at the nominal composition as specified in Annex BB. |  |  |
|  | Piping are not considered to be potential leak points within the area of the appliance to be evaluated if they comply with all of the following | |  |
|  | – are protected from potential damage during normal operation, service and maintenance; |  |  |
|  | – have no connecting joints; |  |  |
|  | – have no bends with centreline bend radius less than 2,5 times the external pipe diameter |  |  |
| **FF.2** | **Test methods** | |  |
| **FF.2.1** | The appliance is modified by introducing a simulated leak through a capillary tube. |  |  |
|  | The quantity of refrigerant leaked, mFF, is equal to smallest of: | |  |
|  | – the refrigerant charge, mc; |  |  |
|  | – the releasable charge, mrl, as determined by Annex QQ; |  |  |
|  | – for parts of enhanced tightness refrigerating systems which can leak into an indoor space using A2L refrigerant, 10 kg; |  |  |
|  | – for parts of enhanced tightness refrigerating systems which can leak into an indoor space using A2 or A3, the amount that will leak during 1 hour with the leak rate ṁleak of GG.14.3. |  |  |
|  | The leak rate shall be maintained at 25 % ± 5 % of the refrigerant leaked, mFF, per minute |  |  |
|  | For parts of enhanced tightness refrigerating systems which can leak into an indoor space, the leak rate maintained at 10 kg per hour for A2L refrigerants or the leak rate ṁleak of GG.14.3 for A2 and A3 refrigerants. |  |  |
|  | The leak maintained until the quantity of refrigerant leaked, mFF, has leaked |  |  |
|  | The refrigerant is injected at the most unfavourable potential leak point and the most unfavourable direction at ambient temperature (15 °C to 35 °C). |  |  |
| **FF.2.2** | During this test, the appliance is switched off or operated under normal operation at rated voltage |  |  |
|  | If airflow is activated before any potential ignition sources are activated, then the test is not conducted with the appliance switched off. |  |  |
|  | During a test where the appliance is operating, refrigerant gas injection is started at the same time as the appliance is switched on |  |  |
|  | In "switched off" mode, the appliance remain connected to the mains and safety mitigation controls, such as refrigerant detection system and circulation airflow or safety shut-off valves, shall be allowed to function as intended |  |  |
| **FF.2.3** | For refrigerant blends, the test carried out using the nominal composition as defined in Annex BB. |  |  |
| **FF.2.4** | The test is conducted in a room that is draught-free and of sufficient size to conduct the test. |  |  |
|  | The minimum volume (V) is: V = (15 x mc)/LFL |  |  |
|  | Care 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 t(90) response time of faster than 30 seconds and 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 any component that can be an ignition source 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. |  |  |
| **GG** | **ANNEX GG - 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 refrigerant charge (M) (mc) used in the appliance, |  |  |
|  | – the releasable charge (mrl), |  |  |
|  | - the installation location, |  |  |
|  | - the type of ventilation of the location or of the appliance. |  |  |
|  | For appliances with multiple refrigerating systems, each refrigerating system shall be evaluated independently |  |  |
|  | Where multiple values of Amin are found based on different operating states, the highest value Amin for the appliance |  |  |
|  | 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 specified in Annex BB. |  |  |
|  | Toxicity charge limits determined per ISO 5149-1:2014, ISO 5149-1:2014/AMD1:2015, and ISO 5149-1:2014/AMD2:2021. If the toxicity-based charge limits are less than the flammability based charge limits, the toxicity charge limits take precedence. |  |  |
|  | For appliances with a refrigerant charge of mc ≤ m1, no minimum room area is required and Clause GG.6 does not apply. |  |  |
|  | For appliances where leaked refrigerant does not enter the indoor space, no minimum room area is required. |  |  |
|  | If releasable charge is determined by Annex QQ: | |  |
|  | – for releasable charge mrl ≤ m1, there is no requirement for minimum room area, Amin, and Clause GG.6 does not apply |  |  |
|  | – for releasable charge mrl > m1, each operating state of the refrigerating system comply with at least one of the clauses: GG.2, GG.3, GG.4, GG.7, GG.9, and GG.14. The refrigerant charge mc may be replaced by the releasable charge mrl in the formulae of Annex GG. |  |  |
| **GG.1.2** | **Determination of the case applicable** | |  |
|  | Determination of the case applicable refrigerant capped quantity limit |  |  |
|  | For A2 and A3 refrigerants, m1, m2, m3 are defined as follows: | |  |
|  | m1 = 4 × LFL |  |  |
|  | m2 = 26 × LFL |  |  |
|  | m3 = 130 × LFL |  |  |
|  | where *LFL* is the lower flammability limit in kg/m3 for the refrigerant used. |  |  |
|  | For A2L refrigerants, m1, m2, m3 is defined as follows: |  |  |
|  | m1 = 6 × LFL |  |  |
|  | m2 = 52 × LFL |  |  |
|  | m3 = 260 × LFL |  |  |
|  | where LFL is the lower flammable limit in kg/m3 for the refrigerant used. |  |  |
| **GG.1.3** | **Determination of unventilated room area** | |  |
| **GG.1.3.1** | General | |  |
|  | For the purpose of determination of room area (A) when used to calculate the maximum allowable refrigerant charge (mmax) in an unventilated space, the following apply. |  |  |
|  | The room area (A) 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 not be considered a single space. |  |  |
| **GG.1.3.2** | Determination of unventilated room area for appliances using A2L refrigerant | |  |
|  | 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 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 Amin, 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 Amin, provided all of the following are met. |  |  |
|  | • The space have appropriate openings according to GG.1.4. |  |  |
|  | • The minimum opening area for natural ventilation, Anv,min, shall not be less than the following: |  |  |
| **GG.1.3.3** | Determination of unventilated room area for appliances using A2 and A3 refrigerant | |  |
|  | For determining compliance to Amin for fixed appliances with release height, h0, according to GG.2.1, not less than 1,6 m, rooms on the same floor and connected by an open passageway between the spaces can be considered a single room 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 determining compliance to Amin for fixed appliances and with release height, h0, according to GG.2.1, less than 1,6 m or fixed appliances with circulation airflow at any release height, h0, rooms on the same floor and connected by an open passageway between the spaces can be considered a single room with an area of the space that the refrigerant can leak directly into plus half of the area of the connected space, if all of the following is complied with: | |  |
|  | – the area of the space in which the unit is installed not be less than 20 % of Amin; |  |  |
|  | – the passageway is a permanent opening; |  |  |
|  | – the passageway extends to the floor; |  |  |
|  | – the passageway is intended for people to walk through. |  |  |
| **GG.1.4** | **Opening conditions for connected rooms and natural ventilation for appliances using A2L refrigerants** | |  |
|  | When the openings for connected rooms or natural ventilation are required, the following conditions shall be applied for the lower opening. |  |  |
|  | -The area of any openings above 300 mm from the floor shall not be considered in determining compliance with Anvmin. 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. |  |  |
|  | For openings extending to the floor, the height not be less than 20 mm above the surface of the floor covering. |  |  |
|  | 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 at least 1,5 m above the floor. |  |  |
|  | Openings shall be permanent openings which cannot be close |  |  |
| **GG.2** | **Requirements for charge limits in unventilated areas** | |  |
| **GG.2.1** | **General** | |  |
|  | Clause GG.2 is applicable for appliances with a refrigerant charge m1 < mc ≤ m2 and for factory sealed single package units which are not fixed appliances with a refrigerant charge of m1 < mc ≤ 2 × m1: |  |  |
|  | For factory sealed single package units which are not fixed appliances with a refrigerant charge of m1 < mc ≤ 2 × m1, the requirements of Clause GG.7 apply. |  |  |
|  | For systems using A2L refrigerants with a refrigerant charge of m1 < mc ≤ m3 that comply with the conditions in 22.125, the requirements of Clause GG.10 can apply. |  |  |
|  | For systems using A2 or A3 refrigerants with a refrigerant charge of m1 < mc ≤ m2 that comply with the conditions in 22.125, the requirements of Clause GG.14 can apply. |  |  |
|  | For other appliances with a refrigerant charge of m1 < mc ≤ m2: |  |  |
|  | The maximum refrigerant charge in a room shall be in accordance with the following: | |  |
|  | mmax = 2,5 × (LFL)(5/4) × h0 × (A)1/2, not to exceed mmax = CF × LFL × h0 × A (GG.8) |  |  |
|  | or the required minimum room area Amin to install an appliance with refrigerant charge mc (kg) shall be in accordance with following: |  |  |
|  | Amin = (mc / (2,5 × (LFL)(5/4) × h0)) 2, not less than Amin = mc / (CF × LFL × h0) (GG.9) |  |  |
|  | If the minimum installed height given by the manufacturer is higher than the reference installed height, then in addition Amin and mmax for the reference installed height given by the manufacturer. An appliance may have multiple reference installed heights. In this case, Amin and mmax 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 cm2, at the lowest position to the space, used for h0. However, h0 shall not be less than 0,6 m. Amin 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 can flow to, considering where the unit is located. Amin 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 Amin, no further measure is required. If any room area of spaces is below Amin, measures according to Clause GG.8 or GG.9 provided for appliances using A2L refrigerants. |  |  |
| **GG.2.2** | **Appliances using A2L refrigerants with circulation airflow** | |  |
| **GG.2.2.1** | **General** | |  |
|  | When the fan integrated into an appliance is continuously operated or operation is initiated by a leak 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 in accordance with mmax |  |  |
|  | or the required minimum room area Amin of installed appliance with refrigerant charge mc(kg) in accordance with Amin |  |  |
|  | Operation of circulation airflow comply with either GG.2.2.2 or GG.2.2.3. |  |  |
| **G.2.2.2** | **Continuous circulation airflow** | |  |
|  | The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be monitored continuously. Within 10 s in the event that the airflow is reduced below Qmin, the following actions taken: | |  |
|  | – warn user that airflow is reduced; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.2.2.3** | **Circulation airflow activated by a detection system** | |  |
|  | If a leak detection system is activated, the following actions shall be taken and continue for at least 5 min after the detection system has reset: |  |  |
|  | – energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Qmin; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.2.3** | **Fixed appliances using A2/A3 refrigerants with integral circulation airflow** | |  |
| **GG.2.3.1** | **General** | |  |
|  | When the fan integrated into an appliance is continuously operated or operation is initiated by a leak detection system with sufficient airflow rate, the maximum refrigerant charge can be increased or minimum room area can be reduced according to following.  mmax = CF × LFL × A × 2,2  Amin = mc/(CF × LFL × 2,2) |  |  |
|  | The fan integrated into an appliance shall have a minimum circulation airflow according to Qmin | |  |
|  | Operation of circulation airflow comply with either GG.2.3.2 or GG.2.3.3. |  |  |
| **GG.2.3.2** | **Continuous circulation airflow** | |  |
|  | The indoor fan shall run continuously, other than for short periods for maintenance and service. The airflow monitored continuously. Within 10 seconds in the event that the airflow is reduced below Qmin, the following actions taken | |  |
|  | – warn user that airflow is reduced; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.2.3.3** | **Circulation airflow activated by a leak detection system** | |  |
|  | If a leak detection system is activated, the following actions shall be taken and continued for at least 5 min after the leak detection system has reset: | |  |
|  | – energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Qmin; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.3** | **Requirements for charge limits in areas with mechanical ventilation** | |  |
|  | 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 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 allow flow from inside the enclosure to the room. |  |  |
|  | The appliance enclosure have a ventilation system that produces airflow from the appliance interior to the outside through an exhaust ventilation shaft duct. |  |  |
|  | The manufacturer specify the exhaust ventilation duct dimensions, the maximum length and number of bends. |  |  |
|  | The negative pressure measurement in the interior of the appliance enclosure shall be 20 Pa or more and the flow rate to the exterior at least Qmin |  |  |
|  | For refrigerating systems which are not enhanced tightness refrigerating systems, the leak rate, ṁleak |  |  |
|  | For enhanced tightness refrigerating systems, the leak rate, ṁleak, determined as: | |  |
|  | – for A2L refrigerants ṁleak = 0,002 78 kg/s, |  |  |
|  | – for A2 and A3 refrigerants, the values of GG.14.3.1, Table GG.6 in kg/s |  |  |
|  | Ventilation shall be to the outside or to a room with a minimum volume as specified in Clause GG.2, Formula (GG.9). |  |  |
|  | The ventilation run continuously, other than for short periods for maintenance and service. The airflow monitored continuously. Within 10 seconds in the event that the airflow is reduced below Qmin, the following actions taken: | |  |
|  | – warn user that airflow is reduced; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released into the enclosure. Or |  |  |
|  | The ventilation is switched on by a leak detection system and the following actions taken and continued for at least 5 min after the leak detection system has reset: | |  |
|  | – energize the fan(s) of the appliance to deliver airflow at or above the minimum airflow Qmin; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the enclosure. |  |  |
| **GG.5** | **Requirements for mechanical ventilation for rooms complying with**  **ISO 5149** | |  |
|  | Machinery rooms shall meet the requirements of Clause 5 of ISO 5149-3:2014. |  |  |
| **GG.6** | **Requirements for refrigerating systems employing secondary heat exchangers** | |  |
|  | If a flammable refrigerant is used and the system contains a secondary heat exchanger, the heat exchanger not allow the release of refrigerant into areas served by the secondary heat exchanger fluid Compliance met by at least one of the following: | |  |
|  | - an open loop secondary system vented to 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 can 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) specifying requirements for specific properties of the secondary heat exchanger fluid to prevent corrosion, including: | |  |
|  | • water: the manufacturer specify in the installation manual the water quality necessary for the specified heat exchanger; |  |  |
|  | • brine: the manufacturer specify in the installation manual the type of brine and its permitted concentration range for which the heat exchanger is suitable. |  |  |
|  | 2) the use of a freezing protection device 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; |  |  |
| **GG.7** | **Factory sealed single package units with a refrigerant charge of *m*1** < ***m*c** ≤ **2** × ***m*1** | |  |
| **GG.7.1** | **Determination of refrigerant charge** | |  |
|  | For factory sealed single package units (i.e. one functional unit in one enclosure) with a refrigerant charge amount of m1 < M mc ≤ 2 × m1, the maximum refrigerant charge in a room in accordance with mmax |  |  |
|  | or the required minimum floor area, Amin, to install an appliance with refrigerant charge mc in accordance with Amin |  |  |
|  | When the appliance is switched on, a fan operate continuously supplying a minimum airflow as under normal steady state conditions, even when the compressor is switched off by the thermostat. |  |  |
| **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. |  |  |
| **GG.7.2.2** | **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. |  |  |
| **GG.7.2.3** | **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 Table GG.4 |  |  |
| **GG7.2.4** | **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. |  |  |
| **GG.7.3** | **Vibration test** | |  |
|  | Vibrations exceeding 0,30 G RMS, when measured with a low pass filter at 200 Hz, are not allowed in the refrigerant containing pipes under normal operation |  |  |
| **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 m1 < mc ≤ m3 |  |  |
|  | Ventilation provided when refrigerant charge is mc > mmax. |  |  |
|  | Natural and mechanical ventilation apply to fixed appliances only. |  |  |
| **GG.8.2** | **Natural ventilation requirements for appliances using A2L refrigerants** | |  |
| **GG.8.2.3** | **Natural ventilation to outdoors** | |  |
|  | If natural ventilation to outdoors is applied, all of the following shall be met. |  |  |
|  | - Natural ventilation to outdoors is not allowed below ground level. |  |  |
|  | – Natural ventilation from an occupied space shall not be made to outdoors. |  |  |
|  | - The openings for natural ventilation comply with GG.1.4. |  |  |
|  | – The maximum refrigerant charge of a system, mmax, and minimum opening area, Anv,min, for natural ventilation to outdoors shall be calculated |  |  |
| **GG.8.3** | **Mechanical ventilation requirements for rooms with appliances using A2L refrigerants** | |  |
| **GG.8.3.1** | **Operation of mechanical ventilation system** | |  |
| **GG.8.3.1.1** | **General** | |  |
|  | Mechanical ventilation in compliance with GG.8.3.1.2 or GG.8.3.1.3 provided. |  |  |
| **GG.8.3.1.2** | **Continuous operation of mechanical ventilation system** | |  |
|  | The mechanical ventilation system run continuously, other than for short periods for maintenance and service. The airflow monitored continuously. Within 10 s in the event that the airflow is reduced, below Qmin, the following actions taken: | |  |
|  | – warn user that airflow is reduced; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.8.3.1.3** | **Mechanical ventilation system activated by a leak detection system** | |  |
|  | If a leak detection system is activated, the following actions taken and continued for at least 5 min after the leak detection system has reset: | |  |
|  | – energize the mechanical ventilation system of the appliance to deliver indoor airflow at or above the minimum airflow Qmin; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **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 considered. |  |  |
| **G.8.3.3** | **Requirement for opening** | |  |
|  | For mechanical ventilation as specified in GG.8.3, the lower edge of openings extracting air from the room not be more than 100 mm above the floor. |  |  |
|  | The openings extracting air from the room positioned relative to the openings supplying air to the room such that the supplied makeup air mixes with the leaked refrigerant. |  |  |
|  | The openings exhausting air from the room positioned relative to the intake openings supplying air to the room to prevent re-circulation back to the room. |  |  |
| **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 < mc ≤ m3..The maximum refrigerant charge can be increased or the minimum room area can be reduced if the following requirements are met. |  |  |
|  | The appliances 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 not be used as a return air duct |  |  |
|  | Operation of circulation airflow comply with either GG.9.2 or GG.9.3. |  |  |
|  | mmax 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 can be limited by zoning dampers not be included in the determination of TA. |  |  |
| **GG.9.2** | **Continuous circulation airflow** | |  |
|  | The fan shall run continuously, other than for short periods for maintenance and service. The airflow monitored continuously. Within 10 s in the event that the airflow is reduced below Qmin, the following actions taken: | |  |
|  | - warn user that airflow is reduced. |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.9.3** | **Circulation airflow activated by a refrigerant detection system** | |  |
|  | If a leak detection system is activated, the following actions shall be taken and continued for at least 5 min after the leak detection system has reset: | |  |
|  | – energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Qmin; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space |  |  |
|  | – fully open all zoning dampers of the appliance and energize control signals to open any external zoning dampers if applicable; |  |  |
|  | – activate additional mechanical ventilation, if required by GG.8.3. |  |  |
| **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 m1 < mc ≤ m3 |  |  |
|  | 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 applicable measures to be taken shall be ventilation (natural or mechanical), safety shut-off valves and safety alarm, in conjunction with leak detection systems as specified in GG.10.2. |  |  |
|  | 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** | **Required measures for allowable refrigerant charge** | |  |
| **GG.10.2.1** | **General** |  |  |
|  | For appliances where the refrigerant charge does not exceed maximum refrigerant charge in GG.10.3.1, no additional measures are required. |  |  |
| **GG.10.2.2** | **Spaces except lowest underground floor of the building** | |  |
|  | For appliances with release height, h0, as determined in Clause GG.2, equal to or greater than 1,8 m or with integral circulation airflow (see GG.10.4), where the refrigerant charge does not exceed maximum refrigerant charge in GG.10.3.2, no additional measures are required. |  |  |
|  | For appliances without integral circulation airflow and having release height, h0, less than 1,8 m, where the refrigerant charge exceeds the maximum refrigerant charge in GG.10.3.1, but is less than or equal to the maximum refrigerant charge in GG.10.3.2, 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.10.3.2, a safety alarm shall be employed in accordance with Clause GG.13, and one additional measure taken in accordance with Clause GG.11 or GG.12. |  |  |
| **GG.10.2.3** | **Lowest underground floor of the building** | |  |
|  | For appliances without integral circulation airflow and having release height, h0, as determined in Clause GG.2, less than 1,8 m, where the refrigerant charge exceeds the maximum refrigerant charge in GG.10.3.1, but is less than or equal to the maximum refrigerant charge in GG.10.3.2, a safety alarm shall be employed in accordance with Clause GG.13, and one additional measure taken in accordance with Clause GG.11 or GG.12. |  |  |
|  | For appliances with release height, h0, equal to or greater than 1,8 m or with integral circulation airflow (see GG.10.4), where the refrigerant charge exceeds the maximum refrigerant charge in GG.10.3.1, but is less than or equal to the maximum refrigerant charge in GG.10.3.2, one additional measure taken in accordance with Clause GG.11, GG.12 or GG.13. |  |  |
|  | The refrigerant charge not exceed the maximum refrigerant charge in GG.10.53.2. |  |  |
| **GG.10.3** | **Maximum refrigerant charge** | |  |
| **GG.10.3.1** | **Maximum refrigerant charge limit A** | |  |
|  | The maximum refrigerant charge mmax in a room and the required minimum room area Amin of the installed appliance with refrigerant charge mc |  |  |
|  | The effective height, Hr, of the unit is determined as follows: | |  |
|  | – Where the release height, h0, as determined in Clause GG.2 is equal to or greater than 1,8 m or the appliance is with integral circulation airflow, the effective height, Hr, is the room height in m but not more than 2,2 m unless h0 is higher than 2,2 m. |  |  |
|  | – In all other cases, the effective height, Hr, is the release height, h0, as determined in Clause GG.2. |  |  |
|  | For room areas exceeding 250 m2, mmax calculated with a room area (A) of 250 m2. |  |  |
| **GG.10.3.2** | **Maximum refrigerant charge limit B** | |  |
|  | The maximum refrigerant charge, mmax, in a room and the minimum room area, Amin are calculated, of the installed appliance with refrigerant charge. |  |  |
|  | The effective height, Hr, of the unit is determined as follows: | |  |
|  | – Where the release height, h0, as determined in Clause GG.2, is equal to or greater than 1,8 m or the appliance is with integral circulation airflow, the effective height, Hr, is the room height in m but not more than 2,2 m unless h0 is higher than 2,2 m. |  |  |
|  | – In all other cases, the effective height, Hr, is the release height, h0, as determined in Clause GG.2. |  |  |
|  | For room areas exceeding 250 m2, mmax calculated with a room area (A) of 250 m2 |  |  |
| **GG.10.4** | **Requirement for units with integral circulation airflow** | |  |
| **GG.10.4.1** | **General** | |  |
|  | The minimum air velocity and minimum airflow as follows: | |  |
|  | – Minimum airflow = 240 m3/h |  |  |
|  | – There is no minimum circulation airflow velocity requirement for downwards airflow. |  |  |
|  | – Minimum air velocity for upwards airflow |  |  |
|  | – The unit air velocity (v) calculated as airflow divided by the nominal face area of the outlet. The grille area shall not be deducted. |  |  |
|  | As an alternative, for airflow angles between 15 degrees and 90 degrees, the minimum air velocity (vmin) can be determined by linear interpolation of the values included in Table GG.5. |  |  |
|  | Operation of circulation airflow comply with either GG.10.4.2 or GG.10.4.3. |  |  |
| **GG.10.4.2** | **Continuous circulation airflow** | |  |
|  | The indoor fan run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 seconds in the event that the airflow is reduced below Qmin, the following actions taken: | |  |
|  | – warn user that airflow is reduced |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.10.4.3** | **Circulation airflow activated by a refrigerant leak detection system** | |  |
|  | If a leak detection system is activated, the following actions taken and continued for at least 5 min after the leak detection system has reset: | |  |
|  | – energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Qmin; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **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. |  |  |
|  | Where ventilation is to an indoor space, the total area of that space and the space in which the appliance is installed shall have a total room area not less than Amin according to the Formula (GG.32). If the opening area in GG.11.2 is not large enough, the measure of GG.11.3 taken with ventilation to the outdoors. |  |  |
|  | The effective height, Hr, of the unit is determined as follows: | |  |
|  | – Where the release height, h0, as determined in Clause GG.2, is equal to or greater than 1,8 m or the appliance is with integral circulation airflow, the effective height, Hr, is the room height in m but not more than 2,2 m unless h0 is higher than 2,2 m; |  |  |
|  | – In all other cases, the effective height, Hr, is the release height, h0, as determined in Clause GG.2. |  |  |
| **GG.11.2** | **Natural ventilation** | |  |
|  | If natural ventilation is applied, the following met. | |  |
|  | – Openings for natural ventilation comply with GG.1.4. |  |  |
|  | – Natural ventilation to outdoors is not allowed below ground level. |  |  |
|  | – Natural ventilation from an occupied space not be made to outdoors. |  |  |
|  | The minimum opening area for natural ventilation (Anv,min) to an indoor space |  |  |
|  | The minimum opening area for natural ventilation (Anv,min) to an outdoor space |  |  |
| **G.11.3** | **Mechanical ventilation** | |  |
| **GG.11.3.1** | **Operation of mechanical ventilation** | |  |
|  | Mechanical ventilation operated continuously or shall be switched on by a leak detection system. |  |  |
|  | Operation shall be according to GG.8.3.1 |  |  |
| **GG.11.3.2** | **Required airflow** | |  |
|  | For (Q × 0,25\*LFL)/10 < 1, the airflow of the mechanical ventilation shall be at least the quantity that satisfies the following formula for mc |  |  |
|  | For (Q × 0,25\*LFL)/10 ≥ 1, the airflow shall be determined according the following formula for Q |  |  |
| **GG.11.3.3** | **Mechanical ventilation openings** | |  |
|  | The upper edge of the air extraction opening from the room located at a height equal to or below the refrigerant release point |  |  |
|  | The mechanical ventilation air extracted from the space positioned relative to the mechanical ventilation air intake openings such that the makeup air will mix with the leaked refrigerant. |  |  |
|  | Where circulation airflow according to GG.10.4 is not provided, the openings shall comply with GG.8.3.3. |  |  |
| **GG.12** | **Safety shut-off valves for enhanced tightness refrigerating systems using**  **A2L refrigerants** | |  |
|  | Safety shut-off valves positioned to enable access for maintenance by an authorized person. |  |  |
|  | For appliances which are not on the lowest underground floor, where the release height, h0, as determined in Clause GG.2 is equal to or greater than 1,8 m or the appliance is with integral circulation airflow, the releasable charge as determined by Annex QQ |  |  |
| **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 leak detection system. The alarm also alert an authorized person to take appropriate action. |  |  |
| **GG.13.2** | **Alarm system warning** |  |  |
| **GG.13.2.1** | **General** |  |  |
|  | The alarm system 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 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. |  |  |
| **GG.14** | **Allowable charge for enhanced tightness refrigerating systems using A2 or A3 refrigerant** | |  |
| **GG.14.1** | **General** | |  |
|  | Clause GG.14 is applicable to enhanced tightness refrigerating systems in compliance with 22.125 using A2 or A3 refrigerants with refrigerant charge m1 < mc ≤ m2. |  |  |
| **GG.14.2** | **Requirement for enhanced tightness units without integral circulation airflow** | |  |
|  | For enhanced tightness refrigerating systems, the maximum refrigerant charge in a room in accordance with the following: | |  |
|  | mmax = CF × LFL × A × h0 |  |  |
|  | or the required minimum room area Amin of installed appliance with refrigerant charge mc in accordance with the following; | |  |
|  | Amin = mc / (CF × LFL × h0) |  |  |
| **GG.14.3** | **Requirement for enhanced tightness units with integral circulation airflow** | |  |
| **GG.14.3.1** | **General** | |  |
|  | When the fan integrated into an appliance is continuously operated or operation is initiated by a leak detection system with sufficient airflow rate, the maximum refrigerant charge can be increased or minimum room area can be reduced according to the following. |  |  |
|  | For enhanced tightness refrigerating systems, the maximum refrigerant charge in a room in accordance with the following: | |  |
|  | mmax = CF × LFL × A × 2,2 |  |  |
|  | or the required minimum room area Amin of installed appliance with refrigerant charge mc in accordance with the following; | |  |
|  | Amin = mc / (CF × LFL × 2,2) |  |  |
|  | The minimum circulation airflow determined as: | |  |
|  |  |  |  |
|  | For refrigerants not listed in Table GG.6, leak mass flow rate (ṁleak) is calculated from: | |  |
|  |  |  |  |
|  | The choked flow mass flux, Ṁs, is: | |  |
|  |  |  |  |
|  | Operation of circulation airflow comply with either GG.14.3.2 or GG.14.3.3. |  |  |
| **GG.14.3.** | **Continuous circulation airflow** | |  |
|  | The indoor fan run continuously, other than for short periods for maintenance and service. The airflow monitored continuously. Within 10 seconds in the event that the airflow is reduced below Qmin, the following actions taken: | |  |
|  | – warn user that airflow is reduced; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **GG.14.3.3** | **Circulation airflow activated by a leak detection system** | |  |
|  | If a leak detection system is activated, the following actions taken and continued for at least 5 min after the leak detection system has reset: | |  |
|  | – energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Qmin; |  |  |
|  | – disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space. |  |  |
| **JJ** | **ANNEX JJ - 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 deff |  |  |
| **JJ.3** | **Determination of maximum allowable opening** | |  |
|  | Relays and similar components not be considered as a potential ignition source if the effective diameter of all holes complies with the following equation: |  |  |
|  | Alternatively, a type test can be used to determine if relays and similar components are not a potential ignition source. This type test 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. |  |  |
| **KK** | **ANNEX KK - 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. |  |  |
| **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 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 cm3 ± 0,2 cm3), tubing for directing the spray. The spray tube from valve to the end 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 thermocouple 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 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 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 heated until a steady test temperature is maintained for 5 min. The plate temperature kept within ±15 °C of the set-point during the test. |  |  |
|  | 2) Refrigerant used for the test 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. |  |  |
|  | 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 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. |  |  |
| **LL** | **ANNEX LL - REFRIGERANT DETECTION SYSTEMS FOR flammable REFRIGERANTS** | |  |
| **LL.1** | **General** | |  |
|  | This annex applies to refrigerant detection systems for use in appliances using flammable refrigerants. |  |  |
|  | Refrigerant detection systems give an output signal at a predetermined alarm set point in response to leaked refrigerant. |  |  |
|  | Refrigerant detection systems may respond directly to the refrigerant concentration or may respond to gases being displaced by the refrigerant |  |  |
|  | In this annex, where LFL is referenced and for refrigerant used for all tests, the composition the nominal composition as specified in Annex BB. |  |  |
|  | The refrigerant detection systems capable of detecting refrigerant concentration above the alarm set point, for the refrigerant marked on the appliance, over the full range of operating temperature and humidity as specified by the appliance manufacturer. Worst case combined effects of declared manufacturing tolerances and drift considered. |  |  |
| **LL.2** | **Test gases and default test condition** | |  |
|  | For the test in Clause LL.3, the test gas 24 % to 25 % of LFL. |  |  |
|  | For the test in Clause LL.4, the low ratio test gas (3 ± 0,3) % of LFL below the alarm set point declared by the manufacturer, but no lower than (1,1 ± 0,1) % of LFL. |  |  |
|  | For the test in Clause LL.4, the high ratio test gas (3 ± 0,3) % of LFL above the alarm set point declared by the manufacturer, but no higher than (24,7 ± 0,3) % of LFL. |  |  |
|  | For the tests in LL.5.9, Clause LL.6, Clause LL.7, Clause LL.8, Clause LL.9, and Clause LL.10, the low ratio test gas (6 ± 0,6) % of LFL below the alarm set point declared by the manufacturer, but no lower than (1,1 ± 0,1) % of LFL. |  |  |
|  | For the tests in LL.5.9, Clause LL.6, Clause LL.7, Clause LL.8, Clause LL.9, and Clause LL.10, the high ratio test gas (6 ± 0,6) % of LFL above the alarm set point declared by the manufacturer, but no higher than (24,7 ± 0,3) % of LFL. |  |  |
|  | Table LL.1 illustrates the relationship between alarm set point, tolerances, and test gas concentrations. |  |  |
|  | For the test in Clause LL.11, the test gas (110 ± 0,5) % of the stoichiometric concentration. |  |  |
| **LL.3** | **Response time of the refrigerant detection system** | |  |
|  | Refrigerant detection system give an output signal within 30 seconds when the refrigerant sensor is put into refrigerant concentration of 25 % of LFL. |  |  |
| **LL.4** | **Refrigerant detection system calibration and short-term stability** | |  |
|  | The refrigerant detection systems have an alarm set point and be calibrated from the factory for the refrigerant marked on the appliance. |  |  |
|  | The refrigerant detection system consistently give an output signal at the alarm set point with a tolerance of ±2,5 % of LFL, but not lower than 1 % of LFL. |  |  |
|  | The alarm set point not be adjustable. Recalibration other than self-recalibration not be allowed. |  |  |
| **LL.5** | **Selectivity test and poisoning test** | |  |
| **LL.5.1** | Refrigerant detection system including refrigerant sensors not have false or nuisance trips, and not be subject to poisoning. |  |  |
|  | After being exposed to the gases in Table LL.2, the refrigerant detection system consistently give an output signal at the alarm set point with a tolerance of ±5 % of LFL, but not lower than 1 % of LFL. |  |  |
| **LL.5.2 - LL.5.9** | Compliance check |  |  |
| **LL.6** | **Refrigerant poisoning and oil spray test** | |  |
| **LL.6.1** | **General** | |  |
|  | The refrigerant detection system not be subject to poisoning or damage by the refrigerant(s) marked on the appliance mixed with oil. |  |  |
|  | After being exposed to the refrigerant(s) marked on the appliance mixed with oil, the refrigerant detection system | |  |
|  | – consistently give an output signal at the alarm set point with a tolerance of ±5 % of LFL, but not lower than 1 % of LFL, and give an output signal within 60 seconds when the refrigerant sensor is put into refrigerant concentration of 25 % of LFL, or |  |  |
|  | – give an output signal indicating a refrigerant leak and notify the user that the refrigerant sensor needs to be replaced. The output signal continue until the refrigerant sensor has been replaced. |  |  |
| **LL.6.2** | **Test set-up** | |  |
| **LL.6.3** | **Test procedure** | |  |
| **LL.6.4** | **Check of alarm set point and response time** | |  |
| **LL.7** | **Long term stability** |  |  |
|  | Over a period of 90 days, the refrigerant detection system consistently give an output signal at the alarm set point with a tolerance of ±5 % of LFL, but not lower than 1 % of LFL. |  |  |
| **LL.8** | **Humidity test** | |  |
|  | Over the humidity range of the appliance, the refrigerant detection system consistently give an output signal at the alarm set point with a tolerance of ±5 % of LFL, but not lower than 1 % of LFL. |  |  |
| **LL.9** | **Temperature** **test** | |  |
|  | Over the temperature range of the appliance, the refrigerant detection system consistently give an output signal at the alarm set point with a tolerance of ±5 % of LFL, but not lower than 1 % of LFL |  |  |
| **LL.10** | **Vibration requirement** | |  |
|  | Vibration requirements this clause apply for refrigerant sensors. Vibration requirements for refrigerant sensors need not apply to the entire appliance. |  |  |
|  | Refrigerant sensors withstand vibration without breakage or damage of parts and continue to function. |  |  |
|  | After the vibration test, the refrigerant detection system give an output signal at the alarm set point with a tolerance of ±5 % of LFL, but not lower than 1 % of LFL. |  |  |
| **LL.11** | **Ignition test** | |  |
|  | Refrigerant sensors not be a source of ignition for leaked refrigerant. |  |  |
| **LL.12** | **Refrigerant detection system self-test routine** | |  |
|  | The refrigerant detection system include a means for self-testing to determine if a refrigerant sensor electrical malfunction has occurred. The self-test shall include missing refrigerant sensor (open circuit), by-passed refrigerant sensor (shorted circuit), and refrigerant sensor output out of range. |  |  |
|  | The test run at least every hour and if a failure is detected, the refrigerant detection system provide a dedicated notification to the end user that replacement is required. |  |  |
|  | If the refrigerant sensor is a limited life refrigerant sensor and requires replacement after a given period, then the refrigerant detection system provide notification to the user that replacement is required at the end of the specified life. |  |  |
| **LL.13** | **Serviceability** | |  |
|  | Refrigerant sensors accessible for inspection and replacement. Refrigerant sensors for replacement specified by the appliance manufacturer. |  |  |
| **LL.14** | **Refrigerant sensor identification** | |  |
|  | The refrigerant sensors or the parts of the appliance containing refrigerant sensors marked or tagged with: | |  |
|  | – "service indicator; read technical manual" (symbol ISO 7000-1659 (2004-01)); |  |  |
|  | – year of manufacturing; |  |  |
|  | – reference number or other means for identifying the refrigerant sensor. |  |  |
|  | The marking visible when servicing the refrigerant sensors. |  |  |
| **MM** | **ANNEX MM - 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 refrigerant 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 refrigerant sensor. |  |  |
| **MM.2** | **Test methods** | |  |
| **MM.2.1** | **General** | |  |
| **MM.2.2** | **Test with fan OFF** | |  |
| **MM.2.3** | **Test with fan ON** | |  |
| **MM.2.4** | **Test set-up** | |  |
| **MM.2.5** | **Instrumentation** | |  |
| **MM.2.6** | **Compliance criteria** | |  |
| **NN** | **ANNEX NN - 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 can become a source of ignition which will withstand an internal ignition of a A2L refrigerant vapour which can 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. |  |  |
| **NN.2** | **Test method** | |  |
| **PP** | **ANNEX PP - Leak detection system confirmation test for flammable refrigerants** | |  |
| **PP.1** | **General** | |  |
|  | This test is applicable to appliances using flammable refrigerants with leak detection systems which initiate safety measures upon detection when required according to Annex GG. This test is not applicable to refrigerant detection systems using remote refrigerant sensors. |  |  |
|  | The leak detection system comply with the following: | |  |
|  | – for leak detection systems using refrigerant detection systems, the requirements in Clause PP.2 shall apply; |  |  |
|  | – for leak detection systems using ultrasonic based detection systems, the requirements of Clause PP.2 apply; |  |  |
|  | – for leak detection systems using system parameter-based detection systems, the requirements of Clause PP.3 apply. |  |  |
|  | For the low leak rate of PP.2.2.2 and the leak rate of PP.2.2.3 and the small leak orifice of PP.3.2, the actions required by Annex GG completed within 90 seconds of the initiation of the simulated leak. |  |  |
|  | For the high leak rate of PP.2.2.2 and the large leak orifice of PP.3.3, the actions required by Annex GG shall be completed within 30 seconds of the initiation of the simulated leak. For appliances where the release height h0 as determined in Clause GG.2 is less than 1 m, the actions required by Annex GG completed within 15 seconds of the initiation of the simulated leak. |  |  |
| **PP.2** | **Test method for leak detection systems using refrigerant detection systems and ultrasonic based detection systems** | |  |
| **PP.2.1** | **Test set-up** | |  |
| **PP.2.1.1** | **General** | |  |
| **PP.2.1.2** | **Simulation of leak** | |  |
| **PP.2.1.3** | **Installation conditions** | |  |
| **PP.2.1.4** | **Test room** | |  |
| **PP.2.2** | **Test procedure** | |  |
| **PP.2.2.1** | **General** | |  |
| **PP.2.2.2** | **Fan OFF** | |  |
| **PP.2.2.3** | **Fan ON** | |  |
| **PP.2.2.3.1** | **General** | |  |
| **PP.2.2.3.2** | **Enhanced tightness refrigerating systems** | |  |
| **PP.2.2.3.3** | **Enhanced tightness refrigerating systems** | |  |
| **PP.3** | **Test method for leak detection systems using system parameter based detection** | |  |
| **QQ** | **Annex QQ - Methods for determining releasable charge** | |  |
| **QQ.1** | **General** | |  |
| **QQ.2** | **Determination of releasable charge by a simulated lea** | |  |
| **QQ.2.1** | **Test set-up** | |  |
| **QQ.2.2** | **Test method** | |  |
| **QQ.3** | Determination of releasable charge by a simulated leak for refrigerating systems complying with Clause GG.10 |  |  |
| **QQ.3.1** | **General** | |  |
|  | The releasable charge, mrl, determined by the test of QQ.3.2 and QQ.3.3. |  |  |
| **QQ.3.2** | **Test set-up** | |  |
|  | Install the appliance, including safety shut-off valves, according to the instructions, in the smallest room as specified by the instructions, with the set-up that will create the largest releasable charge for that room. |  |  |
|  | The refrigerating system evacuated prior to each test, and then charged with refrigerant equal to mc, where mc is the refrigerant charge in kg. |  |  |
|  | A calibrated leak opening installed in the refrigerating system that would result in the greatest amount of refrigerant released in the occupied space. A valve to enable opening and closing of the calibrated leak opening installed between the appliance and the calibrated leak opening. The calibrated leak shall be at the point in the circuit that has the highest saturated pressure in the indoor unit during steady state operation. |  |  |
|  | The calibrated leak opening vent into a volume at atmospheric pressure. |  |  |
|  | The calibrated opening a capillary or orifice that leaks at 2,8 g/s from saturated liquid at a saturated pressure of 63 °C. |  |  |
| **QQ.3.3** | **Test method** | |  |
|  | The refrigerating system operate according to the operating state until steady state is reached for at least 30 minutes, prior to opening the valve of the calibrated leak opening. |  |  |
|  | The test repeated at least 3 times and the releasable charge 2 standard deviations above the mean result |  |  |
|  | The valve to the calibrated leak opening is opened. |  |  |
|  | The refrigerating system shall operate normally for tr1 time with the calibrated leak open, where tr1 is the time before leak is detected as determined in Clause QQ.5. |  |  |
|  | After the tr1 time, the refrigerant charge limited system simulate a detected leak. |  |  |
|  | After the safety shut-off valves are closed, the remaining charge mrm contained in the part of the refrigerating system which is closed by the safety shut-off valves is measured. |  |  |
|  | The releasable charge (in kg) is:  mrl = mc – mrm |  |  |
| **QQ.4** | **Determination of releasable charge by calculation and test for refrigerating systems complying with Clause GG.10** | |  |
| **QQ.4.1** | **General** | |  |
|  | The releasable charge, mrl, calculated as the sum of the refrigerant released in the separate stages according to the following:  mrl = tr1 × 0,002 8 + mr2 + mr3 |  |  |
| **QQ.4.2** | **Refrigerant release between detection and closing the safety shut-off valves** | |  |
|  | The refrigerant amount released between the leak detection system giving an output signal and closing the safety shut-off valves, mr2, determined as:  mr2 = 0,002 8 × tcl |  |  |
| **QQ.4.3** | **Determination of mr3** | |  |
| **QQ.4.3.1** | **General** | |  |
|  | To determine the releasable charge after closing the shut-off valves, mr3, which can leak into the occupied space, determine the releasable charge for each part (unit or piping), mr3,i, that can leak into the occupied space after closing the shut-off valves by one of the following methods: | |  |
|  | – determine apparent density, ρpart,i, by measuring the pressure according to QQ.4.3.2 |  |  |
|  | – determine apparent density, ρpart,i, by applying default values according to QQ.4.3.3; |  |  |
|  | – determine apparent density, ρpart,i, according to QQ.4.3.4. |  |  |
|  | A part shall be the piping or the indoor unit between the field connection points. |  |  |
|  | The releasable charge after closing the shut-off valves, mr3, the sum of the charge of each part that can leak into the occupied space after closing the shut-off valves:  mr3 = ∑ Vpart,i × ρpart,i |  |  |
| **QQ.4.3.2** | **Determine apparent density, ρpart,i, by measuring the pressure** | |  |
|  | To determine the apparent density, ρpart,i, of the releasable charge after closing the shut-off valves for the evaluated part of the system by measuring the pressure, the following procedure applied. |  |  |
| **QQ.4.3.3** | **Determine apparent density, ρpart,i, by default values** | |  |
|  | When no test is executed, the following method applied. |  |  |
|  | The refrigerant state (liquid, gas or mixture) for the evaluated part of the system determined. |  |  |
|  | The apparent density for the evaluated part of the system, ρpart,i, shall be determined as: | |  |
|  | – for liquid piping: the density of saturated liquid at 10 °C; |  |  |
|  | – for gas piping: the density of saturated gas at 42 °C; |  |  |
|  | – for piping containing mixture of gas and liquid: the density of saturated liquid at 10 °C; |  |  |
|  | – for indoor units: the density of saturated liquid at 10 °C. |  |  |
| **QQ.4.3.4** | **Determine apparent density, ρpart,i, by measuring the recovered refrigerant amount from the unit or piping** | |  |
|  | To determine the apparent density, ρpart,i, of the releasable refrigerant after closing the shut-off valves for the evaluated indoor unit or piping by measuring the recovered refrigerant amount, the following procedure applied. |  |  |
|  | Shut-off valves for testing installed upstream and downstream of the part where the apparent density is measured. Shut-off valves for testing shall be of the same type as the safety shut-off valves used for the appliances. The action to shut-off made in accordance with the normal operation of the safety shut-off valves. |  |  |
| **QQ.5** | **Time before the leak is detected, tr1** | |  |
| **QQ.5.1** | **General** | |  |
|  | The time before a leak is detected, tr1, in seconds (s) is determined by one of the following: | |  |
|  | – where the refrigerant sensor location is in compliance with Annex MM when tested at the maximum airflow for the operating state, QQ.5.2 applies; |  |  |
|  | – where the leak detection system is in compliance with Annex PP, QQ.5.2 applies; |  |  |
|  | – for all other cases, QQ.5.3 applies. |  |  |
| **QQ.5.2** | **Determination of tr1 by default time** | |  |
|  | The time before a leak is detected, tr1, in seconds (s) is determined by one of the following: | |  |
|  | – where the refrigerant sensor location is in compliance with Annex MM when tested at the maximum airflow for the operating state, QQ.5.2 applies; |  |  |
|  | – where the leak detection system is in compliance with Annex PP, QQ.5.2 applies; |  |  |
|  | – for all other cases, QQ.5.3 applies. |  |  |
| **QQ.5.2** | **Determination of tr1 by default time** | |  |
|  | The time for the leak detection system to give an output signal, tr1, 120 s. |  |  |
| **QQ.5.3** | **Determination of tr1 based on effective room concentration** | |  |
|  | The time for the refrigerant detection system to give an output signal, tr1, in seconds determined as:  tr1 = (Hr × Amin × LFL × Cset / 0,002 8) + 30 | |  |
| **QQ.6** | **Test conditions for releasable charge limited systems** | |  |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **10.1** | **TABLE: Power input deviation** | | | | | |  |
| Input deviation of/at: | | P rated (W) | P measured (W) | Δ P | Required Δ P | Remark | |
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| Supplementary information: | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **10.2** | **TABLE: Current deviation** | | | | | |  |
| Current deviation of/at: | | I rated (A) | I measured (A) | Δ I | Required Δ I | Remark | |
|  | |  |  |  |  |  | |
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| Supplementary information: | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **11.8** | | **TABLE: Heating test** | | | | |  | |
|  | | Test voltage (V) : | | |  | | ⎯ | |
|  | | Ambient (°C) : | | |  | | ⎯ | |
| Thermocouple locations | | | | Max. temperature measured, T (°C) | | Max. temperature limit, T (°C) | | |
|  | | | |  | |  | | |
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| **Supplementary information:** | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **11.8** | | **TABLE: Heating test, resistance method** | | | | | | | |  | |
|  | | Test voltage (V) : | | | | |  | | | ⎯ | |
|  | | Ambient, t1 (°C) : | | | | |  | | | ⎯ | |
|  | | Ambient, t2 (°C) : | | | | |  | | | ⎯ | |
| Temperature rise of winding | | | | R1 (Ω) | R2 (Ω) | T (°C) | | Max. T (°C) | Insulation class | | |
|  | | | |  |  |  | |  |  | | |
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| Supplementary information: | | | | | | | | | | | |

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| **13.2** | **TABLE: Leakage current** | | | |  |
|  | Heating appliances: 1,15 x rated input (W) : |  | | | ⎯ |
|  | Motor‑operated and combined appliances:  1,06 x rated voltage (V) : |  | | | ⎯ |
| Leakage current between | | | I (mA) | Max. allowed I (mA) | |
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| Supplementary information: | | | | | |

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| **13.3** | **TABLE: Dielectric strength** | | |  |
| Test voltage applied between: | | Test potential applied (V) | Breakdown / flashover (Yes/No) | |
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| Supplementary information: | | | | |

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| **14** | **TABLE: Transient overvoltages** | | | | | |  |
| Clearance between: | | Cl (mm) | Required Cl (mm) | Rated impulse voltage (V) | Impulse test voltage (V) | Flashover (Yes/No) | |
|  | |  |  |  |  |  | |
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| Supplementary information: | | | | | | | |

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| **16.2** | **TABLE: Leakage current** | | |  |
|  | Single phase appliances: 1,06 x rated voltage (V) : |  | | ⎯ |
|  | Three phase appliances 1,06 x rated voltage divided by √3 (V) : |  | | ⎯ |
| Leakage current between | | I (mA) | Max. allowed I (mA) | |
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| Supplementary information: | | | | |

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| **16.3** | **TABLE: Dielectric strength** | | |  |
| Test voltage applied between: | | Test potential applied (V) | Breakdown / flashover (Yes/No) | |
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| Supplementary information: | | | | |

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| **17** | **TABLE: Overload protection** | | |  |
| Thermocouple locations | | Max. temperature rise measured, Δ T (K) | Max. temperature rise limit, Δ T (K) | |
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| Supplementary information: | | | | |

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| **17** | | **TABLE: Overload protection, resistance method** | | | | | | | |  | |
|  | | Test voltage (V) : | | | | |  | | | ⎯ | |
|  | | Ambient, t1 (°C) : | | | | |  | | | ⎯ | |
|  | | Ambient, t2 (°C) : | | | | |  | | | ⎯ | |
| Temperature of winding | | | | R1 (Ω) | R2 (Ω) | Δ T (K) | | T (°C) | Max. T (°C) | | |
|  | | | |  |  |  | |  |  | | |
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| Supplementary information: | | | | | | | | | | | |

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| **19** | **Abnormal operation conditions** | | | | | | | |  |
| Operational characteristics | | | YES/NO | | Operational conditions | | | | |
| Are there electronic circuits to control the appliance operation? | | |  | |  | | | | |
| Are there “off” or “stand‑by” position? | | |  | |  | | | | |
| The unintended operation of the appliance results in dangerous malfunction? | | |  | |  | | | | |
| Sub‑clause | Operating conditions description | Test results description | | PEC description | | EMP 19.11.4 | Software type required | 19.11.3 PEC | Final result |
| 19.2 |  |  | |  | | N.A |  |  |  |
| 19.3 |  |  | |  | |  |  |  |  |
| 19.4 |  |  | |  | |  |  |  |  |
| 19.5 |  |  | |  | |  |  |  |  |
| 19.6 |  |  | |  | | N.A |  |  |  |
| 19.7 |  |  | |  | |  |  |  |  |
| 19.8 |  |  | |  | |  |  |  |  |
| 19.9 |  |  | |  | |  |  |  |  |
| 19.10 |  |  | |  | |  |  |  |  |
| 19.11.2 |  |  | |  | |  |  |  |  |
| 19.11.4.8 |  |  | |  | |  |  |  |  |
| 19.10X |  |  | |  | |  |  |  |  |
| Supplementary information: | | | | | | | | | |

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| **19.4** | **Abnormal operation conditions** | |  |
| Failure description | | Effect | Verdict |
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| Supplementary information: | | | |

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| **19.7** | | **Abnormal operation conditions – locked rotor test other than motor-compressors and stationary circulation pumps in compliance with IEC 60335‑2‑51** | | | | | | |  | |
|  | | Ambient, t1 (°C): | | | | °C | | | ⎯ | |
|  | | Ambient, t2 (°C): | | | | °C | | | ⎯ | |
|  | | Test voltage (V) : | | | | V | | | ⎯ | |
| Temperature limit T of winding: | | | | R1 (Ω) | R2 (Ω) | | Measured T (°C) | Limit  T (°C) | Insulation class | |
|  | | | |  |  | |  |  |  | |
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| **19.7** | **TABLE: electric strength measurements after 72 hours** | | |  |
| Test voltage applied between: | | Test voltage (V) | Breakdown Yes / No | |
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| **19.7** | **TABLE: leakage current measurements after 72 hours** | | |  |
|  | A voltage equal to twice the rated voltage (V) : |  | | ⎯ |
| Leakage current I between : | | I (mA) | Required I (mA) | |
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| **19.7** | **Abnormal operation conditions – Locked rotor test motor-compressor** | | | | | | |  |
|  | Motor‑compressor : | | |  | | | | |
|  | Start device : | | |  | | | | |
|  | Protector : | | |  | | | | |
|  | Start capacitor : | | |  | | | | |
|  | Run capacitor : | | |  | | | | |
|  | Cooling; (static); (fan‑m3/h); (oil); : | | |  | | | | |
|  | Thermal motor‑protection system : | | |  | | | | |
|  | | Self‑resetting | | | | | Manually reset | |
| Rated voltage | | Vn max (V) | | | | Vn max (V) | Vn min (V) | |
|  | | After  72 h | After 288 h | | After 360 h | After 363 h | After 50 cycles | |
| High‑voltage test (see 16.3) | |  |  | |  |  |  | |
| Leakage current (mA) (see 16.2) | |  |  | |  |  |  | |
| Electric strength (see 13.3) | |  |  | |  |  |  | |
| Room temperature (°C) (20 ± 5°C) | |  |  | |  |  |  | |
| Number of cycles (≥ 2000 or 50) | |  |  | |  |  |  | |
| Housing temperature (°C) (≤ 150°C) | |  |  | |  |  |  | |
| supplementary information: | | | | | | | | |

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| **19.11.2** | **Abnormal Operation** | | | |  |
| Fault condition | | Short circuit | Open circuit | Effect | Verdict |
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| **19.13** | **TABLE: Abnormal operation, temperature rises** | | |  | |
| Thermocouple locations | | | Max. temperature rise measured, Δ T (K) | Max. temperature rise limit, Δ T (K) | |
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| Supplementary information: | | | | | |

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| **19.101-104** | **Abnormal operation conditions** | |  |
| Subclause | | Effect | Verdict |
| 19.101 | |  |  |
| 19.102 | |  |  |
| 19.103 | |  |  |
| 19.104 | |  |  |
| Supplementary information: | | | |

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| **21.1** | **TABLE: Impact resistance** | | | |  |
| Impacts per surface | | Surface tested | Impact energy (Nm) | Comments | |
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| Supplementary information: | | | | | |

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| **24.1** | **TABLE: Critical components information** | | | | | |  |
| Object / part No. | | Manufacturer/ trademark | Type / model | Technical data | Standard | Mark(s) of conformity1) | |
|  | |  |  |  |  |  | |
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| Supplementary information:  1) Provided evidence ensures the agreed level of compliance. See OD-CB2039. | | | | | | | |

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| **28.1** | **TABLE: Threaded part torque test** | | | |  |
| Threaded part identification | | Diameter of thread (mm) | Column number  (I, II, or III) | Applied torque (Nm) | |
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| Supplementary information: | | | | | |

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| **29.1** | **TABLE: Clearances** |  |

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|  | Overvoltage category : | | | | |  | | | ⎯ |
|  | | | Type of insulation: | | | | |  | |
| Rated impulse voltage (V): | | Min. cl (mm) | Basic (mm) | Supplementary (mm) | Reinforced (mm) | | Functional (mm) | Verdict / Remark | |
| 330 | | 0,2\* / 0,5 / 0,8\*\* |  |  |  | |  |  | |
| 500 | | 0,2\* / 0,5 / 0,8\*\* |  |  |  | |  |  | |
| 800 | | 0,2\* / 0,5 / 0,8\*\* |  |  |  | |  |  | |
| 1 500 | | 0,5 / 0,8\*\* / 1,0\*\*\* |  |  |  | |  |  | |
| 2 500 | | 1,5 / 2,0\*\*\* |  |  |  | |  |  | |
| 4 000 | | 3,0 / 3,5\*\*\* |  |  |  | |  |  | |
| 6 000 | | 5,5 / 6,0\*\*\* |  |  |  | |  |  | |
| 8 000 | | 8,0 / 8,5\*\*\* |  |  |  | |  |  | |
| 10 000 | | 11,0 / 11,5\*\*\* |  |  |  | |  |  | |
| Supplementary information:  \*) For tracks on printed circuit boards if pollution degree 1 and 2 \*\*) For pollution degree 3 \*\*\*) If the construction is affected by wear, distortion, movement of the parts or during assembly | | | | | | | | | |

| **29.2** | **TABLE: Creepage distances, basic, supplementary and reinforced insulation** | | | | | | | | | | |  | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Working voltage  (V) | | Creepage distance (mm) Pollution degree | | | | | | |  | | | | |
| 1 | 2 | | | 3 | | | Type of insulation | | | | Verdict |
| Material group | | | Material group | | |
| I | II | IIIa/IIIb | I | II | IIIa/IIIb\* | B\*\* | S\*\* | R\*\* | |
| ≤50 | | 0,18 | 0,6 | 0,85 | 1,2 | 1,5 | 1,7 | 1,9 |  | ⎯ | ⎯ | |  |
| ≤50 | | 0,18 | 0,6 | 0,85 | 1,2 | 1,5 | 1,7 | 1,9 | ⎯ |  | ⎯ | |  |
| ≤50 | | 0,36 | 1,2 | 1,7 | 2,4 | 3,0 | 3,4 | 3,8 | ⎯ | ⎯ |  | |  |
| 125 | | 0,28 | 0,75 | 1,05 | 1,5 | 1,9 | 2,1 | 2,4 |  | ⎯ | ⎯ | |  |
| 125 | | 0,28 | 0,75 | 1,05 | 1,5 | 1,9 | 2,1 | 2,4 | ⎯ |  | ⎯ | |  |
| 125 | | 0,56 | 1,5 | 2,1 | 3,0 | 3,8 | 4,2 | 4,8 | ⎯ | ⎯ |  | |  |
| 250 | | 0,56 | 1,25 | 1,8 | 2,5 | 3,2 | 3,6 | 4,0 |  | ⎯ | ⎯ | |  |
| 250 | | 0,56 | 1,25 | 1,8 | 2,5 | 3,2 | 3,6 | 4,0 | ⎯ |  | ⎯ | |  |
| 250 | | 1,12 | 2,5 | 3,6 | 5,0 | 6,4 | 7,2 | 8,0 | ⎯ | ⎯ |  | |  |
| 400 | | 1,0 | 2,0 | 2,8 | 4,0 | 5,0 | 5,6 | 6,3 |  | ⎯ | ⎯ | |  |
| 400 | | 1,0 | 2,0 | 2,8 | 4,0 | 5,0 | 5,6 | 6,3 | ⎯ |  | ⎯ | |  |
| 400 | | 2,0 | 4,0 | 5,6 | 8,0 | 10,0 | 11,2 | 12,6 | ⎯ | ⎯ |  | |  |
| 500 | | 1,3 | 2,5 | 3,6 | 5,0 | 6,3 | 7,1 | 8,0 |  | ⎯ | ⎯ | |  |
| 500 | | 1,3 | 2,5 | 3,6 | 5,0 | 6,3 | 7,1 | 8,0 | ⎯ |  | ⎯ | |  |
| 500 | | 2,6 | 5,0 | 7,2 | 10,0 | 12,6 | 14,2 | 16,0 | ⎯ | ⎯ |  | |  |
| >630 and ≤800 | | 1,8 | 3,2 | 4,5 | 6,3 | 8,0 | 9,0 | 10,0 |  | ⎯ | ⎯ | |  |
| >630 and ≤800 | | 1,8 | 3,2 | 4,5 | 6,3 | 8,0 | 9,0 | 10,0 | ⎯ |  | ⎯ | |  |
| >630 and ≤800 | | 3,6 | 6,4 | 9,0 | 12,6 | 16,0 | 18,0 | 20,0 | ⎯ | ⎯ |  | |  |
| >800 and ≤1000 | | 2,4 | 4,0 | 5,6 | 8,0 | 10,0 | 11,0 | 12,5 |  | ⎯ | ⎯ | |  |
| >800 and ≤1000 | | 2,4 | 4,0 | 5,6 | 8,0 | 10,0 | 11,0 | 12,5 | ⎯ |  | ⎯ | |  |
| >800 and ≤1000 | | 4,8 | 8,0 | 11,2 | 16,0 | 20,0 | 22,0 | 25,0 | ⎯ | ⎯ |  | |  |
| >1000 and ≤1250 | | 3,2 | 5,0 | 7,1 | 10,0 | 12,5 | 14,0 | 16,0 |  | ⎯ | ⎯ | |  |
| >1000 and ≤1250 | | 3,2 | 5,0 | 7,1 | 10,0 | 12,5 | 14,0 | 16,0 | ⎯ |  | ⎯ | |  |
| >1000 and ≤1250 | | 6,4 | 10,0 | 14,2 | 20,0 | 25,0 | 28,0 | 32,0 | ⎯ | ⎯ |  | |  |
| >1250 and ≤1600 | | 4,2 | 6,3 | 9,0 | 12,5 | 16,0 | 18,0 | 20,0 |  | ⎯ | ⎯ | |  |
| >1250 and ≤1600 | | 4,2 | 6,3 | 9,0 | 12,5 | 16,0 | 18,0 | 20,0 | ⎯ |  | ⎯ | |  |
| >1250 and ≤1600 | | 8,4 | 12,6 | 18,0 | 25,0 | 32,0 | 36,0 | 40,0 | ⎯ | ⎯ |  | |  |
| >1600 and ≤2000 | | 5,6 | 8,0 | 11,0 | 16,0 | 20,0 | 22,0 | 25,0 |  | ⎯ | ⎯ | |  |
| >1600 and ≤2000 | | 5,6 | 8,0 | 11,0 | 16,0 | 20,0 | 22,0 | 25,0 | ⎯ |  | ⎯ | |  |
| >1600 and ≤2000 | | 11,2 | 16,0 | 22,0 | 32,0 | 40,0 | 44,0 | 50,0 | ⎯ | ⎯ |  | |  |
| >2000 and ≤2500 | | 7,5 | 10,0 | 14,0 | 20,0 | 25,0 | 28,0 | 32,0 |  | ⎯ | ⎯ | |  |
| >2000 and ≤2500 | | 7,5 | 10,0 | 14,0 | 20,0 | 25,0 | 28,0 | 32,0 | ⎯ |  | ⎯ | |  |
| >2000 and ≤2500 | | 15,0 | 20,0 | 28,0 | 40,0 | 50,0 | 56,0 | 64,0 | ⎯ | ⎯ |  | |  |
| >2500 and ≤3200 | | 10,0 | 12,5 | 18,0 | 25,0 | 32,0 | 36,0 | 40,0 |  | ⎯ | ⎯ | |  |
| >2500 and ≤3200 | | 10,0 | 12,5 | 18,0 | 25,0 | 32,0 | 36,0 | 40,0 | ⎯ |  | ⎯ | |  |
| >2500 and ≤3200 | | 20,0 | 25,0 | 36,0 | 50,0 | 64,0 | 72,0 | 80,0 | ⎯ | ⎯ |  | |  |
| >3200 and ≤4000 | | 12,5 | 16,0 | 22,0 | 32,0 | 40,0 | 45,0 | 50,0 |  | ⎯ | ⎯ | |  |
| >3200 and ≤4000 | | 12,5 | 16,0 | 22,0 | 32,0 | 40,0 | 45,0 | 50,0 | ⎯ |  | ⎯ | |  |
| >3200 and ≤4000 | | 25,0 | 32,0 | 44,0 | 64,0 | 80,0 | 90,0 | 100,0 | ⎯ | ⎯ |  | |  |
| >4000 and ≤5000 | | 16,0 | 20,0 | 28,0 | 40,0 | 50,0 | 56,0 | 63,0 |  | ⎯ | ⎯ | |  |
| >4000 and ≤5000 | | 16,0 | 20,0 | 28,0 | 40,0 | 50,0 | 56,0 | 63,0 | ⎯ |  | ⎯ | |  |
| >4000 and ≤5000 | | 32,0 | 40,0 | 56,0 | 80,0 | 100,0 | 112,0 | 126,0 | ⎯ | ⎯ |  | |  |
| >5000 and ≤6300 | | 20,0 | 25,0 | 36,0 | 50,0 | 63,0 | 71,0 | 80,0 |  | ⎯ | ⎯ | |  |
| >5000 and ≤6300 | | 20,0 | 25,0 | 36,0 | 50,0 | 63,0 | 71,0 | 80,0 | ⎯ |  | ⎯ | |  |
| >5000 and ≤6300 | | 40,0 | 50,0 | 72,0 | 100,0 | 126,0 | 142,0 | 160,0 | ⎯ | ⎯ |  | |  |
| >6300 and ≤8000 | | 25,0 | 32,0 | 45,0 | 63,0 | 80,0 | 90,0 | 100,0 |  | ⎯ | ⎯ | |  |
| >6300 and ≤8000 | | 25,0 | 32,0 | 45,0 | 63,0 | 80,0 | 90,0 | 100,0 | ⎯ |  | ⎯ | |  |
| >6300 and ≤8000 | | 50,0 | 64,0 | 90,0 | 126,0 | 160,0 | 180,0 | 200,0 | ⎯ | ⎯ |  | |  |
| >8000 and ≤10000 | | 32,0 | 40,0 | 56,0 | 80,0 | 100,0 | 110,0 | 125,0 |  | ⎯ | ⎯ | |  |
| >8000 and ≤10000 | | 32,0 | 40,0 | 56,0 | 80,0 | 100,0 | 110,0 | 125,0 | ⎯ |  | ⎯ | |  |
| >8000 and ≤10000 | | 64,0 | 80,0 | 112,0 | 160,0 | 200,0 | 220,0 | 250,0 | ⎯ | ⎯ |  | |  |
| >10000 and ≤12500 | | 40,0 | 50,0 | 71,0 | 100,0 | 125,0 | 140,0 | 160,0 |  | ⎯ | ⎯ | |  |
| >10000 and ≤12500 | | 40,0 | 50,0 | 71,0 | 100,0 | 125,0 | 140,0 | 160,0 | ⎯ |  | ⎯ | |  |
| >10000 and ≤12500 | | 80,0 | 100,0 | 142,0 | 200,0 | 250,0 | 280,0 | 320,0 | ⎯ | ⎯ |  | |  |
| Supplementary information:  \*) Material group IIIb is allowed if the working voltage does not exceed 50 V \*\*) B = Basic insulation, S = Supplementary insulation, R = Reinforced insulation | | | | | | | | | | | | | |

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| **29.2** | **TABLE: Creepage distances, functional insulation** | | | | | | | | | | | | | | | | |  | |
| Working voltage  (V) | | | Creepage distance (mm) Pollution degree | | | | | | | | | | | | | | Verdict / Remark | | |
| 1 | 2 | | | | | | | 3 | | | | | |
| Material group | | | | | | | Material group | | | | | |
| I | | II | | IIIa/IIIb | | | I | | II | | IIIa/IIIb\* | |
| ≤10 | | | 0,08 | | | 0,4 | | 0,4 | | 0,4 | 1,0 | | 1,0 | | 1,0 | |  | | |
| 50 | | | 0,16 | | | 0,56 | | 0,8 | | 1,1 | 1,4 | | 1,6 | | 1,8 | |  | | |
| 125 | | | 0,25 | | | 0,71 | | 1,0 | | 1,4 | 1,8 | | 2,0 | | 2,2 | |  | | |
| 250 | | | 0,42 | | | 1,0 | | 1,4 | | 2,0 | 2,5 | | 2,8 | | 3,2 | |  | | |
| 400 | | | 0,75 | | | 1,6 | | 2,2 | | 3,2 | 4,0 | | 4,5 | | 5,0 | |  | | |
| 500 | | | 1,0 | | | 2,0 | | 2,8 | | 4,0 | 5,0 | | 5,6 | | 6,3 | |  | | |
| >630 and ≤800 | | | 1,8 | | | 3,2 | | 4,5 | | 6,3 | 8,0 | | 9,0 | | 10,0 | |  | | |
| >800 and ≤1000 | | | 2,4 | | | 4,0 | | 5,6 | | 8,0 | 10,0 | | 11,0 | | 12,5 | |  | | |
| >1000 and ≤1250 | | | 3,2 | | | 5,0 | | 7,1 | | 10,0 | 12,5 | | 14,0 | | 16,0 | |  | | |
| >1250 and ≤1600 | | | 4,2 | | | 6,3 | | 9,0 | | 12,5 | 16,0 | | 18,0 | | 20,0 | |  | | |
| >1600 and ≤2000 | | | 5,6 | | | 8,0 | | 11,0 | | 16,0 | 20,0 | | 22,0 | | 25,0 | |  | | |
| >2000 and ≤2500 | | | 7,5 | | | 10,0 | | 14,0 | | 20,0 | 25,0 | | 28,0 | | 32,0 | |  | | |
| >2500 and ≤3200 | | | 10,0 | | | 12,5 | | 18,0 | | 25,0 | 32,0 | | 36,0 | | 40,0 | |  | | |
| >3200 and ≤4000 | | | 12,5 | | | 16,0 | | 22,0 | | 32,0 | 40,0 | | 45,0 | | 50,0 | |  | | |
| >4000 and ≤5000 | | | 16,0 | | | 20,0 | | 28,0 | | 40,0 | 50,0 | | 56,0 | | 63,0 | |  | | |
| >5000 and ≤6300 | | | 20,0 | | | 25,0 | | 36,0 | | 50,0 | 63,0 | | 71,0 | | 80,0 | |  | | |
| >6300 and ≤8000 | | | 25,0 | | | 32,0 | | 45,0 | | 63,0 | 80,0 | | 90,0 | | 100,0 | |  | | |
| >8000 and ≤10000 | | | 32,0 | | | 40,0 | | 56,0 | | 80,0 | 100,0 | | 110,0 | | 125,0 | |  | | |
| >10000 and ≤12500 | | | 40,0 | | | 50,0 | | 71,0 | | 100,0 | 125,0 | | 140,0 | | 160,0 | |  | | |
| Supplementary information:  \*) Material group IIIb is allowed if the working voltage does not exceed 50 V | | | | | | | | | | | | | | | | | | | |

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| **30.1** | **TABLE: Ball Pressure Test of Thermoplastics** | | | |  |
| **Allowed impression diameter (mm)  :** | | |  | | ⎯ |
| **Object/ Part No./ Material** | | **Manufacturer/ trademark** | **Test temperature (°C)** | **Impression diameter (mm)** | |
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| Supplementary information: | | | | | |

| **30.2** | **TABLE: Resistance to heat and fire - Glow wire tests** | | | | | | | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Object/ Part No./ Material** | | **Manufacturer/ trademark** | **Glow wire test (GWT); (°C)** | | | | | | **Verdict** | |
| **550** | **650** | | **750** | | **850** |
| **te** | **ti** | **te** | **ti** |
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| **Object/ Part No./ Material** | | **Manufacturer/ trademark** | **Glow‑wire flammability index (GWFI), °C** | | | | **GW ignition temp. (GWIT), °C** | | **Verdict** | |
| **550** | **650** | **750** | **850** | **675** | **775** |
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| The test specimen passed the glow wire test (GWT) with no ignition [(te – ti) ≤ 2s] (Yes/No) : | | | | | | | | |  | |
| If no, then surrounding parts passed the needle‑flame test of annex E (Yes/No) : | | | | | | | | |  | |
| The test specimen passed the test by virtue of most of the flaming material being withdrawn with the glow‑wire (Yes/No)? : | | | | | | | | |  | |
| Ignition of the specified layer placed underneath the test specimen (Yes/No) : | | | | | | | | |  | |
| Supplementary information:  - 550 °C GWT not relevant (or applicable) to parts of material classified at least HB40 or if relevant HBF - The GWIT pre‑selection option, the 850 °C GWFI pre‑selection option, and the 850 °C GWT are not relevant (or applicable) for attended appliances | | | | | | | | | | |

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| **30.2/30.2.4** | **TABLE: Needle- flame test (NFT)** | | | | |  |
| **Object/ Part No./ Material** | | **Manufacturer/ trademark** | **Duration of application of test flame (ta); (s)** | **Ignition of specified layer Yes/No** | **Duration of burning (tb) (s)** | **Verdict** |
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| Supplementary information:  - NFT not relevant (or applicable) for Parts of material classified as V‑0 or V‑1 - NFT not relevant (or applicable) for Base material of PCBs classified as V‑0 or if relevant VTM-0 | | | | | | |

**List of test equipment used:**

A completed list of used test equipment shall be provided in the Test Reports when a Manufacturer Testing Laboratory according to CTF stage 1 or CTF stage 2 procedure has been used.

Note: This page may be removed when CTF stage 1 CTF stage 2 are not used. See also clause 4.8 in OD 2020 for more details.

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| **Clause** | **Measurement / testing** | **Testing / measuring equipment / material used, (Equipment ID)** | **Range used** | **Last Calibration date** | **Calibration due date** |
| §13 | ETR3.2 | Supply |  | 12/2022 | 12/2023 |
| §13 | leakage current/dielectric strength | EG38.102 : |  | 03/2023 | 03/2024 |
| §27 | Earthing tester | El.38.100 |  | 02/2023 | 02/2025 |
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**Statement of Measurement Uncertainty**

The Test Report shall include a statement concerning the uncertainty of the measurement systems used for the tests conducted when it is required by the standard, client or other authorities.

In such cases, the table below is to be used for reporting U of M.

This page may be removed from the final Test Report when not required. See also clause 4.8 in   
OD 2020 for more details.

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| --- | --- | --- | --- |
| **Clause #** | **Parameter/ Measurement / test method** | **Requirement % or k** | **Calculated U of M\*** |
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\*Note: Calculations leading to the reported value are on file with the NCB