

INTERNATIONAL STANDARD

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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**

**Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire –
Partie 2-011: Exigences particulières pour appareils de réfrigération**



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INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2-011: Particular requirements for REFRIGERATING EQUIPMENT

FOREWORD

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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.

The text of this standard is based on the following documents:

FDIS	Report on voting
66/589/FDIS	66/598/RVD

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

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

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

IEC 61010-2-011 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) of IEC 61010-1.

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, that subclause applies as far as is reasonable. Where this part 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.

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

- reconfirmed,
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INTRODUCTION

This standard, in conjunction with Part 2-010 and Part 2-012, addresses the specific HAZARDS associated with the heating and cooling of materials by equipment which are segregated 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 cooling 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 whether the interaction between the two systems will generate additional or more severe HAZARDS than if the systems were evaluated separately (application temperature, see flow chart 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 results from the combining of the heating and cooling function, or 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 favorable 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 unfavorable conditions may 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 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 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 favorable NORMAL USE conditions as well as the most unfavorable testing results under SINGLE FAULT CONDITIONS.

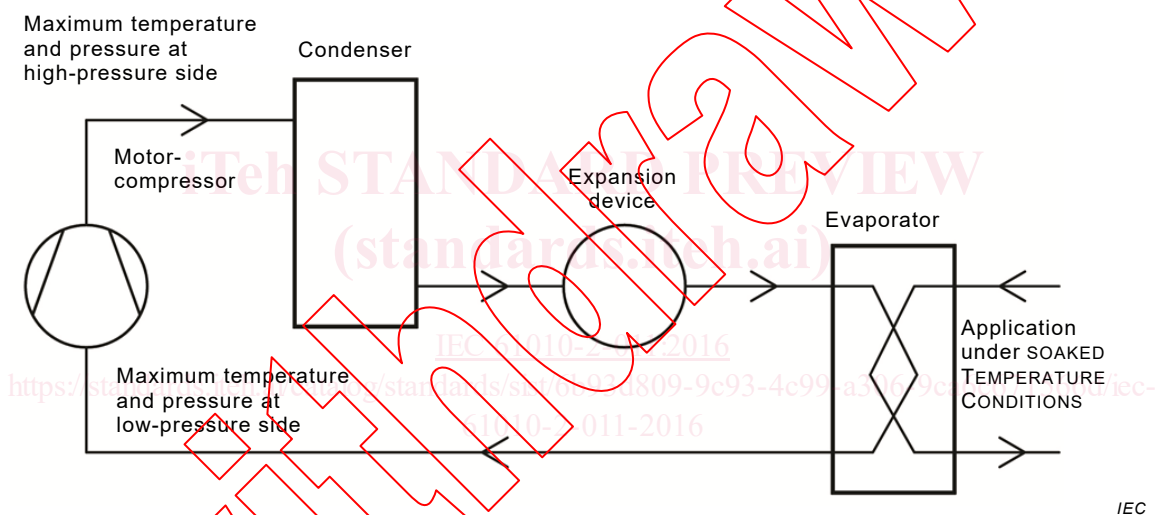


Figure 101 – Schema of a REFRIGERATING SYSTEM incorporating a condenser

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

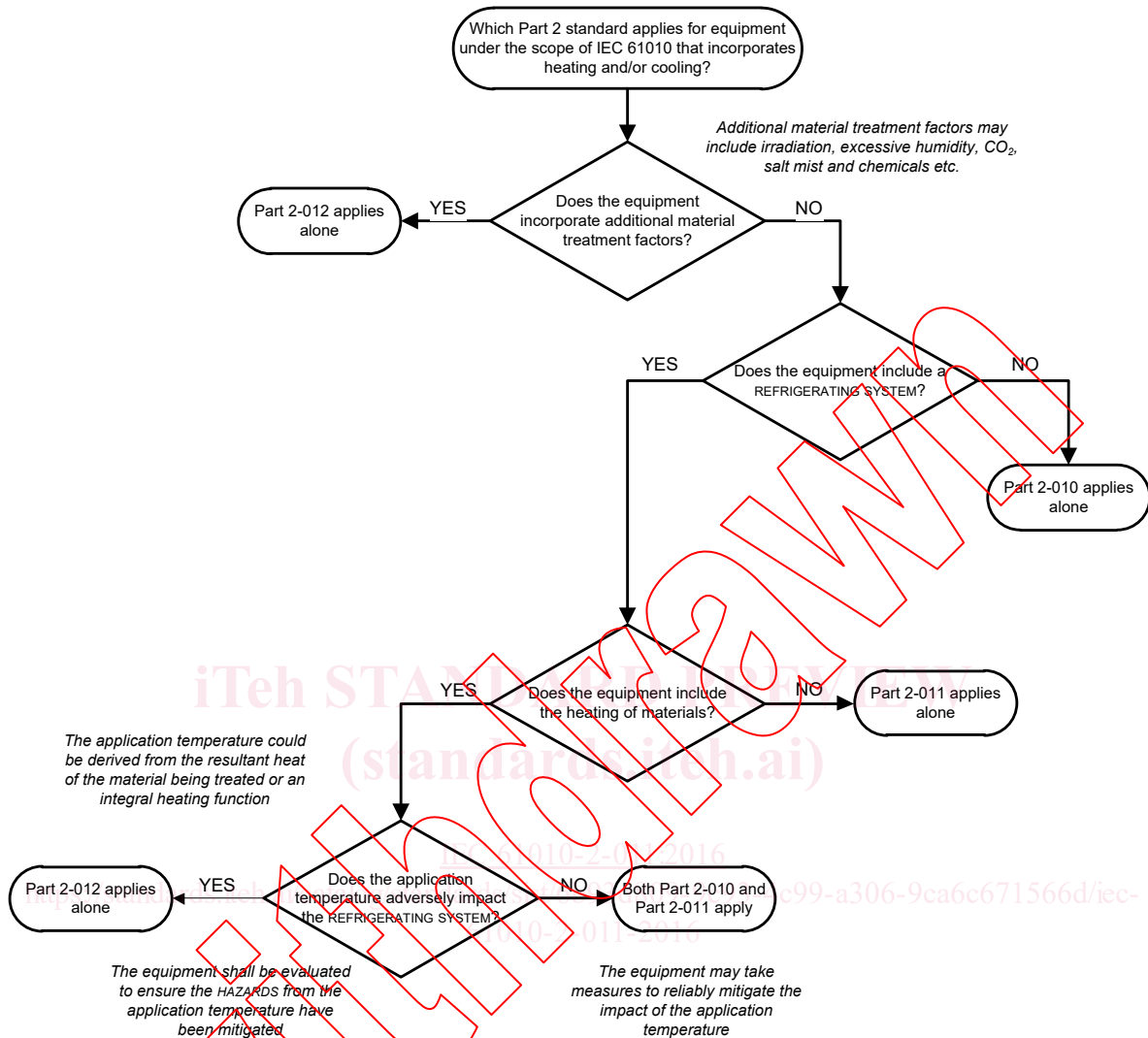


Figure 102 – Flow chart illustrating the selection process

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 the scope

Replacement:

Replace the first 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 an integral part of, or remote to the equipment and the equipment is in direct control of the REFRIGERATING SYSTEM.

This Part 2 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 standard 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 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 the requirement of those other Part 2 standards, In particular, if equipment is intended to be used as a centrifuge, it should meet the requirements of IEC 61010-2-020. However, when the equipment incorporates a REFRIGERATING SYSTEM and a heating function where the combination of the two introduces additional or more sever HAZARDS than if treated separately then the application of IEC 61010-2-012 should be considered instead of this Part 2.

See further information in the flow chart 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):

aa) equipment incorporating transcritical refrigerant system (system that use CO₂) or system that use 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 Part 2 is to assure 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 SYSTEM 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

UL 471:2010, *Commercial Refrigerators and Freezers*

3 Terms and definitions

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

Addition:

Add the following 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 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

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**PS**

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

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

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

3.107**ABNORMAL OPERATION**

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

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 d):

Since the operating temperatures, pressures and current draw 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 draw of a REFRIGERATING SYSTEM shall be conducted under the following environmental conditions:

- aa) a 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 4.4.2.101 applies.

4.3.2 State of equipment

4.3.2.1 General

Addition:

Add the following after the first paragraph:

When measuring temperatures, pressures and current draws of equipment incorporating 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.

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. The temperatures and pressures shall be monitored at short intervals throughout the test for the pressures to ensure that that peak pressures are captured. This test is conducted at a room ambient of $25\text{ °C} \pm 3\text{ °C}$.

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

The REFRIGERATING SYSTEM is to be operated with the condensing water shut off and also with the condensing water restricted 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 that peak pressures are captured. This test is conducted at a room ambient 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), e) or f), then it shall be reset manually within 6 seconds of operation for 10 cycles.

If an automatic reset HPCO is relied upon to limit the peak pressure during tests d), 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), e) or f), the manufacturer may 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 with both air-cooled and water-cooled condensers – only one can be faulted at a time unless the customer is permitted to run either air-cooled or water-cooled (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 elect to run each condenser stage individually under the tests of d), 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.

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 Uncontrolled cooling test

Temperature controllers shall be overridden to produce uncontrolled cooling. This applies 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:

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