

INTERNATIONAL STANDARD



GROUP SAFETY PUBLICATION

**Safety requirements for electrical equipment for measurement, control, and
laboratory use –
Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT**

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2019 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IECNORM.COM : Click to view the full text of IEC 60399-01:2019 RLV



IEC 61010-2-011

Edition 2.0 2019-03
REDLINE VERSION

INTERNATIONAL STANDARD



GROUP SAFETY PUBLICATION

**Safety requirements for electrical equipment for measurement, control, and
laboratory use –
Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 19.080

ISBN 978-2-8322-6726-4

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	4
INTRODUCTION	7
1 Scope and object	10
2 Normative references	11
3 Terms and definitions	11
4 Tests	13
5 Marking and documentation	16
6 Protection against electric shock	19
7 Protection against mechanical HAZARDS	20
8 Resistance to mechanical stresses	20
9 Protection against the spread of fire	20
10 Equipment temperature limits and resistance to heat	20
11 Protection against HAZARDS from fluids and solid foreign objects	22
12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure	33
13 Protection against liberated gases and substances, explosion and implosion	33
14 Components and subassemblies	33
15 Protection by ~~safety~~ interlocks	33
16 HAZARDS resulting from application	33
17 RISK assessment	34
Annexes	35
Annex G (informative) Leakage and rupture from fluids under pressure	36
Annex L (informative) Index of defined terms	37
Annex AA (normative) Non-sparking "n" electrical ~~apparatus~~ device	38
Annex BB (informative) HAZARDS associated with REFRIGERATING SYSTEMS and REFRIGERANTS	39
Annex CC (informative) Safety requirements for components and piping	41
Annex DD (informative) Equipment containing FLAMMABLE REFRIGERANTS – Information and marking requirements	46
Bibliography	50
Figure 101 – Schema of a REFRIGERATING SYSTEM incorporating a condenser	8
Figure 102 – Flow chart illustrating the selection process	9
Figure 103 – Scratching TOOL tip details	28
Table 1 – Symbols	17
Table 101 – Maximum temperatures for MOTOR-COMPRESSORS	21
Table 102 – Minimum temperature for determination of saturated vapor pressure of REFRIGERANT	23
Table 103 – REFRIGERANT flammability parameters	31
Table CC.1 – Parameters of pressure vessels according to EN 14276-1	41
Table CC.2 – Parameters of piping according to EN 14276-2	43

Table CC.3 – Component and piping requirements	44
Table CC.4 – Minimum wall thickness for copper and steel tubing	45
Table DD.1 – Quantity of Group A2/A3 REFRIGERANT per occupied space.....	49

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE –

Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 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.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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.

INTRODUCTION

This Part 2-011, ~~in conjunction~~ along with Part 2-010 and Part 2-012, taken together, addresses the specific HAZARDS associated with the heating and cooling of materials by equipment ~~which are segregated~~ 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 (~~application~~ 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?

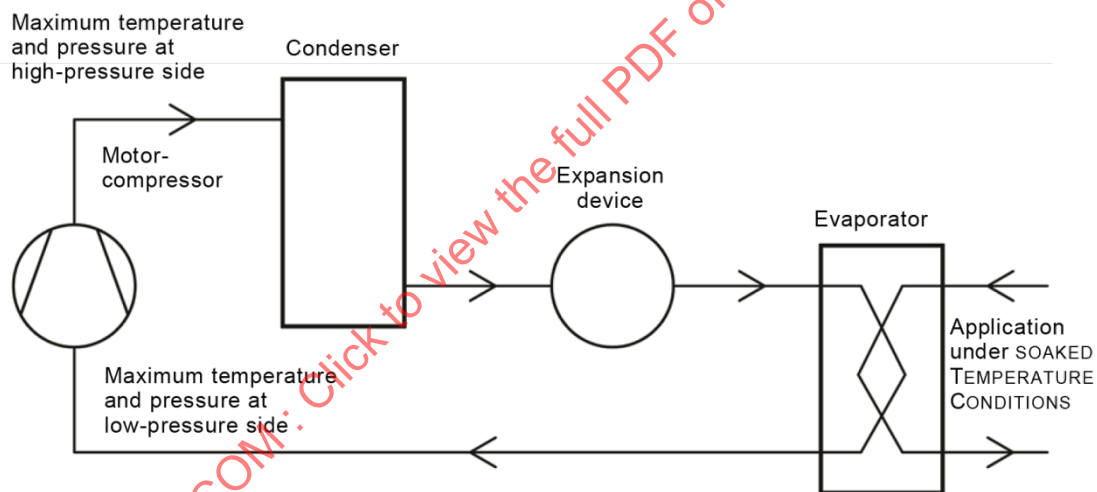
The typical HAZARDS for a REFRIGERATING SYSTEM (see Figure 101) consisting of a MOTOR-COMPRESSOR, a condenser, an expansion device and an evaporator include but are not limited to:

- 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 ~~may~~ 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 ~~application~~ 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 ~~application~~ 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.

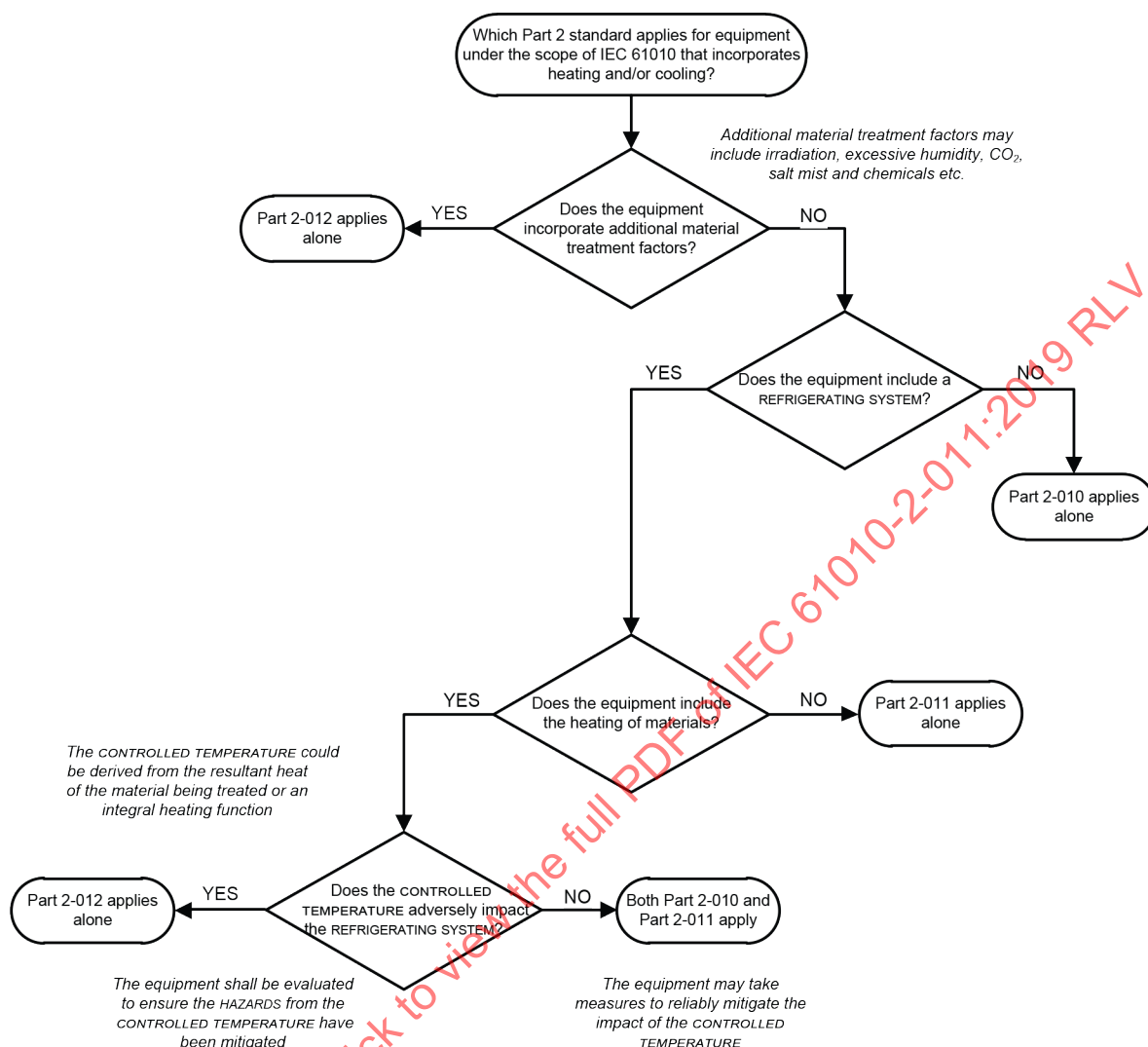
The worst-case conditions should be determined for the equipment and will include both the least favourable NORMAL USE conditions as well as the most unfavourable testing results under SINGLE FAULT CONDITIONS.



IEC

Figure 101 – Schema of a REFRIGERATING SYSTEM incorporating a condenser

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



IEC

Figure 102 – Flow chart illustrating the selection process

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 ~~first~~ *second* paragraph by the following:

~~This group safety publication is primarily intended to be used as a product safety standard for the products mentioned in the scope, but shall also be used by technical committees in the preparation of their publications for products similar to those mentioned in the scope of this standard, in accordance with the principles laid down in IEC guide 104 and ISO/IEC Guide 51.~~

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 ~~whether~~ *as* an integral part of, or ~~remote to~~ *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, ~~etc.~~

~~If~~ *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, ~~it should also meet~~ *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, ~~it should meet~~ 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 ~~the application of it is possible that IEC 61010-2-012 should be considered~~ *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 CO₂) or a system that uses ammonia (NH₃) 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

~~UL 471:2010, *Commercial Refrigerators and Freezers*~~

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 ~~remote to~~ separate from the equipment

3.102

REFRIGERATING SYSTEM

~~factory assembled unit for performing part of the refrigerant cycle (compression and condensation) comprising one or more refrigerant compressors with motors, condensers, liquid receivers (where required), interconnecting pipe work and ancillary equipment~~

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 allowable pressure as determined by the collated test results detailed in 11.7~~

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 ~~room~~ ambient temperature

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

3.107

ABNORMAL OPERATION

operation of a REFRIGERATING ~~SYSTEM~~ 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 gasketed 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 ~~operating~~ 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 4.43.2.101 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 ($\pm 10\%$) 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 ~~a room~~ an ambient temperature of $25\text{ °C} \pm 3\text{ °C}$.

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

The REFRIGERATING SYSTEM ~~is to~~ shall be operated with the condensing water shut off ~~and also~~, 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 ~~a room~~ an ambient temperature of $25\text{ °C} \pm 3\text{ °C}$.

- ~~f) Condenser fins shall be blocked to simulate clogging with dust etc.~~

If a manual reset HPCO is relied upon to limit the peak pressure during tests d) or e) ~~or f)~~, 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) ~~or f)~~, 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) ~~or f)~~, the manufacturer ~~may~~ 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 ~~units~~ 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 ~~may~~ can elect to run each condenser stage individually under the tests of d) or e) ~~or f)~~ accordingly. In this case, disabling the first stage system is considered to simulate the second stage running under a ~~stalled fan or condenser water failure test~~ test condition of d) or e).

Addition:

Add the following new subclauses:

~~4.4.2.101~~ **Extreme operating ambient abnormal (ABNORMAL OPERATION)**

~~For REFRIGERATING EQUIPMENT intended to operate in a restricted environment and tested in accordance with 4.3.1 then 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 unit 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 unit 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 device. 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.~~

~~4.4.2.102~~ **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 ~~a second new paragraph~~ the following paragraph after the first paragraph:

~~Due~~ Owing to the time it ~~may~~ can take to achieve stable conditions for a REFRIGERATING SYSTEM, the duration of single fault tests ~~may~~ 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

5.2 Warning markings

Replacement:

Replace the first paragraph with the following:

~~Warning markings specified in this standard shall meet the following requirements.~~

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 ~~after the last 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 ~~unit~~ equipment near the declaration of the REFRIGERANT type and charge information. It shall be visible after installation of the REFRIGERATING EQUIPMENT.

5.4 Documentation

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

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 1 It is recommended to add~~ 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 2 101~~ 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 ~~appliance~~ 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:** ~~Keep all ventilation openings in the enclosure or, in the structure for building in, clear of obstruction.~~ 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

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

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 ~~may~~ can cause crushing HAZARDS ~~of hand~~ for hands or fingers, the symbol 104 of Table 1 shall be marked on the location or part where the HAZARD ~~may~~ 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.

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 Warnings ~~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 ~~second paragraph~~:

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 4.4.2.101~~ 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 ~~winding temperatures~~ of the windings are not measured. For MOTOR-COMPRESSORS not conforming with these requirements, ~~then~~ the temperature test methods detailed in IEC 60335-2-34 shall be employed to measure the temperature of the windings.

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 ($\pm 10\%$) 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 ~~unit~~ 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 ~~at the end of Clause 10:~~

10.101 Protection against cold surfaces

If the minimum surface temperature of easily touched cold surfaces exceeds the value of $-30\text{ }^{\circ}\text{C}$, 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 ~~at the end of 11.7:~~

11.7.101 Maximum pressure in a REFRIGERATING SYSTEM

The maximum pressure to which a part of the equipment can be subjected ~~to~~ 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 4.4.3.2.101 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 may be 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, CO₂ 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 ~~shall take into consideration these certification differences.~~

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 ~~operating~~ 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 ~~operating~~ 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.

11.7.102.3 Fatigue test

If the continuous ~~operating~~ 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 ~~operating~~ CONTROLLED TEMPERATURE. Static test pressure shall be increased by the ratio of the allowable stress of the material at ~~room ambient~~ temperature to that at the highest continuous ~~operating~~ 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 ~~is~~ be used.

- For components at the low-pressure side, ~~maximum~~ the PS for the low-pressure side shall be applied for the first cycle. For components at the high-pressure side, ~~maximum~~ 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 ~~may~~ can be.

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

11.7.104.2 Protected ~~cooling~~ REFRIGERATING SYSTEM

REFRIGERATING EQUIPMENT with a protected ~~cooling~~ REFRIGERATING SYSTEM is that:

- without any part of the ~~cooling~~ REFRIGERATING SYSTEM inside an OPERATOR access compartment;
- where any part of the ~~cooling~~ 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 ~~cooling~~ 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 ~~cooling~~ 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 ~~cooling~~ 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 ~~cooling~~ REFRIGERATING SYSTEM, no additional requirements apply to electrical components located inside OPERATOR access compartments.

Equipment with a protected ~~cooling~~ REFRIGERATING SYSTEM which, when tested, is found not to comply with the requirements specified for a protected ~~cooling~~ REFRIGERATING SYSTEM, ~~may~~ can be considered as having an unprotected ~~cooling~~ REFRIGERATING SYSTEM if it is tested in accordance with 11.7.104.5 and found to comply with the requirement for an unprotected ~~cooling~~ 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 ~~cooling~~ REFRIGERATING SYSTEM, it ~~may~~ 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 $0,7 \text{ mm} \pm 0,05 \text{ mm}$ 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 ~~may need to be positioned~~ 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 ~~operation~~ 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 $\pm 1,5 \text{ g}$ 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) $32 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ for leakage simulation on low-~~side~~-pressure-~~side~~ circuits;
- b) $70 \text{ }^{\circ}\text{C} \pm 2 \text{ }^{\circ}\text{C}$ for leakage simulation on high-~~side~~-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-cooling REFRIGERATING SYSTEMS

All ACCESSIBLE surfaces of the protected-cooling REFRIGERATING SYSTEM, including ACCESSIBLE surfaces in intimate contact with the protected-cooling 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 $\pm$ 3 N;*
- *force parallel to the surface to be tested not exceeding 250 N.*

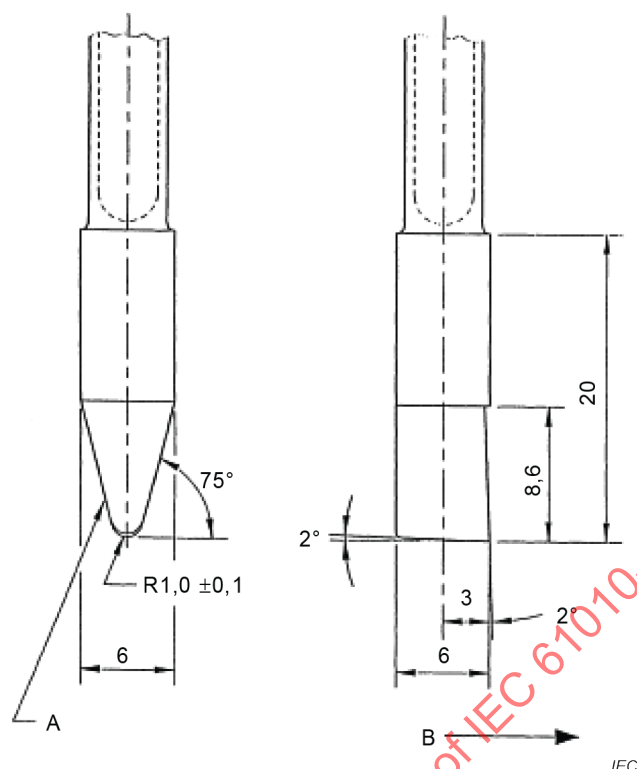
The TOOL is drawn across the surface to be tested at a rate of approximately 1 mm/s.

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 %.

Dimensions in millimetres



Key

A Hard-soldered carbide tip K10

B Direction of movement

Figure 103 – Scratching TOOL tip details

11.7.104.5 Unprotected ~~cooling~~ REFRIGERATING SYSTEMS

REFRIGERATING EQUIPMENT with an unprotected ~~cooling~~ REFRIGERATING SYSTEM is that where at least one part of the ~~cooling~~ 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 ~~cooling~~ 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 ~~OPERATION~~ 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 ~~least~~ 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 ~~may~~ can be carried out using the stoichiometric concentration of the REFRIGERANT used. However, it is not necessary to test ~~apparatus equipment~~ which has been independently tested and found to comply with Annex AA using the gas specified for group IIA ~~need not be tested~~.

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 ~~conditions of~~ NORMAL ~~operation~~ 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 ~~appliance~~ 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 $\pm 1,5$ 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 ~~appliances~~ equipment having more than one door or lid, the most unfavourable sequence or combination of opening the lids or doors is used.

For ~~appliances~~ 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 ~~operation~~ 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 ~~apparatus~~ 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 ~~appliance~~ equipment switched off or operated under NORMAL ~~operation~~ 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 $\pm 1,5$ 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 ~~cooling~~ 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 ~~may~~ 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 ₃ CH ₃	515	3,1
R290	Propane	CH ₃ CH ₂ CH ₃	470	1,7
R600	n-Butane	CH ₃ CH ₂ CH ₂ CH 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 ~~below~~ 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.

11.7.104.8.2 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 ~~to~~ 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 ~~safety~~ 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 ~~in 16.1~~ as follows:

The equipment shall comply with the requirements of this document during NORMAL USE, including mistakes, lapse, slips or use of ~~an~~ 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 ~~specified~~ 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 ~~may~~ 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 ~~user~~ 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.

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

Annexes

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

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

Annex G (informative)

Leakage and rupture from fluids under pressure

~~This Annex of Part 1 is applicable except as follows:~~

Addition:

Add the following new second paragraph:

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

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

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 ~~apparatus~~ device

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 ~~using~~ 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 ~~apparatus~~ devices producing arcs, sparks or hot surfaces

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

Annex BB (informative)

HAZARDS associated with REFRIGERATING SYSTEMS and REFRIGERANTS

These HAZARDS are associated essentially with the physical and chemical characteristics of REFRIGERANTS as well as **with** the pressures and temperatures occurring in refrigeration cycles.

Inadequate precautions ~~may~~ **can** result in:

- component rupture or explosion, with RISK of projectiles;
- escape of REFRIGERANT with the RISK of environmental damage or toxicity due to a fracture, a leakage caused by bad design, incorrect operation, and inadequate maintenance, repair, charging or disposal;
- burning or combustion of the escaping REFRIGERANT with consequent RISK of fire including the RISK of toxic products of combustion from non-FLAMMABLE REFRIGERANTS.

REFRIGERANTS, their mixtures and combinations with oils, water or other materials, which are present in the REFRIGERATING SYSTEM, **whether** intended or unintended, affect the internal surrounding materials chemically and physically for example due to pressure and temperature. They can, if they have detrimental properties, endanger persons, property and the environment directly or indirectly due to global long term effects (ozone depletion potential, global warming potential) when escaping from the REFRIGERATING SYSTEM.

HAZARDS due to the states of pressure and temperature in REFRIGERATING SYSTEMS are essentially due to the simultaneous presence of the liquid and vapour phases. Furthermore, the state of the REFRIGERANT and the stresses that it exerts on the various components do not depend solely on the processes and functions inside the plant, but also on external factors.

The following HAZARDS are worthy of note:

- a) from the direct effect of extreme temperature, for example:
 - brittleness of materials at low temperatures;
 - freezing of enclosed liquid (water, brine or similar);
 - thermal stresses;
 - changes of volume due to temperature changes;
 - injurious effects to persons caused by low temperatures;
 - touchable hot surfaces;
- b) from excessive pressure due to, for example:
 - increase in the pressure of condensation, caused by inadequate cooling or the partial pressure of non-condensable gases or an accumulation of oil or liquid REFRIGERANT;
 - increase in the pressure of saturated vapour due to excessive external heating, for example of a liquid cooler, or when defrosting an air cooler or high ambient temperature when the plant is at a standstill;
 - expansion of liquid REFRIGERANT in a closed space without the presence of vapour, caused by a rise in external temperature;
 - fire;
- c) from the direct effect of the liquid phase, for example:
 - excessive charge or flooding of equipment;
 - presence of liquid in compressors, caused by syphoning, or condensation in the compressor;

- liquid hammer in piping;
 - loss of lubrication due to dilution of oil;
 - condensation-induced shock;
- d) from the escape of REFRIGERANTS, for example:
- fire;
 - explosion;
 - toxicity including products of combustion;
 - caustic effects;
 - freezing of skin;
 - asphyxiation;
 - panic;
 - depletion of the ozone layer;
 - global warming;
- e) from the moving parts of machinery, for example:
- injuries;
 - hearing loss from excessive noise;
 - damage due to vibration.

Attention is drawn to HAZARDS common to all compression systems, such as excessive temperature at discharge, liquid slugging (REFRIGERANT getting into the compressor's oil reservoir reducing the lubrication or creating a frothy, incompressible mixture which could then get sucked into the piston), erroneous operation and reduction in mechanical strength caused by corrosion, erosion, thermal stress, liquid hammer or vibration.

~~Corrosion, however, should have~~ Special consideration should be given to corrosion, however, as conditions peculiar to REFRIGERATING SYSTEMS arise due to alternate frosting and defrosting or the covering of equipment by insulation.

Annex CC (informative)

Safety requirements for components and piping

CC.1 Overview

The applicable component requirements for sealed system components and the associated piping are defined differently for geographical regions depending on the classification of the pressure vessels in question.

For Europe, the sealed system components ~~may~~ can be considered pressure vessels in accordance with the Pressure Equipment Directive (PED) ~~97/23/EC depending on~~ 2014/68/EU according to the classification in Table CC.1 and Table CC.2. If the components or piping are classified as a Category II or higher pressure vessel according to the PED then the requirements of Table CC.3 shall apply including the use of a Notified Body to the PED.

For North America, the component requirements of Clause CC.2 apply.

Table CC.1 – Parameters of pressure vessels according to EN 14276-1

Fluid	Nature	PS (bar) ^a	V (L)	$PS \times V$ (bar $\times$ L)	Category/ article
if	and	and	and	and	then
Group 1	Gas	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and ≤ 200	≤ 1	—	Art. 3.3 ^c
			> 1	≤ 25	Art. 3.3 ^c
				> 25 and ≤ 50	I
				> 50 and ≤ 200	II
		> 200 and $\leq 1\,000$	≤ 1	—	III
		$\leq 1\,000$	> 1	> 200 and $\leq 1\,000$	III
				$> 1\,000$	IV
		$> 1\,000$	—	—	IV
	Liquid ^d	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and ≤ 500	≤ 1	—	Art. 3.3 ^c
			> 1	≤ 200	Art. 3.3 ^c
		$> 0,5$ and ≤ 10		> 200	I
		> 10 and ≤ 500			II
		> 500	< 1	—	II
		> 500	> 1	—	III

Fluid	Nature	PS (bar) ^a	V (L)	$PS \times V$ (bar $\times$ L)	Category/ article
if	and	and	and	and	then
Group 2	Gas	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and $\leq 1\,000$	≤ 1	—	Art. 3.3 ^c
			> 1	≤ 50	Art. 3.3 ^c
				> 50 and ≤ 200	I
				> 200 and $\leq 1\,000$	II
		$> 1\,000$ and $\leq 3\,000$	≤ 1	—	III
			> 1	$> 1\,000$ and $\leq 3\,000$	III
		$> 0,5$ and ≤ 4		$> 1\,000$	III
		> 4		$> 3\,000$	IV
		$> 3\,000$	—	—	IV
	Liquid ^d	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and ≤ 10	—	—	Art. 3.3 ^c
		> 10 and $\leq 1\,000$	≤ 10	—	Art. 3.3 ^c
		> 10 and $\leq 1\,000$	> 10	$\leq 10\,000$	Art. 3.3 ^c
		> 10 and ≤ 500	—	$> 10\,000$	I
		$> 1\,000$	< 10	—	I
		> 500	> 10	$> 10\,000$	II

^a 1 bar = 0,1 Mpa.

^b PED = Pressure Equipment Directive 2014/68/EU.

^c Art. 3.3 = reference to article of the Pressure Equipment Directive 2014/68/EU.

^d Liquids are considered to be fluids having a vapour pressure not more than 0,5 bar above normal atmospheric pressure (1 013 mbar).

Table CC.2 – Parameters of pipping according to EN 14276-2

Fluid	Nature	PS (bar) ^a	DN	PS × DN (bar) ^a	Category/article
if	and	and	and	and	then
Group 1	Gas	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5	≤ 25	—	Art. 3.3 ^c
			> 25 and ≤ 100	≤ 1 000	I
			> 100 and ≤ 350	> 1 000 and ≤ 3 500	II
			> 350	> 3 500	III
	Liquid ^d	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5	≤ 25	—	Art. 3.3 ^c
			—	≤ 2 000	Art. 3.3 ^c
		> 0,5 and ≤ 10	—	> 2 000	I
		> 10 and ≤ 500	> 25		II
		> 500	—	III	
Group 2	Gas	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5	≤ 32	—	Art. 3.3 ^c
			—	≤ 1 000	Art. 3.3 ^c
			> 32 and ≤ 100	> 1 000 and ≤ 3 500	I
			> 100 and ≤ 250	> 3 500 and ≤ 5 000	II
			> 250	> 5 000	III
	Liquid ^d	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5 and ≤ 10	—	—	Art. 3.3 ^c
		—	—	≤ 5 000	Art. 3.3 ^c
		—	≤ 200	—	Art. 3.3 ^c
		> 10 and ≤ 500	> 200	> 5 000	I
> 500		—		II	

^a 1 bar = 0,1 Mpa.

^b PED = Pressure Equipment Directive 2014/68/EU.

^c Art. 3.3 = reference to article of the Pressure Equipment Directive 2014/68/EU.

^d Liquids are considered to be fluids having a vapour pressure not more than 0,5 bar above normal atmospheric pressure (1 013 mbar).

Table CC.3 – Component and piping requirements

Component	Related standard and requirements
Heat exchangers: – pipe coil without air (tube in tube)	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Plate heat exchangers	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Headers and coils with air as a secondary fluid	EN 14276-2 combined with a production leak tightness test based on guidance from EN 1779
Receiver / accumulator / economiser	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Oil separator	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Drier	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Filter	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Muffler	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Hermetic positive displacement compressor	IEC 60335-2-34 or EN 12693
Semi-hermetic positive displacement compressor	IEC 60335-2-34 or EN 12693
Open positive displacement compressor	EN 12693
Non positive displacement compressor	EN 14276-1 or EN 13445 (all parts) if applicable combined with IEC 60204-1
Pump General requirements	EN 809 combined with IEC 60204-1, and combined with a production leak tightness test based on guidance from EN 1779:1999 and the marking requirements from 5.1.2 of this document
Piping	EN 14276-2 or EN 13480
Piping joints Permanent joints Detachable joints	EN 14276-2 combined with a production leak tightness test based on guidance from EN 1779 and an evaluation of the suitability of the joint for the pipe, piping material, pressure, temperature and fluid
Flexible piping	EN 1736
Valves	EN 12284
safety valve	EN 13136 and EN ISO 4126-1 combined with a production leak tightness test based on guidance from EN 1779
safety switching devices for limiting the pressure	EN 12263 combined with a production leak tightness test based on guidance from EN 1779
isolating valves	EN 12284
hand operated valves	EN 12284
valves with seal cap	EN 12284
Bursting disc	EN ISO 4126-2 and EN 13136 combined with a production leak tightness test based on guidance from EN 1779
Fusible plug	EN 13136 combined with a production leak tightness test based on guidance from EN 1779 and marked with the melting temperature and working pressure of the fusible material
Liquid level indicators	EN 12178 combined with a production leak tightness test based on guidance from EN 1779
Gauges	EN 837-1, EN 837-2 and EN 837-3 combined with a production leak tightness test based on guidance from EN 1779
Brazing and soldering materials	Soldering alloys shall not be used for REFRIGERANT-containing purposes where strength is a factor. Brazing alloys shall only be used when their compatibility with refrigerators and lubricants has been proven by test or experience
Welding materials	EN 14276-2

CC.2 Components and subassemblies requirements for switches and controls used in REFRIGERATING EQUIPMENT for North America

The minimum RATING for the number of operations for switches and controls used in a REFRIGERATING SYSTEM shall be as follows:

- quick freeze switches 300
- manual and semi-automatic defrost switches 300
- door switches 50 000
- on/off switches 300
- thermostats which control a MOTOR-~~compressors~~ COMPRESSOR 100 000
- temperature limiters which control defrosting heaters 100 000
- MOTOR-COMPRESSOR starting relays 100 000
- self-resetting thermal motor-protector for MOTOR-COMPRESSORS 2 000
- NOTE 2 000 or the number of operations during the 15-day locked rotor test, whichever is the greater.
- non-self-resetting thermal motor-protector for MOTOR-COMPRESSORS 50
- other automatic thermal motor-protectors except for fan motors 2 000
- other manual reset thermal motor-protectors 30
- interlock devices 100 000

Table CC.4 – Minimum wall thickness for copper and steel tubing

Outside diameter		Copper				Steel	
		Protected within refrigerator		Unprotected			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)
1/4	(6,35)	0,024 5	(0,623)	0,026 5	(0,673)	0,025	(0,635)
5/16	(7,94)	0,024 5	(0,623)	0,026 5	(0,673)	0,025	(0,635)
3/8	(9,53)	0,024 5	(0,623)	0,026 5	(0,673)	0,025	(0,635)
1/2	(12,70)	0,024 5	(0,623)	0,028 5	(0,724)	0,025	(0,635)
5/8	(15,88)	0,031 5	(0,799)	0,031 5	(0,799)	0,032	(0,813)
3/4	(19,05)	0,031 5	(0,799)	0,038 5	(0,978)	0,032	(0,813)
7/8	(22,23)	0,041 0	(1,041)	0,041 0	(1,041)	0,046	(1,168)
1	(25,40)	0,046 0	(1,168)	0,046 0	(1,168)	—	—
1-1/8	(28,58)	0,046 0	(1,168)	0,046 0	(1,168)	0,046	(1,168)
1-1/4	(31,75)	0,050 5	(1,283)	0,050 5	(1,283)	0,046	(1,168)
1-3/8	(34,93)	0,050 5	(1,283)	0,050 5	(1,283)	—	—
1-1/2	(38,10)	0,055 5	(1,410)	0,055 5	(1,410)	0,062	(1,575)
1-5/8	(41,28)	0,055 5	(1,410)	0,055 5	(1,410)	—	—
2-1/8	(53,98)	0,064 0	(1,626)	0,064 0	(1,626)	—	—
2-5/8	(66,68)	0,074 0	(1,880)	0,074 0	(1,880)	—	—

Nominal wall thickness of tubing will have to be greater than the thickness indicated to maintain the minimum wall thickness.

Annex DD (informative)

Equipment containing FLAMMABLE REFRIGERANTS – Information and marking requirements

DD.1 Marking, installation and operating instructions (SB6)

DD.1.1 General

NOTE For the US, additional marking and informational requirements exist for REFRIGERATING EQUIPMENT which utilises FLAMMABLE REFRIGERANTS. The source document reference, **UL 471, Annex SB6**, is included in brackets at the end of each subclause.

DD.1.2 Marking

When a FLAMMABLE REFRIGERANT is used, the markings as outlined in DD.1.3 to DD.1.6, or the equivalent, shall be

- a) in letters no less than 6,4 mm (1/4 inch) high, and
- b) permanently marked on the REFRIGERATING EQUIPMENT in the indicated locations.

(UL 471 10th Edition, Annex SB6.1.1 revised November 17, 2014)

DD.1.3 OPERATOR markings

"DANGER – RISK Of Fire Or Explosion. FLAMMABLE REFRIGERANT Used. Do Not Use Mechanical Devices To Defrost REFRIGERATING EQUIPMENT. Do Not Puncture REFRIGERANT Tubing".

This marking shall be provided on or near any evaporators that can be contacted by the ~~user~~ OPERATOR.

(UL 471 10th Edition, Annex SB6.1.2 revised June 28, 2013)

DD.1.4 Service markings

For self-contained REFRIGERATING EQUIPMENT, the following markings shall be located near the machine compartment. For a remote CONDENSING UNIT, the following markings shall be located ~~by~~ near the inter-connecting REFRIGERANT tubing connections and ~~by~~ the nameplate:

- a) "DANGER – RISK Of Fire Or Explosion. FLAMMABLE REFRIGERANT Used. To Be Repaired Only By Trained Service Personnel. Do Not Puncture REFRIGERANT Tubing".
- b) "CAUTION – RISK Of Fire Or Explosion. FLAMMABLE REFRIGERANT Used. Consult Repair Manual/Owner's Guide Before Attempting To Install Or Service This Equipment. All Safety Precautions Must be Followed".

(UL 471 10th Edition, Annex SB6.1.3 revised November 30, 2012)

DD.1.5 Disposal

"CAUTION – RISK Of Fire Or Explosion. Dispose Of Properly In Accordance With Federal Or Local Regulations. FLAMMABLE REFRIGERANT Used".

This marking shall be provided on the exterior of the REFRIGERATING EQUIPMENT.

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.1.6 Exposed tubing

"CAUTION – Risk Of Fire Or Explosion Due To Puncture Of REFRIGERANT Tubing. Follow Handling Instructions Carefully. FLAMMABLE REFRIGERANT Used".

This marking shall be provided near all exposed REFRIGERANT tubing.

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.1.7 Accessing the REFRIGERANT circuit

Refrigeration tubing or other devices through which the REFRIGERANT is intended to be serviced shall be painted, coloured, or labelled red, Pantone® Matching System (PMS) No. 185. This colour shall be present at all places where service puncturing or otherwise creating an opening in the REFRIGERANT circuit might be expected. In the case of a process tube on a MOTOR-COMPRESSOR, the colour mark shall extend at least 2,5 cm (1 inch) from the MOTOR-COMPRESSOR.

(UL 471 10th Edition, Annex SB6.1.6 revised November 17, 2014)

DD.1.8 Symbol for warning of flammable materials

The marking in item DD.1.4 a) shall also contain symbol 102 of Table 1 for warning of flammable materials.

The colour and format of the symbol shall be exactly the same as shown. The perpendicular height of the triangle shall be at least 15 mm (9/16 in).

(UL 471 10th Edition, Annex SB6.1.7 revised June 28, 2013)

DD.1.9 Equipment containing a remote CONDENSING UNIT

For equipment containing a remote CONDENSING UNIT, the following marking shall be located near the tubing intended for the connection of the field supplied REFRIGERANT tubing:

"CAUTION – This equipment is intended for use with FLAMMABLE REFRIGERANT. Install in accordance with the FLAMMABLE REFRIGERANT requirements specified in the ANSI/ASHRAE 15".

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.1.10 REFRIGERATING EQUIPMENT intended for laboratory use

REFRIGERATING EQUIPMENT intended for laboratory use that contains an A3 REFRIGERANT shall be marked:

"This ~~unit~~ equipment is intended for use in commercial, industrial, or institutional occupancies as defined in the Safety Standard for Refrigeration Systems, ANSI/ASHRAE 15".

(UL 471 10th Edition, Annex SB6.1.9 added November 30, 2012)

DD.2 Installation and operating instructions

DD.2.1 Handling and moving

Installation and operating instructions shall be provided with cautionary statements concerning the handling, moving, and use of the REFRIGERATING EQUIPMENT to avoid either damaging the REFRIGERANT tubing, or increasing the RISK of a leak.

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.2.2 Packaging markings

The shipping carton of REFRIGERATING EQUIPMENT that employs a FLAMMABLE REFRIGERANT shall be marked:

"Caution – RISK Of Fire Or Explosion due to FLAMMABLE REFRIGERANT Used. Follow Handling Instructions Carefully in Compliance with U.S. Government Regulations".

The warning marking of symbol 102 of Table 1 shall also appear on the shipping carton.

(UL 471 10th Edition, Annex SB6.2.2 revised November 17, 2014)

DD.2.3 Replacement components and servicing

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

DD.2.4 Installation instructions for equipment containing a remote CONDENSING UNIT

In addition to the above, the installation instructions for equipment containing a remote CONDENSING UNIT shall contain the following:

- a) Information for spaces where pipes containing FLAMMABLE REFRIGERANT are allowed, including statements that (1) the pipe work shall be protected from physical damage and, (2) compliance with the installation requirements of ANSI/ASHRAE 15 shall be observed.
- b) The minimum necessary room volume per REFRIGERATING SYSTEM charge allowed. See Table DD.1. This may be in the form of a table indicating minimum room volume per REFRIGERANT charge amount, but shall not reference a formula.
- c) Information for handling, installation, cleaning, servicing and disposal of REFRIGERANT.
- d) A warning that the equipment shall not be installed in a room with continuously operating open flame or ignition sources.

Table DD.1 – Quantity of Group A2/A3 REFRIGERANT per occupied space ^a

REFRIGERANT number	Chemical name	Formula	Quantity of REFRIGERANT per occupied space ^a		
			lb/1 000 ft ³	parts per million by volume	g/m ³
R142b	1-Chloro-1,1,- Difluoroethane	CH ₃ CClF ₂	3,7	14 000	60
R152a	1,1,- Difluoroethane	CH ₃ CHF ₂	1,2	7 000	20
R170	Ethane	CH ₃ CH ₃	0,50	6 400	8,0
R290	Propane	C ₃ H ₈	0,50	4 400	8,0
R600	Butane	C ₄ H ₁₀	0,51	3 400	8,2
R600A	2-Methyl propane (Isobutane)	CH(CH ₃) ₃	0,51	3 400	8,2
R1150	Ethene (Ethylene)	C ₂ H ₄	0,38	5 200	6,0
R1270	Propene (Propylene)	C ₃ H ₆	0,37	3 400	5,9
NOTE Listed equipment for use in laboratories with more than 100 ft ² (9,3 m ²) of space per person is exempt from this limit provided the equipment is installed in accordance with the listing and with the manufacturer's installation instruction.					
^a Values for REFRIGERANTS are from ANSI/ASHRAE 15-2013, Table 1.					

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

Bibliography

The Bibliography of Part 1 is applicable, except as follows:

Addition:

Add the following entries to the list:

~~IEC 60079-20:2010, Explosive Atmospheres – Part 20: Material characteristics for gas and vapour classification~~

IEC TR 60079-20, *Electrical apparatus for explosive gas atmospheres – Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus*¹

IEC 60079-20-1, *Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data*²

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 61010-2-020, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-020: Particular requirements for laboratory centrifuges*

ISO 817, *Refrigerants – Designation and safety classification*

ISO 4126-1, *Safety devices for protection against excessive pressure – Part 1: Safety valves*

ISO 4126-2, *Safety devices for protection against excessive pressure – Part 2: Bursting disc safety devices*

ISO 5149 (all parts), *Refrigerating systems and heat pumps – Safety and environmental requirements*

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

ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration Systems*³

ANSI/ASHRAE 34-2013, *Designation and Safety Classification of Refrigerants*⁴

CSA C22.2 No. 120-13, *Refrigeration Equipment*

EN 378-1:2008, *Refrigerant-condensing systems and heat pumps – Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria*

EN 378-1:2008/AMD2:2012⁵

¹ Withdrawn publication.

² Withdrawn publication.

³ An updated edition is available.

⁴ An updated edition is available.

⁵ Updated editions of the EN 378 series are available.

EN 378-2:2008, *Refrigerant~~-condensing~~ systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation*
EN 378-2:2008/AMD2:2012

EN 378-3:2008, *Refrigerating systems and heat pumps – Safety and environmental requirements. Installation site and personal protection*
EN 378-3:2008/AMD1:2012

EN 378-4:2008, *Refrigerating systems and heat pumps – Safety and environmental requirements. Operation, maintenance, repair and recovery*
EN 378-4:2008/AMD1:2012

EN 809:1998, *Pumps and pump units for liquids – Common safety requirements*

EN 1736:2000, *Refrigerating systems and heat pumps – Flexible pipe elements, vibration isolators and expansion joints – Requirements, design and installation*⁶

EN 1779:1999, *Non-destructive testing – Leak testing – Criteria for method and technique selection*

EN 12263:1998, *Refrigerating systems and heat pumps – Safety switching devices for limiting the pressure – Requirements and tests*

EN 12284:2003, *Refrigerating systems and heat pumps – Valves – Requirements, testing and marking*

EN 12693:2006, *Refrigerating systems and heat pumps – Safety and environmental requirements – Positive displacement refrigerant compressors*⁷

EN 13136:2001, *Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation*⁸

EN 13445-1:2002, *Unfired pressure vessels – Part 1: General*⁹

EN 13445-2:2002, *Unfired pressure vessels – Part 2: Materials*

EN 13445-3:2002, *Unfired pressure vessels – Part 3: Design*

EN 13445-4:2002, *Unfired pressure vessels – Part 4: Fabrication*

EN 13445-5:2002, *Unfired pressure vessels – Part 5: Inspection and testing*

EN 13445-6:2002, *Unfired pressure vessels – Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*

EN 13445-8:2006, *Unfired pressure vessels – Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

⁶ An updated edition is available.

⁷ An updated edition is available.

⁸ An updated edition is available.

⁹ Updated editions of the EN 13445 series are available.

EN 14276-1:2006, *Pressure equipment for refrigerating systems and heat pumps – Part 1: Vessels – General requirements*

EN 14276-2:2007, *Pressure equipment for refrigerating systems and heat pumps – Part 2: Piping – General requirements*

UL 471:2010, *Commercial refrigerators and freezers*, 10th Edition, Annex SB6

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

INTERNATIONAL STANDARD

NORME INTERNATIONALE



GROUP SAFETY PUBLICATION
PUBLICATION GROUPEE DE SÉCURITÉ

Safety requirements for electrical equipment for measurement, control, and laboratory use –

Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT

Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire –

Partie 2-011: Exigences particulières pour APPAREILS DE REFRIGERATION

CONTENTS

FOREWORD	4
INTRODUCTION	7
1 Scope and object	10
2 Normative references	11
3 Terms and definitions	11
4 Tests	13
5 Marking and documentation	16
6 Protection against electric shock	19
7 Protection against mechanical HAZARDS	19
8 Resistance to mechanical stresses	19
9 Protection against the spread of fire	19
10 Equipment temperature limits and resistance to heat	20
11 Protection against HAZARDS from fluids and solid foreign objects	21
12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure	32
13 Protection against liberated gases and substances, explosion and implosion	32
14 Components and subassemblies	32
15 Protection by interlocks	33
16 HAZARDS resulting from application	33
17 RISK assessment	33
Annexes	34
Annex G (informative) Leakage and rupture from fluids under pressure	35
Annex L (informative) Index of defined terms	36
Annex AA (normative) Non-sparking "n" electrical device	37
Annex BB (informative) HAZARDS associated with REFRIGERATING SYSTEMS and REFRIGERANTS	38
Annex CC (informative) Safety requirements for components and piping	40
Annex DD (informative) Equipment containing FLAMMABLE REFRIGERANTS – Information and marking requirements	45
Bibliography	49
Figure 101 – Schema of a REFRIGERATING SYSTEM incorporating a condenser	8
Figure 102 – Flow chart illustrating the selection process	9
Figure 103 – Scratching TOOL tip details	27
Table 1 – Symbols	17
Table 101 – Maximum temperatures for MOTOR-COMPRESSORS	20
Table 102 – Minimum temperature for determination of saturated vapor pressure of REFRIGERANT	22
Table 103 – REFRIGERANT flammability parameters	31
Table CC.1 – Parameters of pressure vessels according to EN 14276-1	40
Table CC.2 – Parameters of piping according to EN 14276-2	42

Table CC.3 – Component and piping requirements	43
Table CC.4 – Minimum wall thickness for copper and steel tubing	44
Table DD.1 – Quantity of Group A2/A3 REFRIGERANT per occupied space.....	48

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE –

Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 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.

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 PLV

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?

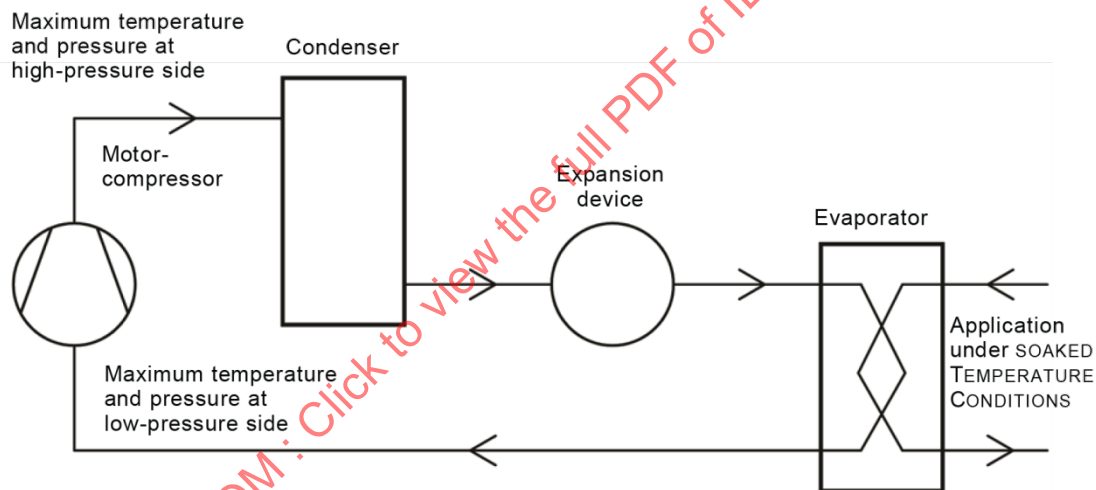
The typical HAZARDS for a REFRIGERATING SYSTEM (see Figure 101) consisting of a MOTOR-COMPRESSOR, a condenser, an expansion device and an evaporator include but are not limited to:

- 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.

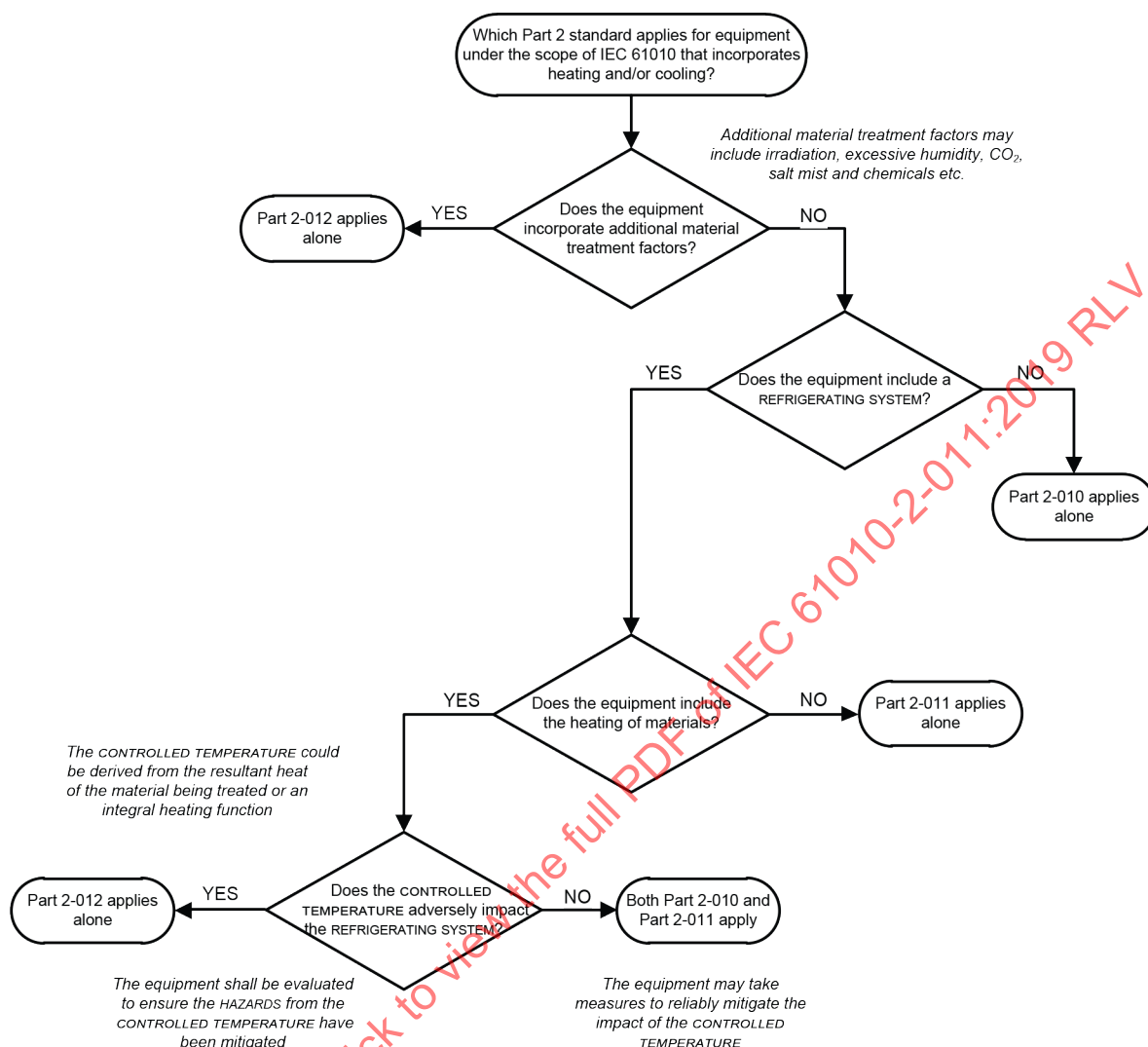
The worst-case conditions should be determined for the equipment and will include both the least favourable NORMAL USE conditions as well as the most unfavourable testing results under SINGLE FAULT CONDITIONS.



IEC

Figure 101 – Schema of a REFRIGERATING SYSTEM incorporating a condenser

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



IEC

Figure 102 – Flow chart illustrating the selection process

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 CO₂) or a system that uses ammonia (NH₃) 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 gasketed 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 ($\pm 10\%$) 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 $25\text{ °C} \pm 3\text{ °C}$.

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 $25\text{ °C} \pm 3\text{ °C}$.

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

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.

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.

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 ($\pm 10\%$) 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 $-30\text{ }^{\circ}\text{C}$, 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:

- the maximum pressure developed during the temperature runs as defined by 10.4.1;
- 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);
- the maximum pressure developed during the test of 4.3.2.101 if applicable;
- 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, CO₂ 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 $\geq$ 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.

11.7.102.3 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 $0,7 \text{ mm} \pm 0,05 \text{ mm}$ 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 $\pm 1,5 \text{ g}$ 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) $32\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for leakage simulation on low-pressure-side circuits;
- b) $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ 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 $\pm$ 3 N;
- force parallel to the surface to be tested not exceeding 250 N.

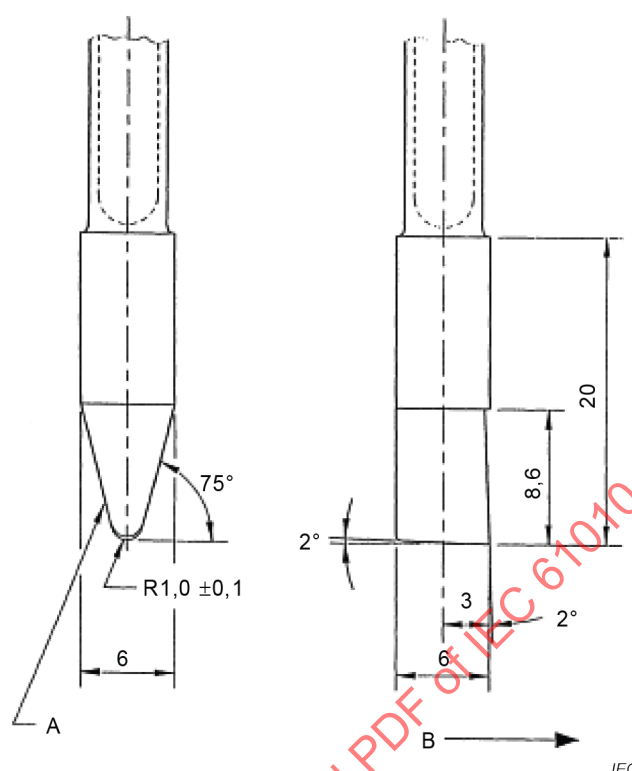
The TOOL is drawn across the surface to be tested at a rate of approximately 1 mm/s.

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 %.

Dimensions in millimetres



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 $\pm 1,5$ 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 $\pm 1,5$ 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 ₃ CH ₃	515	3,1
R290	Propane	CH ₃ CH ₂ CH ₃	470	1,7
R600	n-Butane	CH ₃ CH ₂ CH ₂ CH 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.

11.7.104.8.2 Transport temperature test method 1

The steps for this method are:

- calculate the total volume of the REFRIGERATING SYSTEM in question;
- calculate the charge-to-volume ratio for the design charge;
- 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:

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

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.

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RV

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

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.

Annex BB (informative)

HAZARDS associated with REFRIGERATING SYSTEMS and REFRIGERANTS

These HAZARDS are associated essentially with the physical and chemical characteristics of REFRIGERANTS as well as with the pressures and temperatures occurring in refrigeration cycles.

Inadequate precautions can result in:

- component rupture or explosion, with RISK of projectiles;
- escape of REFRIGERANT with the RISK of environmental damage or toxicity due to a fracture, a leakage caused by bad design, incorrect operation, and inadequate maintenance, repair, charging or disposal;
- burning or combustion of the escaping REFRIGERANT with consequent RISK of fire including the RISK of toxic products of combustion from non-FLAMMABLE REFRIGERANTS.

REFRIGERANTS, their mixtures and combinations with oils, water or other materials, which are present in the REFRIGERATING SYSTEM, whether intended or unintended, affect the internal surrounding materials chemically and physically for example due to pressure and temperature. They can, if they have detrimental properties, endanger persons, property and the environment directly or indirectly due to global long term effects (ozone depletion potential, global warming potential) when escaping from the REFRIGERATING SYSTEM.

HAZARDS due to the states of pressure and temperature in REFRIGERATING SYSTEMS are essentially due to the simultaneous presence of the liquid and vapour phases. Furthermore, the state of the REFRIGERANT and the stresses that it exerts on the various components do not depend solely on the processes and functions inside the plant, but also on external factors.

The following HAZARDS are worthy of note:

- a) from the direct effect of extreme temperature, for example:
 - brittleness of materials at low temperatures;
 - freezing of enclosed liquid (water, brine or similar);
 - thermal stresses;
 - changes of volume due to temperature changes;
 - injurious effects to persons caused by low temperatures;
 - touchable hot surfaces;
- b) from excessive pressure due to, for example:
 - increase in the pressure of condensation, caused by inadequate cooling or the partial pressure of non-condensable gases or an accumulation of oil or liquid REFRIGERANT;
 - increase in the pressure of saturated vapour due to excessive external heating, for example of a liquid cooler, or when defrosting an air cooler or high ambient temperature when the plant is at a standstill;
 - expansion of liquid REFRIGERANT in a closed space without the presence of vapour, caused by a rise in external temperature;
 - fire;
- c) from the direct effect of the liquid phase, for example:
 - excessive charge or flooding of equipment;
 - presence of liquid in compressors, caused by syphoning, or condensation in the compressor;

- liquid hammer in piping;
 - loss of lubrication due to dilution of oil;
 - condensation-induced shock;
- d) from the escape of REFRIGERANTS, for example:
- fire;
 - explosion;
 - toxicity including products of combustion;
 - caustic effects;
 - freezing of skin;
 - asphyxiation;
 - panic;
 - depletion of the ozone layer;
 - global warming;
- e) from the moving parts of machinery, for example:
- injuries;
 - hearing loss from excessive noise;
 - damage due to vibration.

Attention is drawn to HAZARDS common to all compression systems, such as excessive temperature at discharge, liquid slugging (REFRIGERANT getting into the compressor's oil reservoir reducing the lubrication or creating a frothy, incompressible mixture which could then get sucked into the piston), erroneous operation and reduction in mechanical strength caused by corrosion, erosion, thermal stress, liquid hammer or vibration.

Special consideration should be given to corrosion, however, as conditions peculiar to REFRIGERATING SYSTEMS arise due to alternate frosting and defrosting or the covering of equipment by insulation.

Annex CC (informative)

Safety requirements for components and piping

CC.1 Overview

The applicable component requirements for sealed system components and the associated piping are defined differently for geographical regions depending on the classification of the pressure vessels in question.

For Europe, the sealed system components can be considered pressure vessels in accordance with the Pressure Equipment Directive (PED) 2014/68/EU according to the classification in Table CC.1 and Table CC.2. If the components or piping are classified as a Category II or higher pressure vessel according to the PED then the requirements of Table CC.3 shall apply including the use of a Notified Body to the PED.

For North America, the component requirements of Clause CC.2 apply.

Table CC.1 – Parameters of pressure vessels according to EN 14276-1

Fluid	Nature	PS (bar) ^a	V (L)	$PS \times V$ (bar $\times$ L)	Category/ article
if	and	and	and	and	then
Group 1	Gas	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and ≤ 200	≤ 1	—	Art. 3.3 ^c
			> 1	≤ 25	Art. 3.3 ^c
				> 25 and ≤ 50	I
				> 50 and ≤ 200	II
		> 200 and $\leq 1\,000$	≤ 1	—	III
		$\leq 1\,000$	> 1	> 200 and $\leq 1\,000$	III
				$> 1\,000$	IV
		$> 1\,000$	—	—	IV
	Liquid ^d	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and ≤ 500	≤ 1	—	Art. 3.3 ^c
			> 1	≤ 200	Art. 3.3 ^c
		$> 0,5$ and ≤ 10		> 200	I
		> 10 and ≤ 500			II
		> 500	< 1	—	II
		> 500	> 1	—	III

Fluid	Nature	PS (bar) ^a	V (L)	$PS \times V$ (bar $\times$ L)	Category/ article
if	and	and	and	and	then
Group 2	Gas	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and $\leq 1\,000$	≤ 1	—	Art. 3.3 ^c
			> 1	≤ 50	Art. 3.3 ^c
				> 50 and ≤ 200	I
				> 200 and $\leq 1\,000$	II
		$> 1\,000$ and $\leq 3\,000$	≤ 1	—	III
			> 1	$> 1\,000$ and $\leq 3\,000$	III
		$> 0,5$ and ≤ 4		$> 1\,000$	III
		> 4		$> 3\,000$	IV
		$> 3\,000$	—	—	IV
	Liquid ^d	$\leq 0,5$	—	—	Not submitted to PED ^b
		$> 0,5$ and ≤ 10	—	—	Art. 3.3 ^c
		> 10 and $\leq 1\,000$	≤ 10	—	Art. 3.3 ^c
		> 10 and $\leq 1\,000$	> 10	$\leq 10\,000$	Art. 3.3 ^c
		> 10 and ≤ 500	—	$> 10\,000$	I
		$> 1\,000$	< 10	—	I
		> 500	> 10	$> 10\,000$	II

^a 1 bar = 0,1 Mpa.

^b PED = Pressure Equipment Directive 2014/68/EU.

^c Art. 3.3 = reference to article of the Pressure Equipment Directive 2014/68/EU.

^d Liquids are considered to be fluids having a vapour pressure not more than 0,5 bar above normal atmospheric pressure (1 013 mbar).

Table CC.2 – Parameters of pipping according to EN 14276-2

Fluid	Nature	PS (bar) ^a	DN	PS × DN (bar) ^a	Category/article
if	and	and	and	and	then
Group 1	Gas	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5	≤ 25	—	Art. 3.3 ^c
			> 25 and ≤ 100	≤ 1 000	I
			> 100 and ≤ 350	> 1 000 and ≤ 3 500	II
			> 350	> 3 500	III
	Liquid ^d	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5	≤ 25	—	Art. 3.3 ^c
			—	≤ 2 000	Art. 3.3 ^c
		> 0,5 and ≤ 10	—	> 2 000	I
		> 10 and ≤ 500	> 25		II
		> 500	—	III	
Group 2	Gas	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5	≤ 32	—	Art. 3.3 ^c
			—	≤ 1 000	Art. 3.3 ^c
			> 32 and ≤ 100	> 1 000 and ≤ 3 500	I
			> 100 and ≤ 250	> 3 500 and ≤ 5 000	II
			> 250	> 5 000	III
	Liquid ^d	≤ 0,5	—	—	Not submitted to PED ^b
		> 0,5 and ≤ 10	—	—	Art. 3.3 ^c
		—	—	≤ 5 000	Art. 3.3 ^c
		—	≤ 200	—	Art. 3.3 ^c
		> 10 and ≤ 500	> 200	> 5 000	I
		> 500		—	II

^a 1 bar = 0,1 Mpa.

^b PED = Pressure Equipment Directive 2014/68/EU.

^c Art. 3.3 = reference to article of the Pressure Equipment Directive 2014/68/EU.

^d Liquids are considered to be fluids having a vapour pressure not more than 0,5 bar above normal atmospheric pressure (1 013 mbar).

Table CC.3 – Component and piping requirements

Component	Related standard and requirements
Heat exchangers: – pipe coil without air (tube in tube)	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Plate heat exchangers	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Headers and coils with air as a secondary fluid	EN 14276-2 combined with a production leak tightness test based on guidance from EN 1779
Receiver / accumulator / economiser	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Oil separator	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Drier	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Filter	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Muffler	EN 14276-1 or EN 13445 (all parts) if applicable combined with 11.7.102 of this document
Hermetic positive displacement compressor	IEC 60335-2-34 or EN 12693
Semi-hermetic positive displacement compressor	IEC 60335-2-34 or EN 12693
Open positive displacement compressor	EN 12693
Non positive displacement compressor	EN 14276-1 or EN 13445 (all parts) if applicable combined with IEC 60204-1
Pump General requirements	EN 809 combined with IEC 60204-1, and combined with a production leak tightness test based on guidance from EN 1779:1999 and the marking requirements from 5.1.2 of this document
Piping	EN 14276-2 or EN 13480
Piping joints Permanent joints Detachable joints	EN 14276-2 combined with a production leak tightness test based on guidance from EN 1779 and an evaluation of the suitability of the joint for the pipe, piping material, pressure, temperature and fluid
Flexible piping	EN 1736
Valves	EN 12284
safety valve	EN 13136 and EN ISO 4126-1 combined with a production leak tightness test based on guidance from EN 1779
safety switching devices for limiting the pressure	EN 12263 combined with a production leak tightness test based on guidance from EN 1779
isolating valves	EN 12284
hand operated valves	EN 12284
valves with seal cap	EN 12284
Bursting disc	EN ISO 4126-2 and EN 13136 combined with a production leak tightness test based on guidance from EN 1779
Fusible plug	EN 13136 combined with a production leak tightness test based on guidance from EN 1779 and marked with the melting temperature and working pressure of the fusible material
Liquid level indicators	EN 12178 combined with a production leak tightness test based on guidance from EN 1779
Gauges	EN 837-1, EN 837-2 and EN 837-3 combined with a production leak tightness test based on guidance from EN 1779
Brazing and soldering materials	Soldering alloys shall not be used for REFRIGERANT-containing purposes where strength is a factor. Brazing alloys shall only be used when their compatibility with refrigerators and lubricants has been proven by test or experience
Welding materials	EN 14276-2

CC.2 Components and subassemblies requirements for switches and controls used in REFRIGERATING EQUIPMENT for North America

The minimum RATING for the number of operations for switches and controls used in a REFRIGERATING SYSTEM shall be as follows:

- quick freeze switches 300
- manual and semi-automatic defrost switches 300
- door switches 50 000
- on/off switches 300
- thermostats which control a MOTOR-COMPRESSOR 100 000
- temperature limiters which control defrosting heaters 100 000
- MOTOR-COMPRESSOR starting relays 100 000
- self-resetting thermal motor-protector for MOTOR-COMPRESSORS 2 000
- NOTE 2 000 or the number of operations during the 15-day locked rotor test, whichever is the greater.
- non-self-resetting thermal motor-protector for MOTOR-COMPRESSORS 50
- other automatic thermal motor-protectors except for fan motors 2 000
- other manual reset thermal motor-protectors 30
- interlock devices 100 000

Table CC.4 – Minimum wall thickness for copper and steel tubing

Outside diameter		Copper				Steel	
		Protected within refrigerator		Unprotected			
inches	(mm)	inches	(mm)	inches	(mm)	inches	(mm)
1/4	(6,35)	0,024 5	(0,623)	0,026 5	(0,673)	0,025	(0,635)
5/16	(7,94)	0,024 5	(0,623)	0,026 5	(0,673)	0,025	(0,635)
3/8	(9,53)	0,024 5	(0,623)	0,026 5	(0,673)	0,025	(0,635)
1/2	(12,70)	0,024 5	(0,623)	0,028 5	(0,724)	0,025	(0,635)
5/8	(15,88)	0,031 5	(0,799)	0,031 5	(0,799)	0,032	(0,813)
3/4	(19,05)	0,031 5	(0,799)	0,038 5	(0,978)	0,032	(0,813)
7/8	(22,23)	0,041 0	(1,041)	0,041 0	(1,041)	0,046	(1,168)
1	(25,40)	0,046 0	(1,168)	0,046 0	(1,168)	—	—
1-1/8	(28,58)	0,046 0	(1,168)	0,046 0	(1,168)	0,046	(1,168)
1-1/4	(31,75)	0,050 5	(1,283)	0,050 5	(1,283)	0,046	(1,168)
1-3/8	(34,93)	0,050 5	(1,283)	0,050 5	(1,283)	—	—
1-1/2	(38,10)	0,055 5	(1,410)	0,055 5	(1,410)	0,062	(1,575)
1-5/8	(41,28)	0,055 5	(1,410)	0,055 5	(1,410)	—	—
2-1/8	(53,98)	0,064 0	(1,626)	0,064 0	(1,626)	—	—
2-5/8	(66,68)	0,074 0	(1,880)	0,074 0	(1,880)	—	—

Nominal wall thickness of tubing will have to be greater than the thickness indicated to maintain the minimum wall thickness.

Annex DD (informative)

Equipment containing FLAMMABLE REFRIGERANTS – Information and marking requirements

DD.1 Marking, installation and operating instructions (SB6)

DD.1.1 General

NOTE For the US, additional marking and informational requirements exist for REFRIGERATING EQUIPMENT which utilises FLAMMABLE REFRIGERANTS. The source document reference, UL 471, Annex SB6, is included in brackets at the end of each subclause.

DD.1.2 Marking

When a FLAMMABLE REFRIGERANT is used, the markings as outlined in DD.1.3 to DD.1.6, or the equivalent, shall be

- a) in letters no less than 6,4 mm (1/4 inch) high, and
- b) permanently marked on the REFRIGERATING EQUIPMENT in the indicated locations.

(UL 471 10th Edition, Annex SB6.1.1 revised November 17, 2014)

DD.1.3 OPERATOR markings

"DANGER – RISK Of Fire Or Explosion. FLAMMABLE REFRIGERANT Used. Do Not Use Mechanical Devices To Defrost REFRIGERATING EQUIPMENT. Do Not Puncture REFRIGERANT Tubing".

This marking shall be provided on or near any evaporators that can be contacted by the OPERATOR.

(UL 471 10th Edition, Annex SB6.1.2 revised June 28, 2013)

DD.1.4 Service markings

For self-contained REFRIGERATING EQUIPMENT, the following markings shall be located near the machine compartment. For a remote CONDENSING UNIT, the following markings shall be located near the inter-connecting REFRIGERANT tubing connections and the nameplate:

- a) "DANGER – RISK Of Fire Or Explosion. FLAMMABLE REFRIGERANT Used. To Be Repaired Only By Trained Service Personnel. Do Not Puncture REFRIGERANT Tubing".
- b) "CAUTION – RISK Of Fire Or Explosion. FLAMMABLE REFRIGERANT Used. Consult Repair Manual/Owner's Guide Before Attempting To Install Or Service This Equipment. All Safety Precautions Must be Followed".

(UL 471 10th Edition, Annex SB6.1.3 revised November 30, 2012)

DD.1.5 Disposal

"CAUTION – RISK Of Fire Or Explosion. Dispose Of Properly In Accordance With Federal Or Local Regulations. FLAMMABLE REFRIGERANT Used".

This marking shall be provided on the exterior of the REFRIGERATING EQUIPMENT.

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.1.6 Exposed tubing

"CAUTION – Risk Of Fire Or Explosion Due To Puncture Of REFRIGERANT Tubing. Follow Handling Instructions Carefully. FLAMMABLE REFRIGERANT Used".

This marking shall be provided near all exposed REFRIGERANT tubing.

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.1.7 Accessing the REFRIGERANT circuit

Refrigeration tubing or other devices through which the REFRIGERANT is intended to be serviced shall be painted, coloured, or labelled red, Pantone® Matching System (PMS) No. 185. This colour shall be present at all places where service puncturing or otherwise creating an opening in the REFRIGERANT circuit might be expected. In the case of a process tube on a MOTOR-COMPRESSOR, the colour mark shall extend at least 2,5 cm (1 inch) from the MOTOR-COMPRESSOR.

(UL 471 10th Edition, Annex SB6.1.6 revised November 17, 2014)

DD.1.8 Symbol for warning of flammable materials

The marking in item DD.1.4 a) shall also contain symbol 102 of Table 1 for warning of flammable materials.

The colour and format of the symbol shall be exactly the same as shown. The perpendicular height of the triangle shall be at least 15 mm (9/16 in).

(UL 471 10th Edition, Annex SB6.1.7 revised June 28, 2013)

DD.1.9 Equipment containing a remote CONDENSING UNIT

For equipment containing a remote CONDENSING UNIT, the following marking shall be located near the tubing intended for the connection of the field supplied REFRIGERANT tubing:

"CAUTION – This equipment is intended for use with FLAMMABLE REFRIGERANT. Install in accordance with the FLAMMABLE REFRIGERANT requirements specified in the ANSI/ASHRAE 15".

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.1.10 REFRIGERATING EQUIPMENT intended for laboratory use

REFRIGERATING EQUIPMENT intended for laboratory use that contains an A3 REFRIGERANT shall be marked:

"This equipment is intended for use in commercial, industrial, or institutional occupancies as defined in the Safety Standard for Refrigeration Systems, ANSI/ASHRAE 15".

(UL 471 10th Edition, Annex SB6.1.9 added November 30, 2012)

DD.2 Installation and operating instructions

DD.2.1 Handling and moving

Installation and operating instructions shall be provided with cautionary statements concerning the handling, moving, and use of the REFRIGERATING EQUIPMENT to avoid either damaging the REFRIGERANT tubing, or increasing the RISK of a leak.

(UL 471 10th Edition, Annex SB6 released November 24, 2010)

DD.2.2 Packaging markings

The shipping carton of REFRIGERATING EQUIPMENT that employs a FLAMMABLE REFRIGERANT shall be marked:

"Caution – RISK Of Fire Or Explosion due to FLAMMABLE REFRIGERANT Used. Follow Handling Instructions Carefully in Compliance with U.S. Government Regulations".

The warning marking of symbol 102 of Table 1 shall also appear on the shipping carton.

(UL 471 10th Edition, Annex SB6.2.2 revised November 17, 2014)

DD.2.3 Replacement components and servicing

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

DD.2.4 Installation instructions for equipment containing a remote CONDENSING UNIT

In addition to the above, the installation instructions for equipment containing a remote CONDENSING UNIT shall contain the following:

- a) Information for spaces where pipes containing FLAMMABLE REFRIGERANT are allowed, including statements that (1) the pipe work shall be protected from physical damage and, (2) compliance with the installation requirements of ANSI/ASHRAE 15 shall be observed.
- b) The minimum necessary room volume per REFRIGERATING SYSTEM charge allowed. See Table DD.1. This may be in the form of a table indicating minimum room volume per REFRIGERANT charge amount, but shall not reference a formula.
- c) Information for handling, installation, cleaning, servicing and disposal of REFRIGERANT.
- d) A warning that the equipment shall not be installed in a room with continuously operating open flame or ignition sources.

Table DD.1 – Quantity of Group A2/A3 REFRIGERANT per occupied space

REFRIGERANT number	Chemical name	Formula	Quantity of REFRIGERANT per occupied space ^a		
			lb/1 000 ft ³	parts per million by volume	g/m ³
R142b	1-Chloro-1,1,- Difluoroethane	CH ₃ CClF ₂	3,7	14 000	60
R152a	1,1,- Difluoroethane	CH ₃ CHF ₂	1,2	7 000	20
R170	Ethane	CH ₃ CH ₃	0,50	6 400	8,0
R290	Propane	C ₃ H ₈	0,50	4 400	8,0
R600	Butane	C ₄ H ₁₀	0,51	3 400	8,2
R600A	2-Methyl propane (Isobutane)	CH(CH ₃) ₃	0,51	3 400	8,2
R1150	Ethene (Ethylene)	C ₂ H ₄	0,38	5 200	6,0
R1270	Propene (Propylene)	C ₃ H ₆	0,37	3 400	5,9
NOTE Listed equipment for use in laboratories with more than 100 ft ² (9,3 m ²) of space per person is exempt from this limit provided the equipment is installed in accordance with the listing and with the manufacturer's installation instruction.					
^a Values for REFRIGERANTS are from ANSI/ASHRAE 15-2013, Table 1.					

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 PLV

Bibliography

The Bibliography of Part 1 is applicable, except as follows:

Addition:

Add the following entries to the list:

IEC TR 60079-20, *Electrical apparatus for explosive gas atmospheres – Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus*¹

IEC 60079-20-1, *Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data*²

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 61010-2-020, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-020: Particular requirements for laboratory centrifuges*

ISO 817, *Refrigerants – Designation and safety classification*

ISO 4126-1, *Safety devices for protection against excessive pressure – Part 1: Safety valves*

ISO 4126-2, *Safety devices for protection against excessive pressure – Part 2: Bursting disc safety devices*

ISO 5149 (all parts), *Refrigerating systems and heat pumps – Safety and environmental requirements*

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

ANSI/ASHRAE 15-2013, *Safety Standard for Refrigeration Systems*³

ANSI/ASHRAE 34-2013, *Designation and Safety Classification of Refrigerants*⁴

CSA C22.2 No. 120-13, *Refrigeration Equipment*

EN 378-1:2008, *Refrigerant systems and heat pumps – Safety and environmental requirements. Basic requirements, definitions, classification and selection criteria*
EN 378-1:2008/AMD2:2012⁵

EN 378-2:2008, *Refrigerant systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation*
EN 378-2:2008/AMD2:2012

¹ Withdrawn publication.

² Withdrawn publication.

³ An updated edition is available.

⁴ An updated edition is available.

⁵ Updated editions of the EN 378 series are available.

EN 378-3:2008, *Refrigerating systems and heat pumps – Safety and environmental requirements. Installation site and personal protection*
EN 378-3:2008/AMD1:2012

EN 378-4:2008, *Refrigerating systems and heat pumps – Safety and environmental requirements. Operation, maintenance, repair and recovery*
EN 378-4:2008/AMD1:2012

EN 809:1998, *Pumps and pump units for liquids – Common safety requirements*

EN 1736:2000, *Refrigerating systems and heat pumps – Flexible pipe elements, vibration isolators and expansion joints – Requirements, design and installation*⁶

EN 1779:1999, *Non-destructive testing – Leak testing – Criteria for method and technique selection*

EN 12263:1998, *Refrigerating systems and heat pumps – Safety switching devices for limiting the pressure – Requirements and tests*

EN 12284:2003, *Refrigerating systems and heat pumps – Valves – Requirements, testing and marking*

EN 12693:2006, *Refrigerating systems and heat pumps – Safety and environmental requirements – Positive displacement refrigerant compressors*⁷

EN 13136:2001, *Refrigerating systems and heat pumps – Pressure relief devices and their associated piping – Methods for calculation*⁸

EN 13445-1:2002, *Unfired pressure vessels – Part 1: General*⁹

EN 13445-2:2002, *Unfired pressure vessels – Part 2: Materials*

EN 13445-3:2002, *Unfired pressure vessels – Part 3: Design*

EN 13445-4:2002, *Unfired pressure vessels – Part 4: Fabrication*

EN 13445-5:2002, *Unfired pressure vessels – Part 5: Inspection and testing*

EN 13445-6:2002, *Unfired pressure vessels – Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*

EN 13445-8:2006, *Unfired pressure vessels – Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

EN 14276-1:2006, *Pressure equipment for refrigerating systems and heat pumps – Part 1: Vessels – General requirements*

EN 14276-2:2007, *Pressure equipment for refrigerating systems and heat pumps – Part 2: Piping – General requirements*

⁶ An updated edition is available.

⁷ An updated edition is available.

⁸ An updated edition is available.

⁹ Updated editions of the EN 13445 series are available.

UL 471:2010, *Commercial refrigerators and freezers*, 10th Edition, Annex SB6

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

SOMMAIRE

AVANT-PROPOS	54
INTRODUCTION.....	57
1 Domaine d'application et objet.....	60
2 Références normatives	61
3 Termes et définitions	61
4 Essais	63
5 Marquage et documentation	66
6 Protection contre les chocs électriques.....	69
7 Protection contre les DANGERS mécaniques.....	69
8 Résistance aux contraintes mécaniques	70
9 Protection contre la propagation du feu	70
10 Limites de température de l'appareil et résistance à la chaleur	70
11 Protection contre les DANGERS des fluides et des corps solides étrangers.....	72
12 Protection contre les radiations, y compris les sources laser, et contre la pression acoustique et ultrasonique.....	83
13 Protection contre les émissions de gaz et substances, les explosions et les implosions	83
14 Composants et sous-ensembles	83
15 Protection par systèmes de verrouillage	84
16 DANGERS résultant de l'application.....	84
17 Appréciation du RISQUE.....	85
Annexes	86
Annexe G (informative) Fuite et rupture des fluides sous pression.....	87
Annexe L (informative) Index des termes définis.....	88
Annexe AA (normative) Appareils électriques "n" sans étincelle.....	89
Annexe BB (informative) DANGERS associés aux SYSTEMES FRIGORIFIQUES et FLUIDES FRIGORIGENES.....	90
Annexe CC (informative) Exigences de sécurité pour les composants et les tuyauteries	92
Annexe DD (informative) Appareils contenant des FLUIDES FRIGORIGENES INFLAMMABLES – Exigences relatives aux informations et au marquage	97
Bibliographie.....	101
Figure 101 – Schéma d'un SYSTEME FRIGORIFIQUE comprenant un condenseur	58
Figure 102 – Organigramme illustrant le processus de sélection	59
Figure 103 – Éléments détaillés de pointe de l'OUTIL de rayage.....	78
Tableau 1– Symboles	67
Tableau 101 – Températures maximales pour les MOTOCOMPRESSEURS.....	71
Tableau 102 – Température minimale pour la détermination de la pression de vapeur saturée du FLUIDE FRIGORIGENE	73
Tableau 103 – Paramètres d'inflammabilité du FLUIDE FRIGORIGENE.....	82
Tableau CC.1 – Paramètres des récipients sous pression conformément à l'EN 14276-1.....	92
Tableau CC.2 – Paramètres des tuyauteries conformément à l'EN 14276-2	94

Tableau CC.3 – Exigences relatives aux composants et aux tuyauteries.....	95
Tableau CC.4 – Épaisseur minimale de paroi pour les tubes en cuivre et en acier	96
Tableau DD.1 – Quantité de FLUIDE FRIGORIGENE du Groupe A2/A3 par local occupé	100

IECNORM.COM : Click to view the full PDF of IEC 61010-2-011:2019 RLV

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

EXIGENCES DE SÉCURITÉ POUR APPAREILS ÉLECTRIQUES DE MESURAGE, DE RÉGULATION ET DE LABORATOIRE –

Partie 2-011: Exigences particulières pour APPAREILS DE REFRIGERATION

AVANT-PROPOS

- 1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
- 3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
- 4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 61010-2-011 a été établie par le comité d'études 66 de l'IEC: Sécurité des appareils de mesure, de commande et de laboratoire.

Elle a le statut d'une publication groupée de sécurité conformément au Guide IEC 104.

Cette deuxième édition annule et remplace la première édition parue en 2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) alignement sur les modifications apportées par l'Amendement 1 de l'IEC 61010-1:2010;

- b) introduction de nouveaux termes et définitions ou modification de termes pour s'aligner sur la Partie 2-012 et d'autres documents de base. Modifications rédactionnelles permettant d'utiliser les petites majuscules uniquement pour les termes définis. Noter la différence entre "FONCTIONNEMENT ANORMAL" (3.107) utilisé en 4.3.2.101 et "fonctionnement anormal" en 11.7.104.3 et 11.7.104.5;
- c) clarifications relatives aux essais de refroidissement en 4.4.2.10;
- d) modifications relatives à l'emploi précis des termes suivants: "température", "température de fonctionnement", "température d'application", "TEMPERATURE REGULEE", "température du local" et "température ambiante";
- e) utilisation du terme défini "SYSTEME FRIGORIFIQUE" pour remplacer "système de refroidissement";
- f) déplacement du texte de 4.4.2.101 à 4.3.2.101, en ce sens que le FONCTIONNEMENT ANORMAL tel que défini consiste à simuler une défaillance des conditions ambiantes au 1.4.1, mais pas une CONDITION DE PREMIER DEFAUT de l'appareil;
- g) utilisation du terme "appareil" ("equipment" en anglais) pour remplacer le terme "unité", le cas échéant;
- h) les PRESSIONS MAXIMALES ADMISSIBLES (PS) de 5.1.2 dd) des côtés haute et basse pression pour chaque étage du FLUIDE FRIGORIGENE sont exigées uniquement en CONDITION NORMALE;
- i) utilisation du terme défini "CONDITION NORMALE" pour remplacer "fonctionnement normal";
- j) utilisation du terme défini "OPERATEUR" pour remplacer "utilisateur".

Le texte de cette Norme internationale est issu des documents suivants:

CDV	Rapport de vote
66/676/CDV	66/683/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61010, publiées sous le titre général *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire*, peut être consultée sur le site web de l'IEC.

La présente Partie 2-011 doit être utilisée conjointement avec la dernière édition de l'IEC 61010-1. Elle a été établie sur la base de la troisième édition (2010) et son Amendement 1 (2016), ci-après dénommée la Partie 1.

La présente Partie 2-011 complète ou modifie les articles correspondants de l'IEC 61010-1 de façon à transformer cette publication en norme IEC: *Exigences particulières pour APPAREILS DE REFRIGERATION*.

Lorsqu'un paragraphe particulier de la Partie 1 n'est pas mentionné dans la présente Partie 2-011, ce paragraphe est applicable pour autant qu'il soit raisonnable. Lorsque la présente Partie 2-011 spécifie "addition", "modification", "remplacement" ou "suppression", il convient d'adapter en conséquence l'exigence, la modalité d'essai ou la note correspondante de la Partie 1.

Dans la présente norme:

- 1) les caractères d'imprimerie suivants sont utilisés:
 - exigences et définitions: caractères romains;
 - NOTES: petits caractères romains;

- *conformité et essais: caractères italiques;*
- termes définis à l'Article 3 et utilisés dans toute cette norme: PETITES CAPITALES ROMAINES.

2) les paragraphes, figures, tableaux et notes complémentaires à ceux de la Partie 1 sont numérotés à partir de 101. Les annexes complémentaires sont désignées à partir de AA et les listes de termes additionnels à partir de aa).

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

La présente Partie 2-011, ainsi que la Partie 2-010 et la Partie 2-012 pris ensemble, couvrent les DANGERS spécifiques associés à l'échauffement et au refroidissement des matières par des appareils, et sont organisés comme suit:

I'IEC 61010-2-010	Couvre spécifiquement les DANGERS associés aux appareils comportant des systèmes de chauffage.
I'IEC 61010-2-011	Couvre spécifiquement les DANGERS associés aux appareils comportant des SYSTEMES FRIGORIFIQUES.
I'IEC 61010-2-012	Couvre spécifiquement les DANGERS associés aux appareils comportant à la fois des systèmes de chauffage et des SYSTEMES FRIGORIFIQUES qui interagissent entre eux de sorte que les SYSTEMES de chauffage et FRIGORIFIQUES combinés génèrent des DANGERS supplémentaires ou plus graves pour les deux systèmes que s'ils sont traités séparément. Elle couvre également les DANGERS associés au traitement des matières par d'autres facteurs tels que l'exposition aux rayonnements, une humidité excessive, la présence de CO ₂ et un mouvement mécanique.

Recommandations pour l'application de la ou des parties 2 appropriées

Lorsque l'appareil comprend uniquement un système d'échauffement des matières, et aucun SYSTEME FRIGORIFIQUE, ou lorsque d'autres facteurs d'environnement s'appliquent, la Partie 2-010 s'applique alors sans que la Partie 2-011 ou la Partie 2-012 ne s'avère nécessaire. De façon analogue, lorsque l'appareil comprend uniquement un SYSTEME FRIGORIFIQUE et aucun système d'échauffement des matières, ou lorsque d'autres facteurs d'environnement s'appliquent, la Partie 2-011 s'applique sans que la Partie 2-010 ou la Partie 2-012 ne s'avère nécessaire. Toutefois, lorsque l'appareil comporte à la fois un système d'échauffement des matières et un SYSTEME FRIGORIFIQUE ou lorsque les matières traitées dans l'application prévue génèrent une chaleur importante dans le SYSTEME FRIGORIFIQUE, il convient de déterminer si l'interaction entre les deux systèmes engendre des DANGERS supplémentaires ou plus graves que si les systèmes étaient évalués séparément (TEMPERATURE REGULEE, voir l'organigramme de la Figure 102 pour le processus de sélection). Lorsque l'interaction des fonctions de chauffage et de refroidissement n'engendre aucun DANGER supplémentaire ou plus grave, les deux Parties 2-010 et 2-011 s'appliquent alors pour leurs fonctions respectives. Inversement, si des DANGERS supplémentaires ou plus graves proviennent de la combinaison des fonctions de chauffage et de refroidissement, ou lorsque l'appareil inclut des facteurs supplémentaires de traitement des matières, la Partie 2-012 s'applique alors, contrairement aux Parties 2-010 et 2-011.

Quels DANGERS sont applicables dans le cas d'un SYSTEME FRIGORIFIQUE?

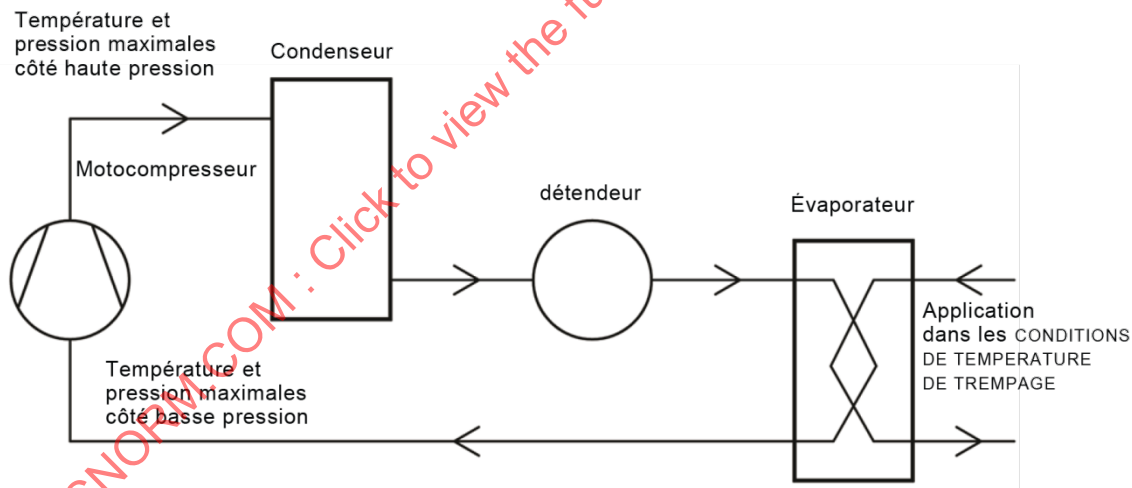
Les DANGERS typiques dans le cas d'un SYSTEME FRIGORIFIQUE (voir Figure 101) comprenant un MOTOCOMPRESSEUR, un condenseur, un détendeur et un évaporateur incluent entre autres:

- L'excès de température côté basse pression (température de retour) en direction du MOTOCOMPRESSEUR est supérieur au niveau admissible. Un MOTOCOMPRESSEUR comporte un moteur refroidi par FLUIDE FRIGORIGENE, et il convient d'établir que les températures maximales du côté basse pression dans les conditions les moins favorables ne dépassent pas les CARACTERISTIQUES ASSIGNEES d'isolation du moteur.
- L'excès de pression côté basse pression au niveau de l'admission du MOTOCOMPRESSEUR est supérieur au niveau admissible. L'enveloppe du MOTOCOMPRESSEUR est exposée à cette pression et il convient d'adapter ses CARACTERISTIQUES ASSIGNEES de conception aux

pressions les plus défavorables tout en assurant la marge de sécurité correcte pour un récipient sous pression.

- L'excès de température côté haute pression en direction du condenseur est supérieur au niveau admissible. Les températures côté haute pression dans les conditions les plus défavorables peuvent présenter un DANGER lié à la température en cas d'exposition de l'OPERATEUR ou de détérioration de l'isolation électrique provoquant un DANGER électrique.
- L'excès de pression côté haute pression en direction du condenseur est supérieur au niveau admissible. Les composants FRIGORIGENES en aval du MOTOCOMPRESSEUR jusqu'au niveau du détendeur sont exposés à cette pression et il convient d'adapter leurs CARACTERISTIQUES ASSIGNEES de conception aux pressions les plus défavorables tout en assurant la marge de sécurité correcte pour un récipient sous pression.
- Les TEMPERATURES maximales REGULEES, desquelles la chaleur est extraite, peuvent affecter la température maximale côté basse pression en direction du MOTOCOMPRESSEUR, ainsi que présenter un DANGER lié à la température en cas d'exposition de l'OPERATEUR ou de détérioration de l'isolation électrique provoquant un DANGER électrique. Que cette TEMPERATURE REGULEE soit issue d'une fonction de chauffage intégrée du dispositif ou de la chaleur dissipée de la matière refroidie, il convient d'évaluer l'effet dans les conditions les plus défavorables.
- Il convient d'établir l'appel de courant de l'appareil lorsque les conditions de fonctionnement les plus défavorables du SYSTEME FRIGORIFIQUE sont prises en compte, y compris les cycles de dégivrage éventuels qui peuvent s'appliquer.

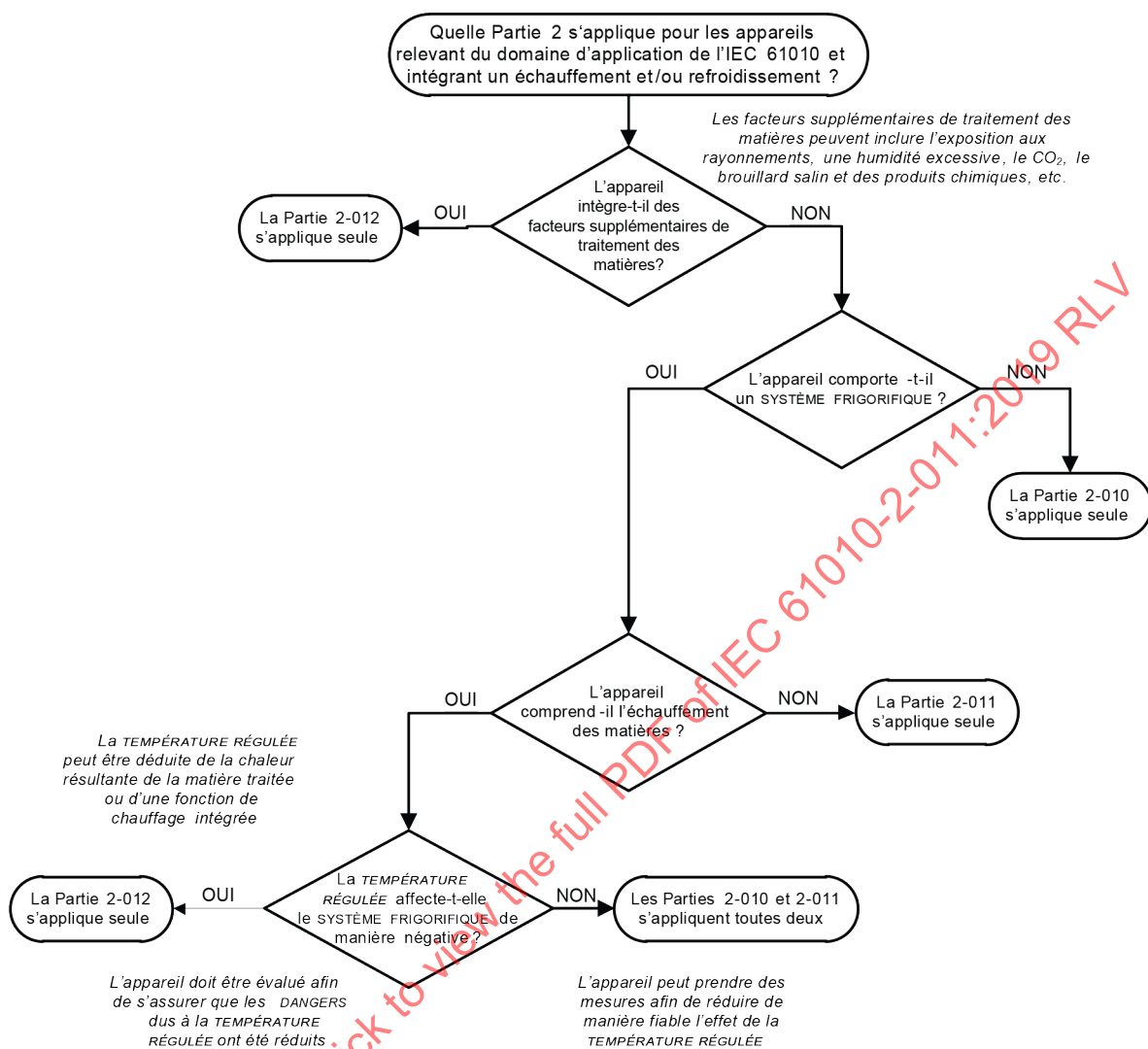
Il convient de déterminer les conditions les plus défavorables pour les appareils qui comprennent à la fois les conditions d'UTILISATION NORMALE les moins favorables, et les résultats d'essai les plus défavorables dans des CONDITIONS DE PREMIER DEFAUT.



IEC

Figure 101 – Schéma d'un SYSTEME FRIGORIFIQUE comprenant un condenseur

Le processus de sélection est illustré dans l'organigramme suivant (voir Figure 102).



IEC

Figure 102 – Organigramme illustrant le processus de sélection

EXIGENCES DE SÉCURITÉ POUR APPAREILS ÉLECTRIQUES DE MESURAGE, DE RÉGULATION ET DE LABORATOIRE –

Partie 2-011: Exigences particulières pour APPAREILS DE REFRIGERATION

1 Domaine d'application et objet

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

1.1.1 Appareils inclus dans le domaine d'application

Remplacement:

Remplacer le deuxième alinéa par le suivant:

La présente Partie 2 de l'IEC 61010 spécifie les exigences de sécurité particulières pour les types a) à c) suivants d'appareils électriques et leurs accessoires, quel que soit l'endroit dans lequel ils sont destinés à être utilisés, lorsque ces appareils comportent des SYSTEMES FRIGORIFIQUES, que ces derniers fassent partie intégrante des appareils ou qu'ils soient séparés des appareils, et que les appareils sont sous la commande directe du SYSTEME FRIGORIFIQUE.

Le présent document décrit de manière détaillée toutes les exigences correspondant à l'utilisation d'une quantité de FLUIDE FRIGORIGÈNE INFLAMMABLE allant jusqu'à 150 g par étage d'un SYSTEME FRIGORIFIQUE. Lorsqu'une charge de FLUIDE FRIGORIGÈNE INFLAMMABLE dépasse cette quantité, des exigences supplémentaires hors du domaine d'application du présent document s'appliquent.

Addition:

Ajouter le texte suivant après le dernier alinéa:

NOTE 101 Les exemples D'APPAREILS DE REFRIGERATION incluent, entre autres, les appareils de laboratoire tels que les réfrigérateurs de laboratoire, les congélateurs, les vitrines réfrigérées.

Il est possible qu'une ou toutes les parties de l'appareil relèvent du domaine d'application d'une ou plusieurs autres Parties 2 de l'IEC 61010, ainsi que du domaine d'application de la présente norme. Dans ce cas, les exigences de ces autres Parties 2 s'appliquent également. En particulier, si l'appareil est prévu pour être utilisé comme centrifugeuse, les exigences de l'IEC 61010-2-020 s'appliquent. Toutefois, lorsque l'appareil comprend un système frigorifique et une fonction de chauffage dont la combinaison des deux introduit des DANGERS supplémentaires ou plus graves que lorsque le traitement est réalisé séparément, alors il est possible que l'IEC 61010-2-012 soit applicable à la place de la présente Partie 2-011.

Voir d'autres informations dans l'organigramme (Figure 102) pour le processus de sélection et les recommandations dans l'Introduction.

1.1.2 Appareils exclus du domaine d'application

Addition:

Ajouter le nouveau point suivant après le point j):

ou appareil incorporant

- aa) un SYSTEME DE REFRIGERATION transcritique (système utilisant du CO₂) ou système utilisant de l'ammoniaque (NH₃) comme FLUIDE FRIGORIGENE.

1.2 Objet

1.2.1 Aspects inclus dans le domaine d'application

Remplacement:

Remplacer le premier alinéa par le suivant:

L'objet du présent document est d'assurer que la conception et les méthodes de construction des APPAREILS DE REFRIGERATION fournissent une protection adéquate aux OPERATEURS, aux spectateurs, au personnel de service formé, ainsi qu'à la zone périphérique contre les DANGERS spécifiques relatifs aux SYSTEMES FRIGORIFIQUES.

Addition:

Ajouter la note suivante après la note existante:

NOTE 101 Une liste des DANGERS typiquement associés aux SYSTEMES FRIGORIFIQUES et aux FLUIDES FRIGORIGENES est incluse dans l'Annexe BB.

2 Références normatives

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

Addition:

Ajouter à la liste les références suivantes:

IEC 60079-15:2010, *Atmosphères explosives – Partie 15: Protection du matériel par mode de protection "n"*

IEC 60335-2-34:2012, *Appareils électrodomestiques et analogues – Sécurité – Partie 2-34: Exigences particulières pour les motocompresseurs*

IEC 60335-2-34:2012/AMD1:2015

IEC 60335-2-34:2012/AMD2:2017

ISO 7010, *Symboles graphiques — Couleurs de sécurité et signaux de sécurité — Signaux de sécurité enregistrés*

3 Termes et définitions

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

Addition:

Ajouter les nouveaux termes et définitions suivants:

3.101

APPAREIL DE REFRIGERATION

appareil d'essai, de mesure, de régulation et de laboratoire comprenant un SYSTEME FRIGORIFIQUE soit comme partie intégrante de l'appareil, soit séparé de celui-ci

3.102

SYSTEME FRIGORIFIQUE

ensemble de parties interconnectées contenant du FLUIDE FRIGORIGENE constituant un CIRCUIT FRIGORIFIQUE dans lequel le FLUIDE FRIGORIGENE circule afin d'extraire ou de rejeter de la chaleur

[SOURCE: ISO 5149-1:2014, 3.1.9, modifié – Le terme entre parenthèses "(pompe à chaleur)", les mots "(c'est-à-dire refroidir et chauffer)", et la note ont été supprimés.]

3.103

FLUIDE FRIGORIGENE INFLAMMABLE

FLUIDE FRIGORIGENE ayant une classification d'inflammabilité de classe 2 ou 3 conformément à l'ISO 5149-1 et l'ISO 817

Note 1 à l'article: Pour les mélanges de FLUIDES FRIGORIGENES ayant plus d'une classification d'inflammabilité, la classification la plus défavorable est choisie pour les besoins de la présente définition ou l'inflammabilité du mélange est elle-même évaluée conformément à l'ISO 817.

3.104

HPCO

PRESSOSTAT DE SECURITE HAUTE PRESSION

dispositif actionné par pression conçu pour arrêter le fonctionnement du générateur de pression

Note 1 à l'article: Le terme abrégé "HPCO" est dérivé du terme anglais développé correspondant "high pressure cut-out".

3.105

PRESSION MAXIMALE ADMISSIBLE

PS

pression maximale pour laquelle l'équipement est conçu, telle que spécifiée par le fabricant

Note 1 à l'article: Le terme abrégé "PS" est dérivé du terme anglais développé correspondant "maximum allowable pressure".

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

3.106

CONDITION DE TEMPERATURE DE TREMPAGE

condition d'environnement de température lorsque toutes les températures de l'appareil en essai (EUT) sont égales à la température ambiante d'essai ± 2 °C

Note 1 à l'article: Le terme abrégé "EUT" est dérivé du terme anglais développé correspondant "equipment under test".

3.107

FONCTIONNEMENT ANORMAL

fonctionnement d'un APPAREIL DE REFRIGERATION ayant une plage limitée de températures ambiantes ASSIGNEE dans des conditions de température ambiante hors des limites imposées par cette plage, mais compris dans les limites définies en 1.4.1

3.108

FLUIDE FRIGORIGENE

fluide utilisé pour le transfert de chaleur dans un SYSTEME FRIGORIFIQUE, qui absorbe la chaleur à basse température et basse pression du fluide et la rejette à haute température et haute pression du fluide, impliquant généralement un changement de phase de ce fluide

[SOURCE: ISO 5149-1:2014, 3.7.9, modifié – la note a été supprimée.]

3.109**TEMPERATURE REGULEE**

température de localisation de l'évaporateur et à laquelle le côté basse pression de l'appareil est exposé, à l'issue du transfert de chaleur, par chauffage actif ou par le système d'application ou l'éprouvette

Note 1 à l'article: Pour les systèmes à pompe à chaleur, lorsqu'une vanne 4 voies est utilisée pour passer de la chaleur au refroidissement, les fonctions du condenseur et de l'évaporateur sont échangées.

3.110**LIMITE INFERIEURE D'EXPLOSIVITE****LEL**

concentration de gaz ou de vapeur inflammable dans l'air, au-dessous de laquelle une atmosphère explosive gazeuse ne peut pas être formée

Note 1 à l'article: Le terme abrégé "LEL" est dérivé du terme anglais développé correspondant "lower explosive limit".

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

3.111**MOTOCOMPRESSEUR**

sous-ensemble de réfrigération composé des mécanismes du compresseur et du moteur, enfermés ensemble dans la même enveloppe étanche, sans arbre extérieur, le moteur fonctionnant dans une atmosphère de FLUIDE FRIGORIGENE, avec ou sans huile

Note 1 à l'article: L'enveloppe peut être fermée de façon permanente par soudage ou par brasage (MOTOCOMPRESSEUR hermétique), ou elle peut être fermée par des joints d'étanchéité (MOTOCOMPRESSEUR hermétique accessible). Une boîte de raccordement, une boîte de raccordement intégrée et d'autres composants électriques ou un dispositif de commande électronique peuvent être inclus.

[SOURCE: IEC 60335-2-34:2012, 3.101, modifié – "appareil" a été remplacé par "sous-ensemble de réfrigération" et la note 2 a été supprimée.]

3.112**GROUPE DE CONDENSATION**

combinaison spécifique de sous-ensembles frigorifiques pour un FLUIDE FRIGORIGENE donné, comprenant un ou plusieurs MOTOCOMPRESSEURS, des condenseurs, des réservoirs de liquide (si nécessaire) et les accessoires habituellement fournis

[SOURCE: ISO 5149-1:2014, 3.4.5, modifié – La définition a été adaptée au cas spécifique des appareils de réfrigération.]

4 Essais

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

4.3 Conditions de référence pour les essais**4.3.1 Conditions d'environnement**

Addition:

Ajouter le texte suivant après le point d):

Étant donné que les températures, pressions et appels de courant pour un SYSTEME FRIGORIFIQUE sont influencés de manière significative par les températures ambiantes de manière non linéaire, une extrapolation linéaire des données d'essai n'est pas possible. Par conséquent, les essais visant à établir les températures, pressions et appels de courant pour un SYSTEME FRIGORIFIQUE doivent être réalisés dans les conditions d'environnement suivantes:

- aa) une température ambiante de 40 °C;
- bb) une humidité relative ne dépassant pas les limites définies en 1.4.1 d).

Si l'appareil est ASSIGNE par le fabricant pour fonctionner dans des conditions d'environnement étendues telles que définies en 1.4.2 ou dans des conditions d'environnement plus limitées conformément à la note 2 de 1.4.1, ces conditions définissent alors les réglages de 4.3.1 aa) ou 4.3.1 bb).

Lorsque le SYSTEME FRIGORIFIQUE est refroidi par eau, la température de l'alimentation en eau doit être la température maximale spécifiée par le fabricant (voir 5.4.3) avec la pression d'eau la plus défavorable spécifiée par le fabricant.

Si une condition d'environnement limitée conformément à la note 2 de 1.4.1, est utilisée, l'essai de 4.3.2.101 s'applique alors.

4.3.2 État de l'appareil

4.3.2.1 Généralités

Addition:

Ajouter le texte suivant après le premier alinéa:

Lors de la mesure des températures, pressions et appels de courant des appareils comportant un SYSTEME FRIGORIFIQUE, les essais doivent commencer dans des CONDITIONS DE TEMPERATURE DE TREMPAGE lorsque toutes les pressions sont totalement équivalentes. Les essais effectués à des valeurs de tension d'entrée extrêmes ($\pm 10\%$) doivent commencer dans ces conditions de tension et atteindre un état stable, mais peuvent ne pas commencer dans des CONDITIONS DE TEMPERATURE DE TREMPAGE. Les dispositifs de sécurité ne doivent pas fonctionner au cours de cet essai.

Addition:

Ajouter le nouveau paragraphe suivant:

4.3.2.101 FONCTIONNEMENT ANORMAL pour simuler la défaillance de l'environnement régulé

Pour les APPAREILS DE REFRIGERATION prévus pour fonctionner dans un environnement limité et soumis à l'essai selon 4.3.1, cet essai supplémentaire de FONCTIONNEMENT ANORMAL doit s'appliquer pour simuler la défaillance de l'environnement régulé dans l'installation.

Lorsque les conditions d'essai les plus défavorables sont déterminées pour les essais de température et de pression définis en 10.4.1, l'appareil est utilisé dans ces conditions jusqu'à stabilisation. L'environnement d'essai est alors porté aux limites de 1.4.1 pour les conditions d'environnement normales (40 °C, HR de 50 %), l'appareil peut se stabiliser et les températures et les pressions maximales sont enregistrées. Le fonctionnement de dispositifs de protection est autorisé au cours de cet essai. Si les conditions de stabilisation ne peuvent pas être atteintes en raison du fonctionnement des dispositifs de protection, les valeurs maximales enregistrées pour cet essai doivent alors être:

- les températures et les pressions maximales au point de fonctionnement de dispositifs non réarmables ou à réarmement manuel. Il n'est pas nécessaire de réarmer le dispositif à réarmement manuel au cours de cet essai; ou
- les températures et les pressions maximales obtenues après des cycles continus des dispositifs de protection à réarmement automatique. Les cycles doivent se poursuivre jusqu'à ce qu'il apparaisse clairement que les cycles successifs ne développent pas de valeurs maximales plus élevées.

4.4.2 Application des conditions de défaut

4.4.2.10 Refroidissement

Remplacement:

Remplacer le texte par ce qui suit:

Pour le refroidissement non associé au refroidissement du SYSTEME FRIGORIFIQUE:

- a) les événements avec filtres doivent être fermés;
- b) le refroidissement forcé par ventilateurs à moteur doit être arrêté;
- c) le refroidissement par circulation d'eau ou autre liquide de refroidissement doit être arrêté.

Pour le refroidissement associé au refroidissement du SYSTEME FRIGORIFIQUE:

- d) Essai de calage des ventilateurs du condenseur – pour les SYSTEMES FRIGORIFIQUES refroidis par air

Un par un, chaque ventilateur de condenseur doit être mis à l'arrêt, à moins qu'un premier défaut ne puisse désactiver tous les ventilateurs du condenseur simultanément, ou avec la limitation du flux d'air du condenseur, suivant le cas le plus défavorable, jusqu'à l'obtention d'une pression maximale stabilisée ou de températures maximales représentatives sous une charge cyclique. Les températures et les pressions doivent être contrôlées selon des intervalles de courte durée tout au long de l'essai afin de vérifier la saisie des valeurs de crête des pressions. Cet essai est réalisé à une température ambiante de $25\text{ °C} \pm 3\text{ °C}$.

- e) Essai de défaillance en eau du condenseur – pour un SYSTEME FRIGORIFIQUE refroidi par eau

Le SYSTEME FRIGORIFIQUE doit être utilisé en coupant l'alimentation en eau de condensation ou en limitant l'eau de condensation, suivant le cas le plus défavorable, jusqu'à l'obtention de températures maximales stabilisées ou de températures maximales représentatives sous une charge cyclique. Les températures et les pressions doivent être contrôlées selon des intervalles de courte durée tout au long de l'essai afin de vérifier la saisie des valeurs de crête des pressions. Cet essai est réalisé à une température ambiante de $25\text{ °C} \pm 3\text{ °C}$.

Si un HPCO à réarmement manuel est utilisé pour limiter la pression de crête au cours des essais d) ou e), il doit alors être réarmé manuellement dans un délai de fonctionnement de 6 s pendant 10 cycles.

Si un HPCO à réarmement automatique est utilisé pour limiter la pression de crête au cours des essais d) ou e), il doit alors pouvoir fonctionner selon des cycles automatiques jusqu'à ce qu'il puisse être démontré que des températures et des pressions de crête ont été obtenues.

Lorsqu'il est possible de démontrer qu'un HPCO fonctionne au cours des essais d) ou e), le fabricant peut choisir de renoncer à l'essai, mais il règle la pression PS pour les côtés haute et basse pression du MOTOCOMPRESSEUR sur la pression assignée du HPCO.

Pour les appareils comprenant des condenseurs refroidis par air et par eau, seul un à la fois peut être mis en conditions de défaut, à moins que le client ne soit autorisé à faire fonctionner soit le refroidissement par air soit le refroidissement par eau (la conception intègre une option redondante de refroidissement pour le condenseur).

Pour un SYSTEME FRIGORIFIQUE en cascade, lorsqu'un échangeur de chaleur du système du premier étage agit en tant que condenseur du système du deuxième étage, le fabricant peut choisir d'utiliser chaque étage du condenseur individuellement dans le cadre des essais correspondants décrits en d) ou e). Dans ce cas, la désactivation du système du premier étage simule le deuxième étage qui fonctionne dans une condition d'essai de d) ou e).

Addition:

Ajouter le nouveau paragraphe suivant:

4.4.2.101 Essai de refroidissement non régulé

Les régulateurs de température doivent être neutralisés pour produire un refroidissement non régulé. Ceci s'applique, que le régulateur contrôle la température des appareils, du moyen de transfert de chaleur ou de la matière traitée.

4.4.3.1 Généralités

Addition:

Ajouter l'alinéa suivant après le premier alinéa:

En raison du temps qu'un SYSTÈME FRIGORIFIQUE peut prendre pour atteindre des conditions de stabilisation, la durée des essais de premier défaut peut être supérieure à 4 h, à moins qu'il soit évident que des conditions stables ont été maintenues pendant au moins 1 h.

5 Marquage et documentation

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

5.1.2 Identification

Addition:

Ajouter les nouveaux points suivants après la note qui suit le point b):

- aa) la masse totale du FLUIDE FRIGORIGÈNE pour chaque CIRCUIT FRIGORIFIQUE distinct;
- bb) pour un FLUIDE FRIGORIGÈNE ayant un seul composant, au moins un des marquages suivants:
 - le nom chimique,
 - la formule chimique,
 - le numéro du FLUIDE FRIGORIGÈNE,
- cc) pour un mélange de FLUIDES FRIGORIGÈNES, au moins un des marquages suivants:
 - le nom chimique et la proportion nominale de chacun de ses composants,
 - la formule chimique et la proportion nominale de chacun de ses composants,
 - le numéro du FLUIDE FRIGORIGÈNE et la proportion nominale de chacun de ses composants,
 - le numéro du FLUIDE FRIGORIGÈNE du mélange de FLUIDES FRIGORIGÈNES,

NOTE 101 Les numéros des FLUIDES FRIGORIGÈNES sont indiqués conformément à l'ISO 817 ou à toute autre norme de classification des FLUIDES FRIGORIGÈNES, par exemple l'ANSI/ASHRAE 34.

- dd) la PRESSION MAXIMALE ADMISSIBLE (PS) en CONDITION NORMALE, côtés haute et basse pression pour chaque étage du FLUIDE FRIGORIGÈNE.

NOTE 102 La compilation des résultats des essais qui définissent PS est détaillée en 11.7.101.

5.1.3 Alimentation RESEAU

Remplacement:

Remplacer la déclaration de conformité comme suit:

La conformité est vérifiée par examen et par mesurage de la puissance ou du courant d'entrée pour vérifier le marquage indiqué en 5.1.3 c). Le mesurage est effectué avec l'appareil en condition de consommation maximale de puissance, mais afin d'exclure tout courant d'appel initial, il n'est pas effectué tant que le courant ne s'est pas stabilisé (généralement après 1 min). Les valeurs transitoires sont ignorées. Pour les APPAREILS DE REFRIGERATION, il est nécessaire d'évaluer l'impact des températures ambiantes extrêmes et l'interaction de tout mode de dégivrage lors de la détermination de la condition de consommation maximale de puissance.

Addition:

Ajouter les nouveaux symboles suivants dans le Tableau 1:

Tableau 1– Symboles

Numéro	Symbole	Référence	Description
101		ISO 7010-W010 (2011-05)	Danger; basses températures/conditions de gel, DANGER de gelure (MOD)
102		ISO 7010-W021 (2011-05)	Danger; matières inflammables
103		ISO 7010-W011 (2011-05)	Danger; surface glissante
104		ISO 7010-W024 (2011-05)	Danger; écrasement des mains

5.2 Marquage des avertissements

Remplacement:

Remplacer le point a) par ce qui suit:

- a) la hauteur perpendiculaire du triangle pour tous les symboles d'avertissement doit être de 15 mm au minimum. La hauteur du texte doit être supérieure ou égale à 1,8 mm, en fonction de la taille de l'appareil, de la lisibilité en UTILISATION NORMALE et de l'espace disponible pour le symbole. Les symboles et le texte doivent avoir une couleur contrastée par rapport à la couleur du fond.

Addition:

Ajouter le nouvel alinéa suivant avant la déclaration de conformité:

Les marquages d'avertissement ou les symboles de DANGERS particuliers qui existent ou se développent uniquement lors de l'installation ou de la maintenance de l'appareil doivent apparaître de manière visible uniquement lors de l'exécution de cette maintenance particulière. Par exemple, le marquage du type de FLUIDE FRIGORIGENE INFLAMMABLE et de l'agent moussant inflammable doit être visible lors de l'accès aux MOTOCOMPRESSEURS, et, dans le cas d'appareils avec un GROUPE DE CONDENSATION DE FLUIDE FRIGORIGENE distant, aux raccords de tuyauteries. Le symbole 102 du Tableau 1 doit être placé sur la plaque signalétique de l'appareil à proximité de la déclaration du type de FLUIDE FRIGORIGENE et des informations de chargement. Il doit être visible après l'installation des APPAREILS DE REFRIGERATION.

5.4.1 Généralités

Remplacement:

Remplacer le point d) par le suivant:

d) les informations spécifiées de 5.4.2 à 5.4.6, en 5.4.101 et 5.4.102;

5.4.3 Installation des appareils

Remplacement:

Remplacer la note par le texte qui suit:

NOTE Une déclaration dans la documentation peut être ajoutée indiquant que, lors de l'installation, la sécurité de tout système intégrant l'appareil relève de la responsabilité de l'assembleur du système.

Ajouter la nouvelle note suivante:

NOTE 101 Aux États-Unis, des instructions complémentaires sont exigées concernant les appareils contenant du FLUIDE FRIGORIGÈNE INFLAMMABLE – voir l'Annexe informative DD.

5.4.4 Fonctionnement de l'appareil

Addition:

Ajouter le nouveau point suivant après 5.4.4 j):

aa) les informations pour permettre un accès sûr au cours de l'utilisation, y compris l'identification des DANGERS de trébuchement et de glissade (voir également 7.3.101 et 16.101).

Addition:

Ajouter les nouveaux paragraphes suivants:

5.4.101 Instructions supplémentaires pour les appareils comprenant un GROUPE DE CONDENSATION DE FLUIDE FRIGORIGÈNE séparé et prévus pour le raccordement à une alimentation en eau

Pour les appareils comprenant un GROUPE DE CONDENSATION DE FLUIDE FRIGORIGÈNE séparé, les instructions doivent inclure un énoncé comprenant les éléments suivants:

L'installation de l'APPAREIL DE REFRIGÉRATION et du GROUPE DE CONDENSATION DE FLUIDE FRIGORIGÈNE ne doit être effectuée que par le personnel de service du fabricant ou une personne ayant des compétences similaires.

Les informations fournies avec l'APPAREIL DE REFRIGÉRATION comprenant un GROUPE DE CONDENSATION DE FLUIDE FRIGORIGÈNE séparé doivent comprendre

- des informations sur le type de GROUPE DE CONDENSATION DE FLUIDE FRIGORIGÈNE séparé à laquelle l'armoire doit être raccordée;
- un schéma électrique présentant les bornes électriques de connexion.

Pour les appareils prévus pour le raccordement à une alimentation en eau à des fins de refroidissement, les instructions doivent comporter des informations sur la température maximale autorisée et les pressions maximales et minimales de l'eau d'entrée cohérentes avec le fonctionnement en toute sécurité des appareils.

5.4.102 Instructions supplémentaires pour les appareils qui utilisent un FLUIDE FRIGORIGÈNE INFLAMMABLE

Pour les appareils qui utilisent un FLUIDE FRIGORIGÈNE INFLAMMABLE, les instructions doivent inclure les informations relatives à la manipulation, à l'entretien et à l'élimination de l'appareil.

Les instructions pour les appareils qui utilisent un FLUIDE FRIGORIGÈNE INFLAMMABLE doivent inclure les avertissements suivants si nécessaire:

- AVERTISSEMENT: S'assurer que toutes les ouvertures de ventilation ne soient pas obstruées.
- AVERTISSEMENT: Ne pas utiliser de dispositifs mécaniques ou d'autres moyens pour accélérer le processus de dégivrage, autres que ceux recommandés par le fabricant.
- AVERTISSEMENT: Ne pas endommager le circuit FRIGORIFIQUE.

Pour les appareils qui utilisent des agents moussants inflammables, les instructions doivent inclure les informations concernant l'élimination des appareils.

Les instructions concernant les conditionneurs d'air à deux blocs qui utilisent un FLUIDE FRIGORIGÈNE INFLAMMABLE doivent inclure l'avertissement suivant:

- AVERTISSEMENT: Afin de réduire les DANGERS d'incendie, l'installation de cet appareil doit être effectuée uniquement par une personne dûment qualifiée.

6 Protection contre les chocs électriques

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

6.8.3.1 Essai en tension alternative

Remplacement:

Remplacer la première phrase du premier alinéa par le texte suivant:

Le générateur de tension doit être capable de maintenir la tension d'essai à $\pm 5\%$ de la valeur spécifiée tout au long de l'essai.

7 Protection contre les DANGERS mécaniques

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

7.3 Parties mobiles

Addition:

Ajouter le nouveau paragraphe suivant:

7.3.101 Mécanismes de fermeture et verrouillage des portes

Pour les dispositifs de verrouillage comprenant ou ne comprenant pas de mécanismes de verrouillage automatique, lorsqu'un fonctionnement imprudent peut engendrer des DANGERS d'écrasement pour les mains ou les doigts, le symbole 104 du Tableau 1, avertissant d'un mouvement de parties mécaniques et contre tout DANGER d'écrasement, doit être marqué à l'emplacement ou sur la partie au niveau desquels le DANGER peut survenir.

La conformité est vérifiée par examen.

8 Résistance aux contraintes mécaniques

L'article de la Partie 1 est applicable.

9 Protection contre la propagation du feu

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

Addition:

Ajouter le nouveau paragraphe suivant:

9.5.101 Exigences d'avertissement relatives aux liquides inflammables

Lorsqu'un FLUIDE FRIGORIGÈNE INFLAMMABLE, des mélanges de FLUIDES FRIGORIGÈNES INFLAMMABLES et/ou des agents moussants inflammables sont utilisés, les appareils doivent être marqués avec le symbole 102 du Tableau 1. Des explications supplémentaires concernant le symbole d'avertissement doivent être détaillées dans la documentation destinée à l'OPÉRATEUR, au personnel de service et à l'AUTORITÉ RESPONSABLE de l'élimination finale des appareils, y compris les avertissements relatifs aux matières inflammables et contre les DANGERS d'incendie et/ou d'explosion (voir 5.4.102).

Dans d'autres cas, lorsqu'une matière inflammable est présente dans l'appareil, le symbole 102 peut être utilisé comme marquage d'avertissement.

10 Limites de température de l'appareil et résistance à la chaleur

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

10.1 Limites de température des surfaces pour la protection contre les brûlures

Remplacement:

Remplacer le deuxième alinéa par le suivant:

Si des surfaces chauffées qui peuvent être facilement touchées sont nécessaires pour des raisons fonctionnelles, qu'elles soient conçues pour fournir de la chaleur ou qu'elles soient chaudes par la proximité des parties chauffées, il est admis que ces surfaces dépassent les valeurs du Tableau 19 en CONDITION NORMALE et 105 °C en CONDITION DE PREMIER DEFECT, à condition qu'elles soient identifiables comme telles par l'aspect ou la fonction ou qu'elles soient marquées avec le symbole 13 du Tableau 1 (voir 5.2).

10.2 Température des bobinages

Addition:

Ajouter le texte et le tableau suivants sous le Tableau 20:

La conformité des MOTOCOMPRESSEURS est vérifiée par mesurage comme spécifié en 10.4, 4.3.2.101 en CONDITION NORMALE et dans les CONDITIONS DE PREMIER DEFECT applicables de 4.4.2.10 et également dans toutes les autres CONDITIONS DE PREMIER DEFECT éventuelles qui peuvent engendrer un DANGER par suite d'une température ou pression excessive. Les limites de température applicables aux MOTOCOMPRESSEURS sont définies dans le Tableau 101. Les pressions sont enregistrées pour utilisation en 11.7.2.

Pour les MOTOCOMPRESSEURS conformes à l'IEC 60335-2-34:2012, l'IEC 60335-2-34:2012/AMD1:2015 et l'IEC 60335-2-34:2012/AMD2:2017 (y compris son Annexe AA), les températures de l'enveloppe et des bobinages des compresseurs ne sont pas mesurées. Pour les MOTOCOMPRESSEURS non conformes à ces exigences, les méthodes d'essai des températures détaillées dans l'IEC 60335-2-34 doivent alors être appliquées pour mesurer les températures des bobinages.

Tableau 101 – Températures maximales pour les MOTOCOMPRESSEURS

Partie du MOTOCOMPRESSEUR	Température (°C)
Bobinages avec	
– isolant synthétique	140
– isolant cellulosique ou analogue	130
Enveloppe	150

10.3 Autres mesures de température

Addition:

Ajouter le nouveau point suivant après 10.3 e):

- aa) La température des composants du SYSTEME FRIGORIFIQUE établit les pressions maximales (voir 11.7.101).

10.4 Réalisation des essais de température

10.4.1 Généralités

Remplacement:

Remplacer le texte par ce qui suit:

La température maximale est déterminée en mesurant la montée en température dans les conditions d'essai de référence définies par 4.3.1 du présent document. L'extrapolation linéaire n'est pas admise. À moins qu'une CONDITION DE PREMIER DEFECT particulaire le spécifie autrement, les instructions du fabricant concernant l'aération, le liquide de refroidissement, les limitations pour usage intermittent, etc. sont respectées. Tout liquide de refroidissement doit être à la température maximale ASSIGNEE. Les pressions de fonctionnement doivent être contrôlées et enregistrées pendant tous les essais de température en vue de leur utilisation dans l'évaluation de la pression maximale admissible.

En variante, les mesurages de température sont effectués à la température ambiante la moins favorable comprise dans la plage de températures ambiantes ASSIGNEES de l'appareil si cela représente une condition moins favorable. Des dispositions sont prises pour corriger les erreurs dues à la méthode d'obtention de la température ambiante d'essai (par exemple, chicanage ou ENVELOPPE appropriée lorsque l'essai est réalisé dans une CHAMBRE D'ESSAI pour essai d'environnement et les mouvements forcés de l'air refroidissent l'extérieur de l'appareil).

Lors de la mesure des températures et des pressions pour les APPAREILS DE REFRIGERATION, les essais doivent commencer dans des CONDITIONS DE TEMPERATURE DE TREMPAGE lorsque toutes les pressions sont totalement équivalentes. Les essais effectués à des valeurs de tension d'entrée extrêmes ($\pm 10\%$) doivent commencer dans ces conditions de tension et atteindre un état stable, mais peuvent ne pas commencer dans des conditions de trempage. Les dispositifs de sécurité ne doivent pas fonctionner au cours des essais en CONDITIONS NORMALES. À la fin de l'essai, le contrôle doit se poursuivre après la mise hors tension de l'appareil, jusqu'à ce que les pressions de chaque étage du FLUIDE FRIGORIGENE soient équivalentes ou démontrent clairement que les valeurs maximales ont été atteintes.

Pendant les essais en CONDITIONS NORMALES, les dispositifs de protection autres que les protecteurs thermiques des moteurs des MOTOCOMPRESSEURS à réarmement automatique ne doivent pas fonctionner. Lorsque les conditions de stabilisation sont établies, les protecteurs thermiques des moteurs des MOTOCOMPRESSEURS ne doivent pas fonctionner.

Addition:

Ajouter le nouveau paragraphe suivant:

10.101 Protection contre les surfaces froides

Si la température minimale de surface des surfaces froides qui peuvent être facilement touchées dépasse -30°C , la surface froide doit être marquée avec le symbole 101 du Tableau 1 afin d'avertir l'OPERATEUR du DANGER de gelure.

La conformité est vérifiée par examen.

11 Protection contre les DANGERS des fluides et des corps solides étrangers

L'article de la Partie 1 est applicable, à l'exception de ce qui suit:

11.7 Fluide sous pression et fuites

Addition:

Ajouter les nouveaux paragraphes suivants:

11.7.101 Pression maximale dans un SYSTEME FRIGORIFIQUE

La pression maximale à laquelle une partie de l'appareil peut être soumise en CONDITION NORMALE ou en CONDITION DE PREMIER DEFECT ne doit pas dépasser la pression de service maximale ASSIGNEE pour cette partie. La pression de service maximale ASSIGNEE d'un composant est déterminée par ses CARACTERISTIQUES ASSIGNEES (si elles sont certifiées par rapport aux exigences relatives aux composants définies en 14.101) ou par conception, si les parties concernées peuvent satisfaire aux essais de 11.7.102.

La PRESSION MAXIMALE ADMISSIBLE (PS) doit être déterminée par essai ou par application des pressions de FLUIDE FRIGORIGENE saturé aux températures minimales spécifiées données dans le Tableau 102. En cas de doute, des essais doivent être effectués. Si la pression de début de décharge d'une soupape de surpression ou la pression définie d'un élément de rupture utilisé dans le système scellé est inférieure à la pression de vapeur saturée déduite du Tableau 102, elle peut être utilisée pour limiter la pression maximale admissible adaptée à ce système. Lorsque des pressions de FLUIDE FRIGORIGENE saturé servent à définir la pression PS, le fabricant n'est pas tenu d'enregistrer les pressions pendant les essais pour une utilisation normale et pour une utilisation anormale. La valeur de la pression PS lorsqu'elle est déterminée par essai doit être considérée comme étant la valeur la plus élevée des valeurs de pression suivantes:

- a) la pression maximale développée pendant les essais de température comme définie en 10.4.1;
- b) la pression maximale développée pendant l'essai en CONDITION DE PREMIER DEFECT pour le refroidissement tel que spécifié en 4.4.2.10 d) ou 4.4.2.10 e);
- c) la pression maximale développée pendant l'essai défini en 4.3.2.101, le cas échéant;
- d) la pression maximale développée pendant l'essai défini en 11.7.104.8.

NOTE 1 Pour chaque étage de réfrigération, le système de pression peut être réparti en deux sections, à savoir le côté haute pression et le côté basse pression de chaque compresseur, et la valeur de la pression PS peut être différente pour chaque côté du système de pression.

NOTE 2 Il est possible que les appareils satisfaisant aux exigences de 11.7 ne soient pas acceptés comme conformes aux exigences nationales relatives à des pressions élevées. Des notes s'appliquent aux exigences appropriées qui détaillent la modification de ces exigences afin d'être acceptées comme preuve de conformité aux règlements nationaux des États-Unis, du Canada et de certains autres pays.

Tableau 102 – Température minimale pour la détermination de la pression de vapeur saturée du FLUIDE FRIGORIGÈNE

Conditions ambiantes	≤43 °C	≤55 °C
Côté haute pression avec condenseur refroidi par air	63 °C	67 °C
Côté haute pression avec condenseur refroidi par eau ou pompe à chaleur à eau	Température maximale de l'eau d'évacuation +8 K	
Côté haute pression avec condenseur évaporateur	43 °C	55 °C
Côté basse pression avec exposition de l'échangeur de chaleur à la température ambiante extérieure	43 °C	55 °C
Côté basse pression avec exposition de l'échangeur de chaleur à la température ambiante intérieure	38 °C	38 °C
NOTE 1 Pour le côté haute pression, les températures spécifiées sont considérées comme les températures maximales qui se produisent en fonctionnement. Ces températures sont supérieures aux températures susceptibles d'être observées lorsque le compresseur a fonctionné puis a été arrêté. Pour le côté basse pression, le calcul de la pression peut simplement être fondé sur la température prévue du compresseur après qu'il a fonctionné puis a été arrêté. Ces températures sont les températures minimales et déterminent ainsi que le système n'est pas conçu pour une PRESSION MAXIMALE ADMISSIBLE (PS) inférieure à la pression de vapeur saturée de FLUIDE FRIGORIGÈNE correspondant à ces températures minimales. NOTE 2 L'utilisation de températures spécifiées ne produit pas toujours une pression de vapeur saturée de FLUIDE FRIGORIGÈNE dans le système, par exemple, un système à charge limitée ou un système qui fonctionne à la température critique ou à une température plus élevée, du CO₂ notamment. NOTE 3 Pour les mélanges zéotropes, la PRESSION MAXIMALE ADMISSIBLE (PS) est la pression au point de bulle.		

11.7.102 Fuites et ruptures à haute pression

11.7.102.1 Généralités

Les parties d'un SYSTÈME FRIGORIFIQUE contenant le FLUIDE FRIGORIGÈNE ne doivent pas engendrer de DANGER par rupture ou par fuite. Les exigences spécifiques concernant l'utilisation de FLUIDES FRIGORIGÈNES INFLAMMABLES ou de mélanges de FLUIDES FRIGORIGÈNES INFLAMMABLES sont traitées en 11.7.104.

Pour les composants soumis à la pression côté haute ou basse pression du SYSTÈME FRIGORIFIQUE, la résistance structurale des parties contenant le fluide doit satisfaire à une pression équivalant à trois fois la pression PS comme cela est défini en 11.7.101 pour le côté haute ou basse pression du SYSTÈME FRIGORIFIQUE.

La conformité est vérifiée par examen des CARACTERISTIQUES ASSIGNEES des composants exposés à cette pression et, si un DANGER peut survenir, par l'essai de pression suivant. Les composants qui sont certifiés selon les exigences applicables définies en 14.101 et qui sont utilisés avec leurs CARACTERISTIQUES ASSIGNEES (pression assignée des composants ≥ PS) sont considérés comme satisfaisant à cette exigence sans effectuer d'essai.

NOTE 1 Pour la preuve de conformité aux règlements nationaux des États-Unis, du Canada et dans certains autres pays, la résistance structurale des composants est identique, mais les CARACTERISTIQUES ASSIGNEES de conception des composants sont différentes en fonction de la marge de sécurité exigée par les règlements nationaux. Par exemple, aux États-Unis, les caractéristiques assignées de conception pour un composant conforme au Boiler Code de l'ASME sont égales à 1/5 de la résistance structurale du composant.

NOTE 2 Conjointement avec la NOTE 1, la résistance structurale assignée minimale des composants contenant le FLUIDE FRIGORIGÈNE aux États-Unis et au Canada est égale à cinq fois la pression maximale mesurée au cours des essais de pression pour une utilisation normale et à trois fois la pression maximale mesurée au cours des essais de pression pour une utilisation anormale. À noter ces différences de certification au cours de la sélection de composants certifiés d'Amérique du Nord basées sur les essais effectués dans le présent document.

11.7.102.2 Essai de pression

La pression du composant ou de l'ensemble (appareil en essai (EUT)) est augmentée par l'action de l'air ou d'un gaz non dangereux ou au moyen d'un essai de pression hydrostatique, de manière progressive jusqu'à la valeur d'essai spécifiée, et est maintenue à cette valeur pendant 1 min. Si la TEMPERATURE REGULEE continue de l'EUT est inférieure ou égale à 125 °C pour le cuivre ou l'aluminium, ou à 200 °C pour l'acier, la température d'essai de l'EUT pendant cet essai doit être au moins de 20 °C. Si la TEMPERATURE REGULEE continue de l'EUT dépasse 125 °C pour le cuivre ou l'aluminium, ou 200 °C pour l'acier, la température d'essai de l'EUT pendant cet essai doit être au moins de 150 °C pour le cuivre ou l'aluminium et de 260 °C pour l'acier. Pour d'autres matériaux ou pour des températures plus élevées, les effets de la température sur les caractéristiques de fatigue des matériaux doivent être évalués.

L'EUT est considéré comme ayant satisfait aux exigences du présent essai s'il résiste à l'essai de pression sans rupture. Si l'EUT ne satisfait pas aux exigences, une autre méthode de démonstration de la conformité consiste alors à soumettre l'EUT à l'essai de fatigue défini ci-dessous.

11.7.102.3 Essai de fatigue

Si la TEMPERATURE REGULEE continue de l'EUT dépasse 125 °C pour le cuivre ou l'aluminium, ou 200 °C pour l'acier, la température d'essai de fatigue des parties ou ensembles à ces températures doit être au moins 10 K supérieure à la TEMPERATURE REGULEE continue. La pression statique d'essai doit être augmentée par le rapport de la contrainte admissible du matériau à la température ambiante sur la contrainte admissible à la TEMPERATURE REGULEE continue la plus élevée. Pour les autres matériaux, les effets de la température sur les caractéristiques de fatigue doivent être évalués afin de déterminer les conditions d'essai.

Trois échantillons d'essai doivent être remplis de fluide et doivent être raccordés à une source d'alimentation de la pression. La pression doit être augmentée et réduite entre les valeurs cycliques supérieures et inférieures à un débit spécifié par le fabricant pour un nombre total de 250 000 cycles. La course de pression spécifiée complète doit se produire pendant chaque cycle.

Les pressions d'essai suivantes doivent être appliquées:

Pour des raisons de sécurité, il est proposé d'utiliser un fluide non compressible.

- Pour les composants côté basse pression, la pression maximale admissible PS pour le côté basse pression doit être appliquée pour le premier cycle. Pour les composants côté haute pression, la pression maximale admissible PS pour le côté haute pression doit être appliquée pour le premier cycle.
- La pression pour les cycles d'essai doit être la suivante:
la valeur de pression supérieure ne doit pas être inférieure à 0,7 fois la PRESSION MAXIMALE ADMISSIBLE et la valeur de pression inférieure ne doit pas être supérieure à 0,2 fois la PRESSION MAXIMALE ADMISSIBLE.
- Pour le dernier cycle d'essai, la pression d'essai doit être augmentée à 1,4 fois la PRESSION MAXIMALE ADMISSIBLE (2 fois une valeur égale à $0,7 \times$ la PRESSION MAXIMALE ADMISSIBLE).

Le composant ne doit pas se rompre, éclater ou fuir pendant cet essai.

Un essai de résistance à la pression à une pression équivalant à 2 fois la PRESSION MAXIMALE ADMISSIBLE doit être effectué sur trois échantillons, autres que les échantillons utilisés pour l'essai de fatigue.

Le composant ne doit pas se rompre, éclater ou fuir pendant cet essai.