UL 61010-2-011

STANDARD FOR SAFETY

Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 011: Particular Requirements for Refrigerating Equipment

UL Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 011: Particular Requirements for Refrigerating Equipment, UL 61010-2-011

Second Edition, Dated May 13, 2021

Summary of Topics

This New Edition of ANSI/UL 61010-2-011 is an Adoption of IEC 61010-2-011, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 011: Particular Requirements for Refrigerating Equipment (second edition, issued by IEC March 2019) as a new IEC-based UL Standard, UL 61010-2-011 with US National Differences.

The new requirements are substantially in accordance with Proposal(s) on this subject dated October 20, 2020 and February 5, 2021.

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UL 61010-2-011

Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 011: Particular Requirements for Refrigerating Equipment

First Edition – January, 2017

Second Edition

May 13, 2021

This ANSI/UL Standard for Safety consists of the Second Edition.

The most recent designation of ANSI/UL 61010-2-011 as an American National Standard (ANSI) occurred on May 13, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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PREFACE

This UL Standard is based on IEC Publication 61010-2-011: second edition, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 011: Particular Requirements for Refrigerating Equipment. IEC publication 61010-2-011 is copyrighted by the IEC.

This edition has been issued to satisfy UL Standards policy.

This UL Standard 61010-2-011 Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 011: Particular Requirements for Refrigerating Equipment, is to be used in conjunction with the third edition of UL 61010-1. The requirements for particular requirements for refrigerating equipment are contained in this Part 2 Standard and UL 61010-1.

Requirements of this Part 2 Standard, where stated, amend the requirements of UL 61010-1.

Where a particular subclause of UL 61010-1 is not mentioned in UL 61010-2-011, the UL 61010-1 subclause applies.

Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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NATIONAL DIFFERENCES

National Differences from the text of International Electrotechnical Commission (IEC) Publication 61010-2-011, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 011: Particular Requirements for Refrigerating Equipment, copyright 2019 are indicated by notations (differences) and are presented in bold text.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE – Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61010-2-011 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

It has the status of a group safety publication in accordance with IEC Guide 104.

This second edition cancels and replaces the first edition published in 2016. This edition constitutes a technical revision.

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

a) alignment with changes introduced by Amendment 1 of IEC 61010-1:2010;

b) introduction of new defined terms or modified terms to align with Part 2-012 and other source documents. Editorial changes to use small capitals only for defined terms. Note the difference of defined term ABNORMAL OPERATION (3.107) in 4.3.2.101 and abnormal operation in 11.7.104.3 and 11.7.104.5;

c) clarifications for cooling tests in 4.4.2.10;

d) changes pertaining to the accurate employment of the following terms: temperature, operating temperature, application temperature, CONTROLLED TEMPERATURE, room ambient and ambient temperature;

e) use of defined term REFRIGERATING SYSTEM to replace cooling system;

f) move text of 4.4.2.101 to 4.3.2.101, since the purpose of ABNORMAL OPERATION, as defined, is to simulate failure of the ambient conditions of 1.4.1 but not of the SINGLE FAULT CONDITION of the equipment;

g) use of the term equipment to replace unit, apparatus, appliance, where applicable;

h) in 5.1.2 dd) PS for high and low sides for each REFRIGERANT stage are required only under NORMAL CONDITION;

i) use of defined term NORMAL CONDITION to replace normal operation;

j) use of defined term OPERATOR to replace user.

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

CDV	Report on voting
66/676/CDV	66/683/RVC

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

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

A list of all parts of the IEC 61010 series, published under the general title *Safety requirements for electrical equipment for measurement, control, and laboratory use*, can be found on the IEC website.

This Part 2-011 is to be used in conjunction with the latest edition of IEC 61010-1. It was established on the basis of the third edition (2010) and its Amendment 1 (2016), hereinafter referred to as Part 1.

This Part 2-011 supplements or modifies the corresponding clauses in IEC 61010-1 so as to convert that publication into the IEC standard: *Particular requirements for REFRIGERATING EQUIPMENT.*

Where a particular subclause of Part 1 is not mentioned in this Part 2-011, that subclause applies as far as is reasonable. Where this Part 2-011 states "addition", "modification", "replacement", or "deletion", the relevant requirement, test specification, or note in Part 1 should be adapted accordingly.

In this standard:

1) the following print types are used:

– requirements and definitions: in roman type;

– NOTES: in smaller roman type;

– *conformity and tests: in italic type*;

– terms used throughout this standard which have been defined in Clause 3: SMALL ROMAN CAPITALS.

2) subclauses, figures, tables and notes which are additional to those in Part 1 are numbered starting from 101. Additional annexes are lettered starting from AA and additional list items are lettered from aa).

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore. iec. ch" in the data related to the specific document. At this date, the document will be

• reconfirmed,

• withdrawn,

• replaced by a revised edition, or

• amended.

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

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INTRODUCTION

This Part 2-011, along with Part 2-010 and Part 2-012, taken together, address the specific HAZARDS associated with the heating and cooling of materials by equipment and are organized as follows:

IEC 61010-2-010	Specifically addresses the HAZARDS associated with equipment incorporating heating systems.
IEC 61010-2-011	Specifically addresses the HAZARDS associated with equipment incorporating REFRIGERATING SYSTEMS.
IEC 61010-2-012	Specifically addresses the HAZARDS associated with equipment incorporating both heating and REFRIGERATING SYSTEMS that interact with each other such that the combined heating and REFRIGERATING SYSTEM yield additional or more severe HAZARDS for the two systems than if treated separately. It also addresses the HAZARDS associated with the treatment of materials by other factors like irradiation, excessive humidity, CO_2 and mechanical movement.

Guidance for the application of the correct Part 2 standard(s)

When the equipment includes only a material heating system, and no REFRIGERATING SYSTEM or other environmental factors apply, then Part 2-010 applies without needing Part 2-011 or Part 2-012. Similarly, when the equipment includes only a REFRIGERATING SYSTEM, and no material heating system or other environmental factors apply, then Part 2-011 applies without needing Part 2-010 or Part 2-012. However, when the equipment incorporates both a material heating system, and a REFRIGERATING SYSTEM or the materials being treated in the intended application introduce significant heat into the REFRIGERATING SYSTEM, a determination should be made as to whether the interaction between the two systems will generate additional or more severe HAZARDS than if the systems were evaluated separately (CONTROLLED TEMPERATURE, see flow chart of Figure 102 for selection process). If the interaction of the heating and cooling functions yields no additional or more severe HAZARDS then both Part 2-010 and Part 2-011 apply for their respective functions. Conversely, if additional or more severe HAZARDS result from the combining of the heating and cooling functions, or if the equipment incorporates additional material treatment factors, then Part 2-012 applies, but not Part 2-010 or Part 2-011.

What HAZARDS are applicable for a REFRIGERATING SYSTEM?

The typical HAZARDS for a REFRIGERATING SYSTEM (see Figure 101) consisting of a MOTOR-COMPRESSOR, a condenser, an expansion device and an evaporator include but are not limited to:

– The excess of temperature of the low-pressure side (return temperature) to the MOTOR-COMPRESSOR is higher than admissible. A MOTOR-COMPRESSOR incorporates a REFRIGERANT cooled motor and it should be established that the maximum temperatures of low-pressure side under least favourable condition do not exceed the insulation RATINGS within the motor.

– The excess of pressure of the low-pressure side at the inlet to the MOTOR-COMPRESSOR is higher than admissible. The housing of the MOTOR-COMPRESSOR is exposed to this pressure and so the design RATING of the MOTOR-COMPRESSOR housing should accommodate the worst-case pressures whilst providing the correct safety margin for a pressure vessel.

– The excess of temperature of the high-pressure side to the condenser is higher than admissible. The temperatures of the high-pressure side under the most unfavourable conditions can present a temperature HAZARD if the OPERATOR is exposed, or an electrical HAZARD if insulation is degraded.

– The excess of pressure of the high-pressure side to the condenser is higher than admissible. The REFRIGERANT components downstream of the MOTOR-COMPRESSOR up to the expansion device are exposed to this pressure and so the design RATING of these components should accommodate the worst case pressures whilst providing the correct safety margin for a pressure vessel.

– The maximum CONTROLLED TEMPERATURES where the heat is being extracted from, may impact the maximum temperature of the low-pressure side to the MOTOR-COMPRESSOR as well as present a temperature HAZARD if the OPERATOR is exposed, or an electrical HAZARD if insulation is degraded. Whether this CONTROLLED TEMPERATURE is derived from an integral heating function of the device or from the heat dissipated from the material being cooled, the impact under worst-case conditions should be evaluated.

– The current draw of the equipment should be established when including the worst-case running conditions of the REFRIGERATING SYSTEM including any defrost cycles that may apply.

The worst-case conditions should be determined for the equipment and will include both the least favourable NORMAL USE conditions as well as the most unfavourable testing results under SINGLE FAULT CONDITIONS.

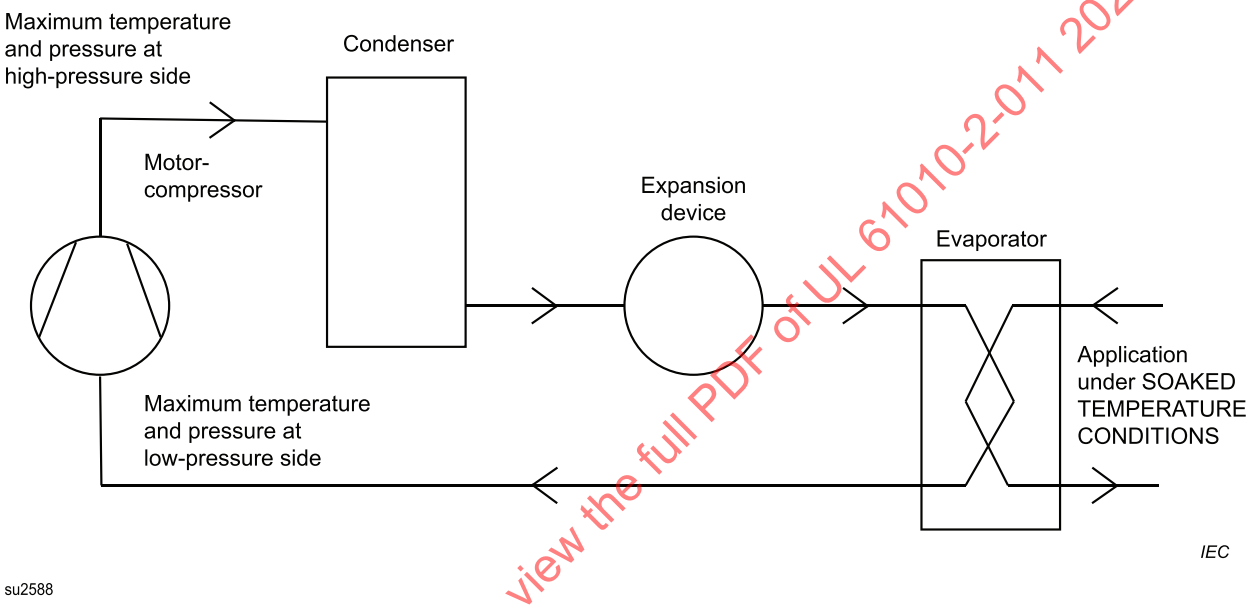

Figure 101

Schema of a REFRIGERATING SYSTEM incorporating a condenser

The selection process is illustrated in the following flow chart (see Figure 102).

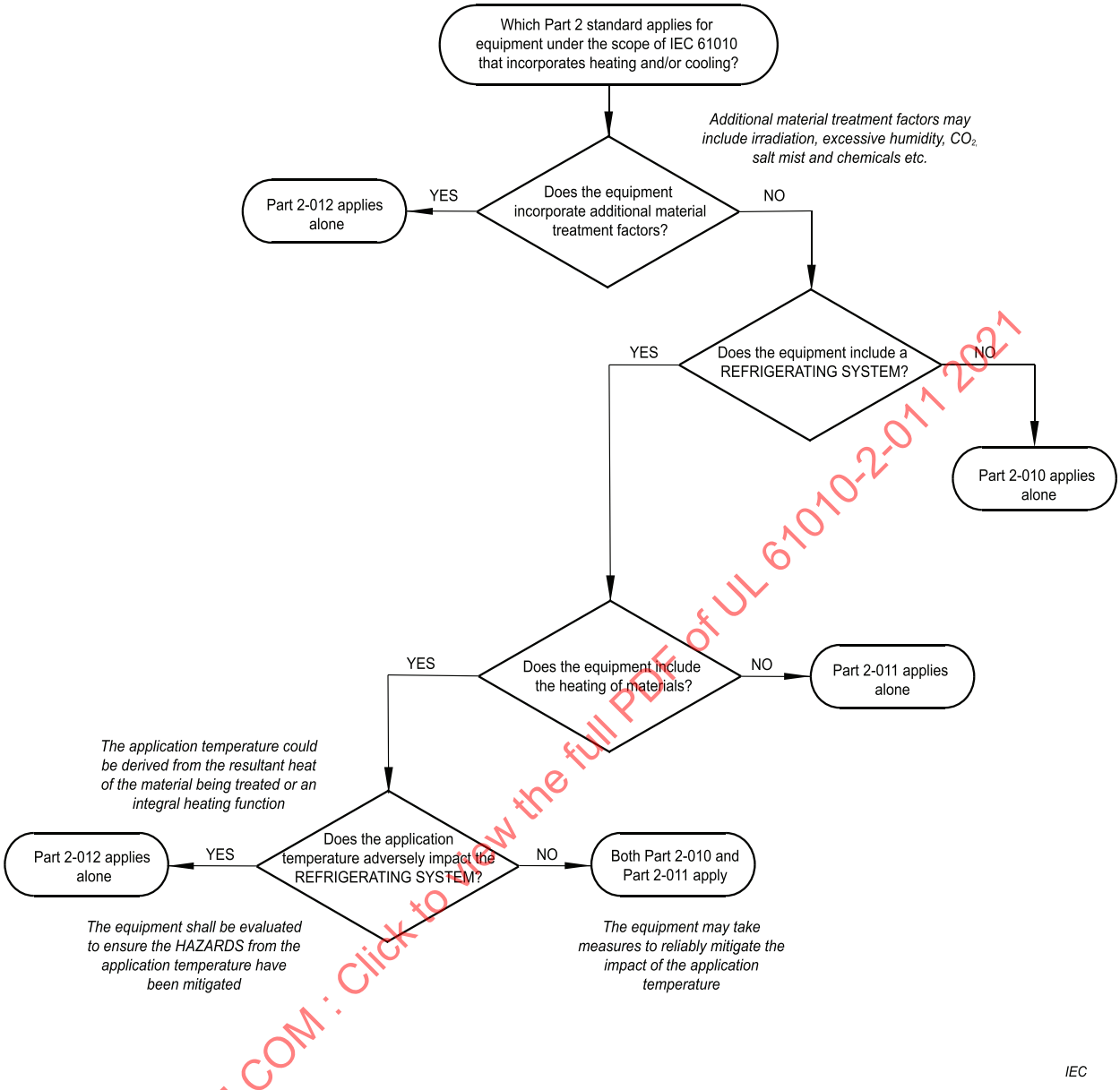

Figure 102

Flow chart illustrating the selection process

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SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE – Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT

1 Scope and object

This clause of Part 1 is applicable, except as follows:

1.1.1 Equipment included in scope

Replacement:

Replace the second paragraph by the following:

This Part 2 of IEC 61010 specifies particular safety requirements for the following types a) to c) of electrical equipment and their accessories, wherever they are intended to be used, whenever that equipment incorporates REFRIGERATING SYSTEMS as an integral part of, or separate from, the equipment and the equipment is in direct control of the REFRIGERATING SYSTEM.

This document details all the requirements when up to 150 g of FLAMMABLE REFRIGERANT are used per stage of a REFRIGERATING SYSTEM. Additional requirements beyond the current scope of this document apply if a REFRIGERANT charge of FLAMMABLE REFRIGERANT exceeds this amount.

Addition:

Add the following text after the last paragraph:

NOTE 101 Examples for REFRIGERATING EQUIPMENT include, but are not limited to, laboratory equipment such as laboratory refrigerators, freezers, refrigerated display cabinets.

It is possible that all or part of the equipment falls within the scope of one or more other Part 2 standards of IEC 61010 as well as within the scope of this standard. In that case, the requirements of those other Part 2 standards will also apply. In particular, if equipment is intended to be used as a centrifuge, the requirements of IEC 61010-2-020 apply. However, when the equipment incorporates a refrigerating system and a heating function where the combination of the two introduces additional or more severe HAZARDS than if treated separately, then it is possible that IEC 61010-2-012 is applicable instead of this Part 2-011.

See further information in the flow chart (Figure 102) for the selection process and guidance in the Introduction.

1.1.2 Equipment excluded from scope

Addition:

Add the following new item after item j):

or equipment incorporating:

aa) a transcritical REFRIGERANT SYSTEM (system that uses CO_2) or a system that uses ammonia (NH_3) as the REFRIGERANT.

1.2 Object

1.2.1 Aspects included in scope

Replacement:

Replace the first paragraph by the following:

The object of this document is to ensure that the design and methods of construction of REFRIGERATING EQUIPMENT provide adequate protection for OPERATORS, bystanders, trained service personnel, and the surrounding area against the specific HAZARDS that relate to REFRIGERATING SYSTEMS.

Addition:

Add the following note after the existing note:

NOTE 101 A list of HAZARDS typically associated with REFRIGERATING SYSTEMS and REFRIGERANTS is included in Annex BB.

2 Normative references

This clause of Part 1 is applicable, except as follows:

Addition:

Add the following references to the list:

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

IEC 60335-2-34:2012, *Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors*
IEC 60335-2-34:2012/AMD1:2015
IEC 60335-2-34:2012/AMD2:2017

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

3 Terms and definitions

This clause of Part 1 is applicable, except as follows:

Addition:

Add the following new terms and definitions:

3.101
REFRIGERATING EQUIPMENT
test, measurement, control or laboratory equipment that incorporates a REFRIGERATING SYSTEM either as an integral part of or separate from the equipment

3.102
REFRIGERATING SYSTEM
combination of interconnected REFRIGERANT-containing parts constituting one closed REFRIGERANT circuit in which the REFRIGERANT is circulated for the purpose of extracting and rejecting heat

[SOURCE: ISO 5149-1:2014, 3.1.9, modified – The term in brackets "(heat pump)", the words "(heating and cooling)", and the note to entry, have been omitted.]

3.103
FLAMMABLE REFRIGERANT
REFRIGERANT with a flammability classification of group 2 or 3 in accordance with ISO 5149-1 and ISO 817

Note 1 to entry: For REFRIGERANT blends which have more than one flammability classification, either the most unfavourable classification is taken for the purpose of this definition or the blend itself is evaluated for flammability in accordance with ISO 817.

3.104
HPCO
HIGH PRESSURE CUT-OUT
pressure-actuated device that is designed to stop the operation of the pressure generator

Note 1 to entry: This note applies to the French language only.

3.105
MAXIMUM ALLOWABLE PRESSURE
PS
maximum pressure for which the equipment is designed, as specified by the manufacturer

Note 1 to entry: This note applies to the French language only.

[SOURCE: ISO 5149-1:2014, 3.3.3]

3.106
SOAKED TEMPERATURE CONDITION
environmental temperature condition when all the temperatures in the equipment under test (EUT) equal to ±2 °C of the test ambient temperature

Note 1 to entry: This note applies to the French language only.

3.107
ABNORMAL OPERATION
operation of a REFRIGERATING EQUIPMENT with a limited RATED ambient temperature range in ambient temperature conditions outside that limitation but within the temperature limits of 1.4.1

3.108
REFRIGERANT
fluid used for heat transfer in a REFRIGERATING SYSTEM, which absorbs heat at a low temperature and a low pressure of the fluid and rejects heat at a higher temperature and a higher pressure of the fluid, usually involving changes of state of the fluid

[SOURCE: ISO 5149-1:2014, 3.7.9, modified – The note has been removed.]

3.109
CONTROLLED TEMPERATURE
temperature where the evaporator is located and to which the low-pressure side of the equipment is exposed, as a result of heat transfer either by active heating or from the application system or specimen

Note 1 to entry: For heat pump systems, where a four-way valve is used to shift between heating and cooling, the function of the condenser and evaporator is exchanged.

3.110
LOWER EXPLOSIVE LIMIT
LEL
concentration of flammable gas or vapour in air, below which an explosive gas atmosphere will not be formed

Note 1 to entry: This note applies to the French language only.

[SOURCE: IEC 60050-426:2008, 426-02-09]

3.111
MOTOR-COMPRESSOR
refrigerating subassembly consisting of the mechanical mechanism of the compressor and the motor, both of which are enclosed in the same sealed housing, with no external shaft seals, and with the motor operating in a REFRIGERANT atmosphere with or without oil

Note 1 to entry: The housing may be permanently sealed, such as by welding or brazing (hermetic MOTOR-COMPRESSOR), or may be sealed by gasketted joints (semi-hermetic MOTOR-COMPRESSOR). A TERMINAL box, a TERMINAL boxcover, and other electrical components or an electronic control system may be included .

[SOURCE: IEC 60335-2-34:2012, 3.101, modified – "appliance" has been replaced by "refrigerating subassembly" and note 2 has been removed.]

3.112
CONDENSING UNIT
specific refrigerating subassembly combination for a given REFRIGERANT, consisting of one or more MOTOR-COMPRESSORS, condensers, liquid receivers (when required) and the regularly furnished accessories

[SOURCE: ISO 5149-1:2014, 3.4.5, modified – The definition has been adapted for the specific case of refrigerating equipment.]

4 Tests

This clause of Part 1 is applicable, except as follows:

4.3 Reference test conditions

4.3.1 Environmental conditions

Addition:

Add the following text after item d):

Since the temperatures, pressures and current draws for a REFRIGERATING SYSTEM are significantly impacted by ambient temperatures in a non-linear way, linear extrapolation of test data is not possible. Therefore tests to establish temperatures, pressures, and current draws of a REFRIGERATING SYSTEM shall be conducted under the following environmental conditions:

aa) an ambient temperature of 40 °C;

bb) a relative humidity not exceeding the limits of 1.4.1 d).

If the equipment is RATED by the manufacturer to operate in extended environmental conditions as defined by 1.4.2 or a more restricted environment condition in accordance with 1.4.1, note 2, then these conditions will define the settings for 4.3.1 aa) or 4.3.1 bb).

When the REFRIGERATING SYSTEM is water cooled, the temperature of the water supply shall be the maximum as specified by the manufacturer (see 5.4.3) with the worst case water pressure as specified by the manufacturer.

If a restricted environment condition in accordance with 1.4.1, note 2, is employed then the test of 4.3.2.101 applies.

4.3.2 State of equipment

4.3.2.1 General

Addition:

Add the following text after the first paragraph:

When measuring temperatures, pressures and current draws of equipment incorporating a REFRIGERATING SYSTEM the tests shall be started from a SOAKED TEMPERATURE CONDITION when all pressures have fully equalized. Tests at the extremes of the input voltage (±10 %) shall start under these voltage conditions and achieve a stable state but need not start from a SOAKED TEMPERATURE CONDITION. Safety protective devices shall not operate during this test.

Addition:

Add the following new subclause:

4.3.2.101 ABNORMAL OPERATION to simulate the failure of the controlled environment

For REFRIGERATING EQUIPMENT intended to operate in a restricted environment and tested in accordance with 4.3.1 this additional test of ABNORMAL OPERATION shall apply to simulate the failure of the controlled environment in the installation.

Having determined the worst case test condition for the temperature and pressure tests under 10.4.1 the equipment is run under these conditions until a steady state has been achieved. The test environment is then increased to the limits from 1.4.1 for normal environmental conditions (40 °C, up to 50 % RH) and the equipment is allowed to stabilize, and the maximum temperatures and pressures are recorded. The operation of protective devices is permitted during this test. If steady state conditions are not possible due to the operation of protective devices then the maximum values recorded for this test shall be either:

– the maximum temperatures and pressures at the point of operation of non-resettable or manually resettable devices. The manually resettable device does not need to be reset during this test; or

– the maximum temperatures and pressures achieved after the cycling of auto-resetting protective devices. Cycling shall continue until it is clear that successive cycles will not develop higher maximum values.

4.4.2 Application of fault conditions

4.4.2.10 Cooling

Replacement:

Replace the text with the following:

For cooling not associated with the cooling of the REFRIGERATING SYSTEM:

a) air-holes with filters shall be closed;

b) forced cooling by motor-driven fans shall be stopped;

c) cooling by circulation of water or other coolant shall be stopped.

For cooling associated with the cooling of the REFRIGERATING SYSTEM:

d) Condenser fan stall test – for an air cooled REFRIGERATING SYSTEM

> Each condenser fan shall be stalled one at a time unless a single fault could disable all condenser fans simultaneously, or with the condenser airflow restricted, whichever is the worst case, until maximum stabilized pressure is attained or until representative maximum temperatures are attained under cycling load. The temperatures and pressures shall be monitored at short intervals throughout the test for the pressures to ensure that peak pressures are captured. This test is conducted at an ambient temperature of 25 °C ± 3 °C.

e) Condenser water failure test – for a water cooled REFRIGERATING SYSTEM

> The REFRIGERATING SYSTEM shall be operated with the condensing water shut off, or with the condensing water restricted whichever is the worst case, until maximum stabilized temperatures are attained or until representative maximum temperatures are attained under cycling load. The temperatures and pressures shall be monitored at short intervals throughout the test for the pressures to ensure that peak pressures are captured. This test is conducted at an ambient temperature of 25 °C ± 3 °C.

If a manual reset HPCO is relied upon to limit the peak pressure during tests d) or e), then it shall be reset manually within 6 s of operation for 10 cycles.

If an automatic reset HPCO is relied upon to limit the peak pressure during tests d) or e), then it shall be permitted to cycle automatically until it can be demonstrated that peak temperatures and pressures have been achieved.

If it can be demonstrated that an HPCO will operate during tests d) or e), the manufacturer can elect to waive this test, but will set the PS for the high and low side of the MOTOR-COMPRESSOR to the RATING of the HPCO.

For equipment with both air-cooled and water-cooled condensers, only one can be faulted at a time unless the customer is permitted to run either the air-cooled or water-cooled condenser (the design incorporates a redundant cooling option for the condenser).

For a cascade REFRIGERATING SYSTEM, if a heat exchanger from the first stage system acts as a condenser to the second stage system, then the manufacturer can elect to run each condenser stage individually

under the tests of d) or e) accordingly. In this case, disabling the first stage system is considered to simulate the second stage running under a test condition of d) or e).

Addition:

Add the following new subclause:

4.4.2.101 Uncontrolled cooling test

Temperature controllers shall be overridden to produce uncontrolled cooling. This applies regardless of whether the controller controls the temperature of the equipment, heat transfer medium or material being processed.

4.4.3.1 General

Addition:

Add the following paragraph after the first paragraph:

Owing to the time it can take to achieve stable conditions for a REFRIGERATING SYSTEM, the duration of single fault tests can be longer than 4 h unless it is clear that stable conditions have been maintained for at least 1 h.

5 Marking and documentation

This clause of Part 1 is applicable, except as follows:

5.1.2 Identification

Addition:

Add the following new items after the note following item b):

aa) the total mass of REFRIGERANT for each separate REFRIGERANT circuit;

bb) for a single component REFRIGERANT, at least one of the following:

– the chemical name,

– the chemical formula,

– the REFRIGERANT number,

cc) for a blended REFRIGERANT, at least one of the following:

– the chemical name and nominal proportion of each of its components,

– the chemical formula and nominal proportion of each of its components,

– the REFRIGERANT number and nominal proportion of each of its components,

– the REFRIGERANT number of the REFRIGERANT blend,

NOTE 101 REFRIGERANT numbers are quoted in accordance with ISO 817 or other REFRIGERANT classification standard, for example ANSI/ASHRAE 34.

dd) MAXIMUM ALLOWABLE PRESSURE (PS) under NORMAL CONDITION, high- and low-pressure sides for each REFRIGERANT stage.

NOTE 102 The collation of the test results that define PS is detailed in 11.7.101.

5.1.3 MAINS supply

Replacement:

Replace the conformity statement as follows:

Conformity is checked by inspection and by measurement of the power or input current to check the marking of 5.1.3 c). The measurement is made with the equipment in the condition of maximum power consumption, but to exclude any initial inrush current, it is not made until the current has stabilized (usually after 1 min). Transients are ignored. For REFRIGERATING EQUIPMENT, the impact of extreme ambient temperatures and the interaction of any defrost mode need to be evaluated in determining the condition of maximum power consumption.

Addition:

Add the following new symbols to Table 1:

Table 1

Symbols

Number	Symbol	Reference	Description
101		ISO 7010 - W010 (2011-05)	Warning; low temperature/freezing conditions, frostbite HAZARD (MOD)
102		ISO 7010 - W021 (2011-05)	Warning; flammable material
103		ISO 7010 - W011 (2011-05)	Warning; slippery surface
104		ISO 7010 - W024 (2011-05)	Warning; crushing of hands

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5.2 Warning markings

Replacement:

Replace item a) by the following:

a) the perpendicular height of the triangle for all warning symbols shall be at least 15 mm. The height of text shall be at least 1,8 mm, depending on the size of the equipment, the legibility during NORMAL USE and the space available for the symbol. Symbols and text shall have clear contrast in colour with the background.

Addition:

Add the following new paragraph before the conformity statement:

Warning markings or symbols for particular HAZARDS, which exist or develop only when performing installation or maintenance of the equipment, shall be marked and visible only when executing this particular maintenance. For example, the marking of the type of FLAMMABLE REFRIGERANT and of the flammable insulation blowing gas, shall be visible when gaining access to the MOTOR-COMPRESSORs, and, in the case of equipment with a remote REFRIGERANT CONDENSING UNIT, the pipe connections. Symbol 102 of Table 1 shall be placed on the nameplate of the equipment near the declaration of the REFRIGERANT type and charge information. It shall be visible after installation of the REFRIGERATING EQUIPMENT.

5.4.1 General

Replacement:

Replace item d) by the following:

d) the information specified in 5.4.2 to 5.4.6, 5.4.101 and 5.4.102;

5.4.3 Equipment Installation

Replacement:

Replace the note with the following text

NOTE A statement in the documentation for the installation can be added to indicate that the safety of any system incorporating the equipment is the responsibility of the assembler of the system.

Add the following new note:

NOTE 101 In the US, equipment containing FLAMMABLE REFRIGERANT is required to have additional instructions – see informative Annex DD.

5.4.4 Equipment operation

Addition:

Add the following new item after 5.4.4 j):

aa) information to allow safe access during use, including identification of trip and slip HAZARDS (see also 7.3.101 and 16.101).

Addition:

Add the following new subclauses:

5.4.101 Additional instructions for equipment with a separate REFRIGERANT CONDENSING UNIT and intended for connection to a water supply

For equipment with a separate REFRIGERANT CONDENSING UNIT, the instructions shall include a statement containing the substance of the following:

The installation of the REFRIGERATING EQUIPMENT and the REFRIGERANT CONDENSING UNIT shall only be made by the manufacturer's service personnel or similarly skilled person.

The information provided with the REFRIGERATING EQUIPMENT with a separate REFRIGERANT CONDENSING UNIT shall include

– information on the type of separate REFRIGERANT CONDENSING UNIT to which the cabinet shall be connected;

– an electrical diagram showing the electrical terminals for connections.

For equipment intended for connection to a water supply for cooling purposes, the instructions shall contain information on the maximum permitted temperature and maximum and minimum pressure of the inlet water consistent with safe operation of the equipment.

5.4.102 Additional instructions for equipment that uses FLAMMABLE REFRIGERANT

For equipment that uses FLAMMABLE REFRIGERANT, the instructions shall include information pertaining to the handling, servicing and disposal of the equipment.

The instructions for equipment which uses a FLAMMABLE REFRIGERANT shall include the substance of the following warnings as necessary:

– WARNING: Ensure all ventilation openings are not obstructed.

– WARNING: Do not use mechanical devices or other means to accelerate the defrosting process, other than those recommended by the manufacturer.

– WARNING: Do not damage the refrigerant circuit.

For equipment which uses flammable insulation blowing gases, the instructions shall include information regarding disposal of the equipment.

The instructions for split-systems that use a FLAMMABLE REFRIGERANT shall include the substance of the following warning:

• WARNING: In order to reduce flammability HAZARDS the installation of this equipment shall only be carried out by a suitably qualified person.

6 Protection against electric shock

This clause of Part 1 is applicable, except as follows:

6.8.3.1 The a.c. voltage test

Replacement:

Replace the first sentence of the first paragraph by the following text:

The voltage tester shall be capable of maintaining the test voltage throughout the test within ±5 % of the specified value.

7 Protection against mechanical HAZARDS

This clause of Part 1 is applicable, except as follows:

7.3 Moving parts

Addition:

Add the following new subclause:

7.3.101 Door closure and locking mechanisms

For door latching or locking devices with or without self-locking mechanisms, where careless operation can cause crushing HAZARDS for hands or fingers, the symbol 104 of Table 1 shall be marked on the location or part where the HAZARD can occur, warning of the motion of mechanical parts and against the HAZARD of crushing.

Conformity is checked by inspection.

8 Resistance to mechanical stresses

This clause of Part 1 is applicable.

8DV D1 ***Addition of Clauses 8.1DV.1 – 8.DV.2 Resistance to mechanical stresses***

This clause of Part 1 is applicable, except as follows:

8DV.1 ***Refrigerant tubing on a refrigerator employing a flammable refrigerant shall be protected or enclosed to avoid mechanical damage and damage that could occur during moving of the product.***

8DV.1.1 ***Refrigerant tubing located within the confines of the cabinet and tubing that does not protrude from the compressor compartment are considered to be protected from mechanical damage.***

8DV.1.2 ***A static condenser coil mounted on the outside of a refrigerator is considered to be protected against mechanical damage if it complies with all of the following:***

– The return bends of the condenser are covered such that they cannot be grasped or handled during moving of the product. The return bends are considered to be adequately covered if they cannot be grasped with the jointed test finger (see Figure B.2) applied with a force of 20 N.

– The other edges of the condenser are covered or secured to prevent damage during moving of the product. They are considered adequately secured if they meet the pull force requirements of 8DV.3 without deformation of the tubing or loosening of the condenser from the refrigerator.

– All other tubing in the condenser is adequately protected by the fill wire. The tubing is considered adequately protected if any single tube cannot be grasped with the jointed test finger (see Figure B.2) applied with a force of 20 N.

8DV.3 ***A static evaporator coil mounted as shelving on the inside of a storage compartment is considered to be protected against mechanical damage if it complies with all of the following:***

– The shelf shall comply with 8DV.3 and 7.5.3 with no permanent deformation or damage resulting in a refrigerant leak, kinked refrigerant tubing, or loosening of the tubing from the refrigerator.

– The tubing shall comply with the scratch test of 11.7.104.4.

8DV.2 ***All joints in a refrigeration system containing a FLAMMABLE REFRIGERANT shall be brazed or welded. Joining methods other than brazing or welding that have been evaluated with respect to corrosion resistance, mechanical stress, leak rates, and similar methods shall be considered to comply.***

8DV.3 ***A force is applied without jerks for 10 s in the most unfavourable direction to parts likely to be weak. The force is as follows:***

– if the shape of the part is such that the fingertips cannot easily slip off, 50 N;

– if the projection of the part that is gripped is less than 10 mm in the direction of removal, 30 N.

The pull force is applied by a suitable means, such as a suction cup, so that the test results are not affected. While the force is being applied, the test finger of Figure B.2 is inserted in any aperture or joint with a force of 10 N. The finger is then slid sideways with a force of 10 N but is not twisted or used as a lever.

9 Protection against the spread of fire

This clause of Part 1 is applicable, except as follows:

Addition:

Add the following new subclause:

9.5.101 Warning requirements for flammable liquids

If a FLAMMABLE REFRIGERANT, FLAMMABLE REFRIGERANT blends and/or flammable insulation blowing gases are used, the equipment shall be marked with symbol 102 of Table 1. Additional explanations for the warning symbol shall be detailed in the documentation for the OPERATOR, service personnel and RESPONSIBLE BODY for final disposal of the equipment, including warnings of the flammable materials and against HAZARDS of fire and/or explosion (see 5.4.102).

In other cases where flammable material is present in the equipment, symbol 102 can be used as a warning marking.

10 Equipment temperature limits and resistance to heat

This clause of Part 1 is applicable, except as follows:

10.1 Surface temperature limits for protection against burns

Replacement:

Replace the second paragraph by the following:

If easily touched heated surfaces are necessary for functional reasons, whether because they are intended to deliver heat or are hot because of proximity to heating parts, they are permitted to exceed the values of Table 19 in NORMAL CONDITION and to exceed 105 °C in SINGLE FAULT CONDITION, provided that they are recognizable as such by appearance or function or are marked with symbol 13 of Table 1 (see 5.2).

10.2 Temperatures of windings

Addition:

Add the following text and table below Table 20:

Conformity for MOTOR-COMPRESSORs is checked by measurement as specified in 10.4, 4.3.2.101 in NORMAL CONDITION, and in the applicable SINGLE FAULT CONDITIONS of 4.4.2.10 and also in any other SINGLE FAULT CONDITIONS that could cause a HAZARD as a result of excessive temperature or pressure. The temperature limits for MOTOR-COMPRESSORS are defined in Table 101. The pressures are recorded for use in 11.7.2.

For MOTOR-COMPRESSORS conforming with IEC 60335-2-34:2012, IEC 60335-2-34:2012/AMD1:2015 and IEC 60335-2-34:2012/AMD2:2017 (including its Annex AA), the temperature of the compressor housing and of the windings are not measured. For MOTOR-COMPRESSORS not conforming with these requirements, the temperature test methods detailed in IEC 60335-2-34 shall be employed to measure the temperature of the windings.

10.2DV DC *Modification: Replacement of the IEC Standards referenced in the above paragraph with the following:*

UL 60335-2-34, 4th Edition (revised 2013-11-19)

UL 60335-2-34, 5th Edition (issued 2013-03-22)

UL 60335-2-34, 6th Edition (issued 2017-11-03)

Table 101
Maximum temperatures for MOTOR-COMPRESSORS

Part of the MOTOR-COMPRESSOR	Temperature (°C)
Windings with	
– synthetic insulation	140
– cellulosic insulation or the like	130
Housing	150

10.3 Other temperature measurements

Addition:

Add the following new item after 10.3 e):

aa) The temperature of components of the REFRIGERATING SYSTEM to establish maximum pressures (see 11.7.101).

10.4 Conduct of temperature tests

10.4.1 General

Replacement:

Replace the text with the following:

Maximum temperature is determined by measuring the temperature rise under reference test conditions defined by 4.3.1 of this document. Linear extrapolation is not permitted. Unless a particular SINGLE FAULT CONDITION specifies otherwise, the manufacturer's instructions concerning ventilation, cooling liquid, limits for intermittent use, etc., are followed. Any cooling liquid shall be at the highest RATED temperature. Operating pressures shall be monitored and recorded during all the temperature runs for use in the evaluation of PS.

Alternatively, temperature measurements are made at the least favourable ambient temperature within the RATED ambient temperature range of the equipment if this represents a less favourable condition. Measures are taken to eliminate errors caused by the method of achieving the test ambient temperature (e.g. suitable baffling or ENCLOSURE if the test is conducted in an environmental testing TEST CHAMBER and the forced air movements would cool the exterior of the equipment).

When measuring temperatures and pressures for REFRIGERATING EQUIPMENT the tests shall be started from a SOAKED TEMPERATURE CONDITION when all pressures have been fully equalized. Tests at the extremes of the input voltage (±10 %) shall start under these voltage conditions and achieve a stable state but need not start from a soaked condition. Safety protective devices shall not operate during NORMAL CONDITION tests. At the termination of the test, the monitoring shall continue after the equipment is switched off until the pressures from each REFRIGERANT stage have equalized or clearly demonstrate that maximum values have been reached.

During NORMAL CONDITION tests, protective devices other than self-resetting thermal motor-protectors for MOTOR-COMPRESSORS shall not operate. When steady conditions have been established, thermal motor-protectors for MOTOR-COMPRESSORS shall not operate.

Addition:

Add the following new subclause:

10.101 Protection against cold surfaces

If the minimum surface temperature of easily touched cold surfaces exceeds the value of −30 °C, the cold surface shall be marked with symbol 101 of Table 1 to warn the OPERATOR against frostbite HAZARD.

Conformity is checked by inspection.

11 Protection against HAZARDS from fluids and solid foreign objects

This clause of Part 1 is applicable, except as follows:

11.7 Fluid pressure and leakage

Addition:

Add the following new subclauses:

11.7.101 Maximum pressure in a REFRIGERATING SYSTEM

The maximum pressure to which a part of the equipment can be subjected under NORMAL CONDITION or SINGLE FAULT CONDITION shall not exceed the RATED maximum working pressure for the part. The RATED maximum working pressure of a component is determined by either its RATING (if certified to the component requirements of 14.101) or by design if the parts can pass the tests of 11.7.102.

The MAXIMUM ALLOWABLE PRESSURE (PS) shall be determined by test or by applying the saturated REFRIGERANT pressures at the minimum specified temperatures given in Table 102. In case of doubt, testing shall be performed. If the start-to-discharge pressure of a pressure relief valve or the set pressure of a rupture member used in the sealed system is less than the saturated vapour pressure derived from Table 102, it can be used to limit PS for that system. When saturated REFRIGERANT pressures are used to define PS, the manufacturer is exempted from recording the pressures during the normal and abnormal tests. The value of PS, when determined by test, shall be considered to be the highest of the following:

a) the maximum pressure developed during the temperature runs as defined by 10.4.1;

b) the maximum pressure developed during the cooling failure SINGLE FAULT CONDITION test defined by 4.4.2.10 d) or 4.4.2.10 e);

c) the maximum pressure developed during the test of 4.3.2.101 if applicable;

d) the maximum pressure developed during the test of 11.7.104.8.

NOTE 1 For each refrigeration stage the pressure system can be separated into two sections, i.e. the high- and low-pressure side of each compressor, and the PS value can be different for each side of the pressure system.

NOTE 2 It is possible that equipment meeting the requirements of 11.7 is not accepted as conforming to national requirements relating to high pressures. There are notes applied to the relevant requirements which detail the modification of these requirements in order to be accepted as evidence of conformity with national regulations in the USA, in Canada, and in some other countries.

Table 102
Minimum temperature for determination of saturated vapour pressure of REFRIGERANT

Ambient conditions	≤ 43 °C	≤ 55 °C
High-pressure side with air cooled condenser	63 °C	67 °C
High-pressure side with water cooled condenser or water heat pump	Maximum leaving water temperature + 8 K	
High-pressure side with evaporative condenser	43 °C	55 °C
Low-pressure side with heat exchanger exposed to the outdoor ambient temperature	43 °C	55 °C
Low-pressure side with heat exchanger exposed to the indoor ambient temperature	38 °C	38 °C
NOTE 1 For the high-pressure side, the specified temperatures are considered the maximum which will occur during operation. These temperatures are higher than the temperatures that would occur if the compressor had been running and then turned off. For the low-pressure side, it is sufficient to base the calculation of pressure on the expected temperature of the compressor after it has been running and then turned off. These temperatures are minimum temperatures and thus determine that the system will not be designed for a MAXIMUM ALLOWABLE PRESSURE (PS) lower than the REFRIGERANT saturated vapour pressure corresponding to these minimum temperatures. NOTE 2 The use of specified temperatures does not always result in REFRIGERANT saturated vapour pressure within the system, for example a limited charge system or a system working at or above critical temperature, CO_2 in particular. NOTE 3 For zeotropic blends the MAXIMUM ALLOWABLE PRESSURE (PS) is the pressure at the bubble point.		

11.7.102 Leakage and rupture at high pressure

11.7.102.1 General

REFRIGERANT containing parts of a REFRIGERATING SYSTEM shall not cause a HAZARD through rupture or leakage. The specific requirements for using FLAMMABLE REFRIGERANT or FLAMMABLE REFRIGERANT blends are addressed in 11.7.104.

For components subject to the high-pressure side or low-pressure side of the REFRIGERATING SYSTEM, the structural strength of the fluid containing parts shall comply with three times the PS as defined in 11.7.101 for the high-pressure side or low-pressure side of the REFRIGERATING SYSTEM.

Conformity is checked by inspection of the RATINGS of the components exposed to this pressure and, if a HAZARD could arise, by the following pressure test. Components that are certified to the component requirements of 14.101 and are used within their RATINGS (component pressure rating ≥ PS) are deemed to comply with this requirement without test.

NOTE 1 For evidence of conformity with national regulations in the USA, in Canada, and in some other countries, the structural strength of components are identical but the design RATING of the component is different based on the safety margin required in the national regulations. For example, in the USA the design RATING for a component complying with the ASME boiler code is 1/5 of the structural strength of the component.

NOTE 2 In conjunction with NOTE 1, the minimum structural strength RATING of REFRIGERANT containing components in the USA and Canada is five times the maximum pressure measured during normal pressure tests and three times the maximum pressure measured during abnormal pressure tests. Note the fact of these certification differences during selection of certified components from North America based on the testing conducted in this document.

11.7.102.2 Pressure test

The pressure of the component or assembly (equipment under test (EUT)) is raised, by air or non-hazardous gas or via a hydrostatic pressure test, gradually to the specified test value and is held at that value for 1 min. If the continuous CONTROLLED TEMPERATURE for the EUT is less than or equal to 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the EUT during this test shall be at least 20 °C. If the continuous CONTROLLED TEMPERATURE for the EUT exceeds 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the EUT during this test shall be at least 150 °C for copper or

aluminium and 260 °C for steel. For other materials or higher temperatures, the effects of temperature on the material fatigue characteristics shall be evaluated.

The EUT is considered to have complied with the requirements of this test if it withstands the pressure test without rupture. If the EUT does not comply, then an alternate method to demonstrate compliance is to subject the EUT to the fatigue test detailed below.

11.7.102.2DV.1 D1 *Addition of the following at the end of the first paragraph:*

The test value shall be determined as the higher of the following 3:

5 times the pressure under normal use [see 11.7.101 a)]

3 times the pressure under transportation [see 11.7.101 d)]

3 times the pressure under single fault condition [see 11.7.101 b) and c)]

11.7.102.3 Fatigue test

If the continuous CONTROLLED TEMPERATURE of the EUT exceeds 125 °C for copper or aluminium, or 200 °C for steel, the fatigue test temperature of the parts or assemblies that are at these temperatures, shall be at least 10 K above the continuous CONTROLLED TEMPERATURE. Static test pressure shall be increased by the ratio of the allowable stress of the material at ambient temperature to that at the highest continuous CONTROLLED TEMPERATURE. For other materials, the effects of temperature on the fatigue characteristics shall be evaluated to determine the test conditions.

Three test samples shall be filled with fluid and shall be connected to a pressure-driving source. The pressure shall be raised and lowered between the upper and lower cyclic values at a rate specified by the manufacturer for a total number of 250 000 cycles. The entire specified pressure excursion shall occur during each cycle.

The following test pressures shall be applied:

For safety purposes, it is suggested that a non-compressible fluid be used.

– For components at the low-pressure side, the PS for the low-pressure side shall be applied for the first cycle. For components at the high-pressure side, the PS for the high-pressure side shall be applied for the first cycle.

The pressure for the test cycles shall be as follows:

– The upper pressure value shall not be less than 0,7 times the PS and the lower pressure value shall not be greater than 0,2 times the PS.

– For the final test cycle, the test pressure shall be increased to 1,4 times the PS (2 times 0,7 times the PS).

The component shall not rupture, burst or leak during this test.

A strength pressure test at 2 times the PS is to be performed on three samples, other than the samples used for the fatigue test.

The component shall not rupture, burst or leak during this test.

11.7.103 Leakage from low-pressure parts of the REFRIGERANT circuit

For REFRIGERATING EQUIPMENT the requirements of 11.7.102 address the low-pressure leakage evaluation of the low-pressure side of the REFRIGERANT circuit.

11.7.104 Additional requirements for REFRIGERATING EQUIPMENT that uses FLAMMABLE REFRIGERANT

11.7.104.1 General

This document addresses the requirements for REFRIGERATING EQUIPMENT which uses FLAMMABLE REFRIGERANT when the amount of REFRIGERANT is limited to a maximum of 150 g in each separate REFRIGERANT circuit. For equipment that uses a REFRIGERANT charge of FLAMMABLE REFRIGERANT that exceeds this amount, additional requirements shall apply.

NOTE 1 ISO 5149 or EN 378-1, EN 378-2, EN 378-3, and EN 378-4 are standards that address requirements for REFRIGERATING SYSTEMS that utilize a quantity greater than 150 g of FLAMMABLE REFRIGERANT and can be used to identify what the additional requirements can be.

NOTE 2 It is possible that equipment containing FLAMMABLE REFRIGERANTS which complies with this document does not meet the requirements for the US. See Annex DD for additional warning markings required for the US.

11.7.104.2 Protected REFRIGERATING SYSTEM

REFRIGERATING EQUIPMENT with a protected REFRIGERATING SYSTEM is that:

– without any part of the REFRIGERATING SYSTEM inside an OPERATOR access compartment;

– where any part of the REFRIGERATING SYSTEM which is located inside an OPERATOR access compartment is constructed so that the REFRIGERANT is contained within an ENCLOSURE with at least two layers of metallic materials separating the REFRIGERANT from the OPERATOR access compartment, each layer having a thickness of at least 0,1 mm. The ENCLOSURE has no joints other than the bonded seams of the evaporator where the bonded seam has a width of at least 6 mm;

– where any part of the REFRIGERATING SYSTEM which is located inside an OPERATOR access compartment has the REFRIGERANT contained in an ENCLOSURE which itself is contained within a separate protective ENCLOSURE. If leakage from the containing ENCLOSURE occurs, the leaked REFRIGERANT is contained within the protective ENCLOSURE and the REFRIGERATING EQUIPMENT will not function as in NORMAL USE. The protective ENCLOSURE shall also withstand the test of 11.7.102. No critical point in the protective ENCLOSURE shall be located within the OPERATOR access compartment.

Separate compartments with a common air circuit are considered to be a single compartment.

REFRIGERATING EQUIPMENT with a protected REFRIGERATING SYSTEM and which uses FLAMMABLE REFRIGERANT shall be so constructed as to avoid any fire or explosion HAZARD in the event of leakage of the REFRIGERANT from the REFRIGERATING SYSTEM.

Separate components such as thermostats which contain less than 0,5 g of FLAMMABLE REFRIGERANT are not considered to cause a fire or explosion HAZARD in the event of a leakage from the component itself.

For REFRIGERATING EQUIPMENT with a protected REFRIGERATING SYSTEM, no additional requirements apply to electrical components located inside OPERATOR access compartments.

Equipment with a protected REFRIGERATING SYSTEM which, when tested, is found not to comply with the requirements specified for a protected REFRIGERATING SYSTEM, can be considered as having an

unprotected REFRIGERATING SYSTEM if it is tested in accordance with 11.7.104.5 and found to comply with the requirement for an unprotected REFRIGERATING SYSTEM.

Compliance is checked by inspection and by the tests of 11.7.104.3 and 11.7.104.4.

11.7.104.3 Leakage test for FLAMMABLE REFRIGERANT

Critical points are only considered to be the interconnecting joints between parts of the REFRIGERANT circuit, including the gasket of a semi-hermetic MOTOR-COMPRESSOR. Welded telescopic joints of the MOTOR-COMPRESSOR, the welding of the pipes through the compressor housing and the welding of the hermetic glass-to-metal seals (fusite) are not considered critical points.

To find the most critical point of the REFRIGERATING SYSTEM, it can be necessary to perform more than one test.

The method for simulating a leakage is to inject the REFRIGERANT vapour through a capillary tube at the critical point. The capillary tube shall have a bore of 0,7 mm ± 0,05 mm and a length between 2 m and 3 m.

Care should be taken that the installation of the capillary tube does not unduly influence the results of the test and that foreign material does not enter the capillary tube during insulation or assembly for test. It can be necessary to position the capillary tube before the equipment is insulated.

During this test the REFRIGERATING EQUIPMENT is tested with doors and lids closed, and is switched off or operated under NORMAL CONDITION at RATED voltage, whichever gives the more unfavourable result.

During a test in which the REFRIGERATING EQUIPMENT is operated, gas injection is started at the same time as the equipment is first switched on.

The quantity of REFRIGERANT of the type indicated by the manufacturer to be injected is equal to 80 % of the nominal charge of the REFRIGERANT ±1,5 g or the maximum that can be injected in 1 h, whichever is the smaller.

The quantity injected is taken from the vapour side of a gas bottle which shall contain enough liquid REFRIGERANT to ensure that, at the end of the test, there is still liquid REFRIGERANT left in the bottle.

If a blend can fractionate, the test is performed using the fraction that has the smallest value of the LOWER EXPLOSIVE LIMIT.

The gas bottle is kept at an ambient temperature of:

a) 32 °C ± 2 °C for leakage simulation on low-pressure-side circuits;

b) 70 °C ± 2 °C for leakage simulation on high-pressure-side circuits.

The quantity of gas injected should preferably be measured by weighing the bottle.

The concentration of leaked REFRIGERANT is measured at least every 30 s from the beginning of the test and for at least 1 h after injection of the gas has stopped, inside and outside OPERATOR ACCESSIBLE areas, as close as possible to electrical components which, during NORMAL CONDITION or abnormal operation, produce sparks or arcs.

The concentration is not measured close to

– non-self-resetting protective devices necessary for compliance with single fault testing under 4.4 even if they produce arcs or sparks during operation,

– intentionally weak parts that become permanently open-circuited during the single fault testing under 4.4 even if they produce arcs or sparks during operation,

– electrical apparatus that has been tested and found to comply with at least the requirements in Annex AA.

The instruments used for monitoring gas concentrations (such as those which use infra-red sensing techniques) should have a fast response, typically 2 s to 3 s and not unduly influence the result of the test.

If gas chromatography is to be used, the gas sampling in confined areas should occur at a rate not exceeding 2 ml every 30 s.

Other instruments are not precluded from being used provided that they do not unduly influence the results.

The measured value shall not exceed 75 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 103, and shall not exceed 50 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 103 for a period exceeding 5 min.

Substitution of an inert gas for leak test purposes is permitted if it can be demonstrated that the molecular mass of an inert gas matches that of the FLAMMABLE REFRIGERANT in question.

11.7.104.4 Scratch test for protected REFRIGERATING SYSTEMS

All ACCESSIBLE surfaces of the protected REFRIGERATING SYSTEM, including ACCESSIBLE surfaces in intimate contact with the protected REFRIGERATING SYSTEM, are scratched using the TOOL the tip of which is shown in Figure 103.

The TOOL is applied using the following parameters:

– force at right angles to the surface to be tested..... 35 N ± 3 N;

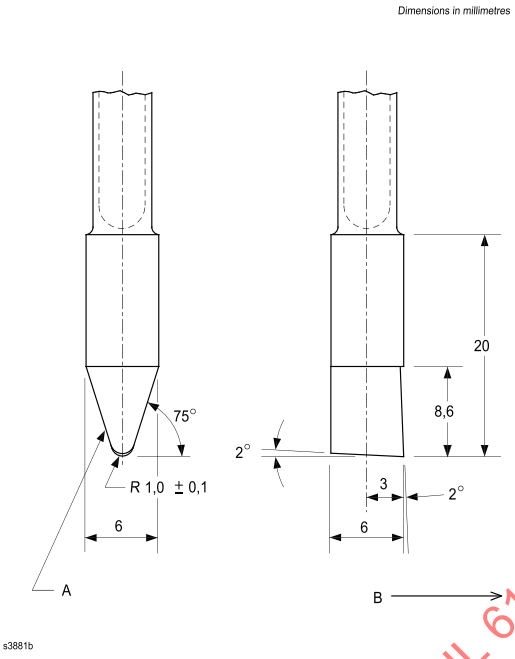
– force parallel to the surface to be tested..... not exceeding 250 N.

The TOOL is drawn across the surface to be tested at a rate of approximately 1 mm/s.

The surface to be tested is scratched at three different positions in a direction at right angles to the axis of the channel and at three different positions on the channel in a direction parallel to it. In the latter case, the length of the scratch shall be approximately 50 mm.

The scratches shall not cross each other.

The appropriate parts of the REFRIGERATING EQUIPMENT shall withstand the test of 11.7.102 with the test pressure reduced by 50 %.



Key

A Hard-soldered carbide tip K10

B Direction of movement

Figure 103

Scratching TOOL tip details

11.7.104.5 Unprotected REFRIGERATING SYSTEMS

REFRIGERATING EQUIPMENT with an unprotected REFRIGERATING SYSTEM is that where at least one part of the REFRIGERATING SYSTEM is placed inside an OPERATOR ACCESSIBLE compartment or that which does not comply with 11.7.104.2.

For REFRIGERATING EQUIPMENT with an unprotected REFRIGERATING SYSTEM and which uses FLAMMABLE REFRIGERANT, any electrical component located inside the OPERATOR ACCESSIBLE compartment, which during NORMAL CONDITION or SINGLE FAULT CONDITION produces arcs or sparks, and luminaries, shall be tested and found at least to comply with the requirements of Annex AA for group IIA gases or for the REFRIGERANT used.

This requirement does not apply to

– non-self-resetting protective devices necessary for compliance with 4.4, nor to

– intentionally weak parts that become permanently open-circuited during the tests of 4.4, even if they produce arcs or sparks during operation.

REFRIGERANT leakage into OPERATOR ACCESSIBLE compartments shall not result in an explosive atmosphere outside the OPERATOR ACCESSIBLE compartments in areas where electrical components that produce arcs and sparks during NORMAL CONDITION or abnormal operation as a result of the REFRIGERANT leakage, or luminaries, are mounted, when doors or lids remain closed or when opening or closing doors or lids, unless these components have been tested and found at a minimum to comply with Annex AA for group IIA gases or for the REFRIGERANT used.

This requirement does not apply to

– non-self-resetting protective devices necessary for compliance with 4.4, nor to

– intentionally weak parts that become permanently open-circuited during the tests of 4.4, even if they produce arcs or sparks during operation.

Separate components such as thermostats which contain less than 0,5 g of flammable gas are not considered to cause a fire or explosion HAZARD in the event of a leakage from the component itself.

Other types of protection for electrical apparatus for potentially explosive atmospheres covered by IEC 60079 (all parts) are also acceptable.

Changing of a lamp is not considered a potential explosion HAZARD, because the door or lid is open during this operation.

Compliance is checked by inspection, by the appropriate tests of IEC 60079-15:2010 and by the following test.

The tests contained in Annex AA can be carried out using the stoichiometric concentration of the REFRIGERANT used. However, it is not necessary to test equipment which has been independently tested and found to comply with Annex AA using the gas specified for group IIA.

Irrespective of the requirement given in IEC 60079-15:2010, 5.1, surface temperature limits are specified in 11.7.104.7.

The test is performed in a draught-free location with the REFRIGERATING EQUIPMENT switched off or operated under NORMAL CONDITION at RATED voltage, whichever gives the more unfavourable result.

During a test in which the REFRIGERATING EQUIPMENT is operated, gas injection is started at the same time as the equipment is first switched on.

The test is performed twice and is repeated a third time if one of the first tests gives more than 40 % of the LOWER EXPLOSIVE LIMIT.

Through an appropriate orifice, 80 % of the nominal REFRIGERANT charge ± 1,5 g, in the vapour state, is injected into an OPERATOR ACCESSIBLE compartment in a time not exceeding 10 min. The orifice is then closed. The injection shall be as close as possible to the centre of the back wall of the compartment at a distance from the top of the compartment approximately equal to one third of the height of the compartment. Thirty minutes after the injection is completed, the door or lid is opened at a uniform rate in a time between 2 s and 4 s, to an angle of 90° or to the maximum possible, whichever is less.

For equipment having more than one door or lid, the most unfavourable sequence or combination of opening the lids or doors is used.

For equipment fitted with fan motors the test is performed with the most unfavourable combination of motor operation.

The concentration of leaked REFRIGERANT is measured every 30 s from the beginning of the test, at positions as close as possible to electrical components. However, it is not measured at the positions of

– non-self-resetting protective devices necessary for compliance with 4.4, nor to

– intentionally weak parts that become permanently open-circuited during the tests of 4.4, even if they produce arcs or sparks during operation.

The concentration values are recorded until they tend to go down.

The measured value shall not exceed 75 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 103, and shall not exceed 50 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 103 for a period exceeding 5 min.

The above test is repeated except that the door or lid is subjected to an open/close sequence at a uniform rate in a time of between 2 s and 4 s, the door or lid being opened to an angle of 90° or to the maximum possible, whichever is less, and closed during the sequence.

11.7.104.6 Stagnation of leaked FLAMMABLE REFRIGERANT

REFRIGERATING EQUIPMENT which uses FLAMMABLE REFRIGERANT shall be constructed so that leaked REFRIGERANT will not stagnate and thus cause a fire or explosion HAZARD in areas outside the OPERATOR ACCESSIBLE compartment where components producing arcs or sparks or luminaires are mounted.

This requirement does not apply to areas where

– non-self-resetting protective devices necessary for compliance with 4.4 or

– intentionally weak parts that become permanently open circuited during the test of 4.4

are mounted, even if they produce arcs and sparks during operation.

Separate components such as thermostats that contain less than 0,5 g of flammable gas are not considered to cause a fire or explosion HAZARD in the event of a leakage of the component itself.

Compliance is checked by the following test unless luminaires and components that produce arcs and sparks during NORMAL CONDITION and which are mounted in the areas under consideration, have been tested and found at least to comply with the requirements in Annex AA for group II A gases or for the REFRIGERANT used.

Irrespective of the requirements given in IEC 60079-15:2010, 5.1, surface temperature limits are specified in 11.7.104.7.

Other types of protection for electrical equipment for potentially explosive atmospheres covered by IEC 60079 (all parts) are also acceptable.

The test is performed in a draught-free location with the equipment switched off or operated under NORMAL CONDITION at RATED voltage, whichever gives the more unfavourable result when an ignition source is present.

During a test in which the equipment is operated, gas injection is started at the same time as the equipment is first switched on.

A quantity equal to 50 % of the REFRIGERANT charge ± 1,5 g is injected into the considered area.

Injection is to be at a constant rate over a period of 1 h and is to be at the point of closest approach of

– pipe-work joints in external parts of the REFRIGERANT circuit,

– the gaskets of semi-hermetic MOTOR-COMPRESSORS,

to the electrical component under consideration. Any direct injection shall be avoided.

Welded telescopic joints of the MOTOR-COMPRESSOR, the welding of the pipes through the compressor housing and the welding of the fusite are not considered to be pipework joints.

The concentration of leaked REFRIGERANT as close as possible to the electrical component is measured continuously from the beginning of the test until it starts to decrease.

The measured value shall not exceed 75 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 103, and shall not exceed 50 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 103 for a period exceeding 5 min.

11.7.104.7 Surface temperature limits

Temperatures on surfaces that can be exposed to leakage of FLAMMABLE REFRIGERANT shall not exceed the ignition temperature of the REFRIGERANT as specified in Table 103, reduced by 100 K.

Compliance is checked by measuring the appropriate surface temperatures during the tests specified in Clause 10 and 4.4.

Temperatures of

– non-self-resetting protective devices that operate during the tests specified in 4.4 or

– intentionally weak parts that become permanently open-circuited during the tests specified in 4.4

are not measured during those tests specified in 4.4 that cause these devices to operate.

Table 103
REFRIGERANT flammability parameters

REFRIGERANT number	REFRIGERANT name	REFRIGERANT formula	REFRIGERANT auto-ignition temperature [a c] °C	REFRIGERANT LOWER EXPLOSIVE LIMIT [b c d e] % V/V
R50	Methane	CH_4	645	4,9
R170	Ethane	CH_3CH_3	515	3,1
R290	Propane	$CH_3CH_2CH_3$	470	1,7
R600	n-Butane	$CH_3CH_2CH_2CH_3$	365	1,5
R600a	Isobutane	$CH(CH_3)_3$	460	1,8
R1150	Ethene	$CH_2 = CH_2$	425	3,1
R1270	Propylene	$CH_2 = CHCH_3$	455	2,3

[a] Values for other FLAMMABLE REFRIGERANTS can be obtained from IEC TR 60079-20 and IEC 60079-20-1.
[b] Values for other FLAMMABLE REFRIGERANTS can be obtained from IEC TR 60079-20 and ISO 5149-1.
[c] IEC TR 60079-20 is the reference document. ISO 5149 can be used if the required data is not contained in IEC TR 60079-20.
[d] Concentration of REFRIGERANT in dry air.
[e] In some documents, the term "flammability limit" is used for "LOWER EXPLOSIVE LIMIT".

11.7.104.8 Transport temperature test

11.7.104.8.1 General

Pressures developed from SOAKED TEMPERATURE CONDITIONS resulting from the temperatures the REFRIGERATING EQUIPMENT is exposed to during transport shall not cause a HAZARD.

These pressures are used as one input for determining PS (11.7.101) and are derived by test (see 11.7.104.8.2, 11.7.104.8.3 or 11.7.104.8.4, as applicable) or from the saturated REFRIGERANT pressures at a transport ambient temperature of 55 °C for normal transport or 70 °C for transport under tropical conditions.

For pressures in parts protected by a pressure relief device, the test pressure shall not exceed 0,9 times the setting of that device during transport.

For a REFRIGERATING SYSTEM that uses FLAMMABLE REFRIGERANTS, the transport ambient temperature shall be 70 °C.

Conformity is checked by inspection of the RATINGS of the components exposed to this pressure and, if a HAZARD could arise, by the tests of 11.7.102. If there is any doubt as to the saturated vapour pressure of the REFRIGERANT in use, then the test pressure shall be derived by one of the following tests: 11.7.104.8.2, 11.7.104.8.3 or 11.7.104.8.4, as applicable.

11.7.104.8.1DV.1 DE *Addition of the following at the end of the paragraph:*

Clause 11.7.104.8 is applicable for flammable as well as for non-flammable refrigerant.

11.7.104.8.2 Transport temperature test method 1

The steps for this method are:

a) calculate the total volume of the REFRIGERATING SYSTEM in question;

b) calculate the charge-to-volume ratio for the design charge;

c) take a charging cylinder of known volume and charge it to give the same volume-to-mass ratio as the system to be simulated;

d) place the cylinder with a pressure gauge or transducer in a controlled ambient temperature defined by the storage and/or transport ambient temperature and allow the cylinder to soak;

e) record the maximum pressure and use this value as the test pressure for the REFRIGERATING SYSTEM.

11.7.104.8.3 Transport temperature test method 2

The steps for this method are:

a) measure the pressure of the REFRIGERATING SYSTEM under SOAKED TEMPERATURE CONDITION;

b) use an evacuated cylinder and heat it up to the SOAKED TEMPERATURE CONDITION;

c) charge the cylinder with the same REFRIGERANT used in the REFRIGERATING SYSTEM under SOAKED TEMPERATURE CONDITION until it has the same pressure as the REFRIGERATING SYSTEM in SOAKED TEMPERATURE CONDITION;

d) place the cylinder with a pressure gauge or transducer in a controlled ambient temperature defined by the storage and/or transport ambient temperature and allow the cylinder to soak;

e) record the maximum pressure and use this value as the test pressure for the REFRIGERATING SYSTEM.

11.7.104.8.4 Transport temperature test method 3

FLAMMABLE REFRIGERANTS are assumed to be ideal gases. Calculate the pressure at transport and storage conditions by using the ideal gas law, based on the pressure and temperature in SOAKED TEMPERATURE CONDITION.

12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure

This clause of Part 1 is applicable.

13 Protection against liberated gases and substances, explosion and implosion

This clause of Part 1 is applicable.

14 Components and subassemblies

This clause of Part 1 is applicable, except as follows:

Addition:

Add the following new subclause:

14.101 Components and subassembly requirements for REFRIGERATING EQUIPMENT

Components and piping that are part of the REFRIGERATING SYSTEM shall comply with the related standards or requirements as indicated in Annex CC or be evaluated in accordance with the pressure RATING requirements of this document (11.7.102).

Conformity is checked by inspection or as specified in 11.7.102, as applicable.

15 Protection by interlocks

This clause of Part 1 is applicable.

16 HAZARDS resulting from application

This clause of Part 1 is applicable except as follows:

16.1 REASONABLY FORESEEABLE MISUSE

Replacement:

Replace the text as follows:

The equipment shall comply with the requirements of this document during NORMAL USE, including mistakes, lapse, slips or use of equipment or system in a way not intended by the manufacturer, but which can result from readily predictable human behaviour. Such acts to consider would include well-meant optimization or readily available shortcuts.

No HAZARD shall arise in NORMAL USE or SINGLE FAULT CONDITION, through readily available adjustments, knobs, or other software-based or hardware-based controls set in a way not intended, or not described in the instructions.

Reckless use, unqualified use or use outside the specifications set by the manufacturer is not considered as part of this document. Similarly, intended acts or intended omission of an act by the OPERATOR of equipment as a result of conduct that is beyond any reasonable means of RISK control by the manufacturer are similarly excluded from the scope of this document.

Other possible cases of REASONABLY FORESEEABLE MISUSE that are not addressed by specific requirements in this document shall be addressed by RISK assessment (see Clause 17).

Addition:

Add the following new subclause:

16.101 Slip HAZARD

For walk-in equipment, where the ground or floor can be slippery when wet or icy, the equipment shall be designed and constructed in such a way as to minimise the risk of slipping. Where a slip HAZARD remains, appropriate means which enable the OPERATORS to maintain their stability shall be fitted (for example handholds that are fixed relative to the OPERATOR) and the equipment shall be permanently marked with symbol 103 of Table 1, warning of slippery surface and against the HAZARD of falling. The symbol shall be placed on the door or on the inside wall of the equipment, where it is clearly visible for the OPERATOR during NORMAL USE.

Conformity is checked by inspection.

17 RISK assessment

This clause of Part 1 is applicable.

Annexes

The annexes of Part 1 are applicable, except as follows:

Annex G
(informative)

Leakage and rupture from fluids under pressure

Addition:

Add the following new second paragraph:

For fluidic pressure systems incorporating a REFRIGERANT the requirements of 11.7 of this document apply.

Annex L
(informative)

Index of defined terms

Addition:

Add the following new defined terms:

Term	Definition
ABNORMAL OPERATION	3.107
CONDENSING UNIT	3.112
CONTROLLED TEMPERATURE	3.109
FLAMMABLE REFRIGERANT	3.103
HIGH PRESSURE CUT-OUT	3.104
HPCO	3.104
LEL	3.110
LOWER EXPLOSIVE LIMIT	3.110
MAXIMUM ALLOWABLE PRESSURE	3.105
MOTOR-COMPRESSOR	3.111
PS	3.105
REFRIGERANT	3.108
REFRIGERATING EQUIPMENT	3.101
REFRIGERATING SYSTEM	3.102
SOAKED TEMPERATURE CONDITION	3.106

Addition:

Add the following new annexes:

Annex AA
(normative)

Non-sparking "n" electrical device

Annex AADV DC *Modification: Replace in the entire Annex IEC 60079-15:2010 with UL 60079-15:2013*

The numbering of the following clauses and subclauses corresponds to the clause and subclause numbers of IEC 60079-15:2010. The clauses and subclauses are applicable except as modified hereafter.

11 Supplementary requirements for non-sparking luminaires

This clause of IEC 60079-15:2010 is applicable, with the exception of the following subclauses: 11.2.4.1, 11.2.4.5, 11.2.5, 11.2.6, 11.2.7, 11.3.4, 11.3.5, 11.3.6 and 11.4.

17 Supplementary requirements for enclosed-break devices and non-incendive components producing arcs, sparks or hot surfaces

This clause of IEC 60079-15:2010 is applicable.

19 Supplementary requirements for sealed devices producing arcs, sparks or hot surfaces

This clause of IEC 60079-15:2010 is applicable, except for subclauses 19.1 and 19.6, which are replaced as follows:

19.1 Non-metallic materials

Replacement:

Seals are tested in accordance with 22.5. However, if the device is tested in the equipment, then 22.5.1 and 22.5.2 are not applicable. However, after the tests of 4.4, an inspection shall reveal no damage of the encapsulation, such as cracks in the resin or exposure of encapsulated parts that could impair the type of protection.

19.6 Type tests

Replacement:

The type tests described in 22.5 shall be performed where relevant.

20 Supplementary requirements for restricted-breathing enclosures protecting devices producing arcs, sparks or hot surfaces

This clause of IEC 60079-15:2010 is applicable.