



UL 61010-2-012 (IEC 61010-2-012:2016)

STANDARD FOR SAFETY

Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-012: Particular Requirements for Climatic and Environmental Testing and Other Temperature Conditioning Equipment

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UL Standard for Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-012: Particular Requirements for Climatic and Environmental Testing and Other Temperature Conditioning Equipment, UL 61010-2-012 (IEC 61010-2-012:2016)

First Edition, Dated February 20, 2017

Summary of Topics

Adoption of IEC 61010-2-012, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-012: Particular Requirements for Climatic and Environmental Testing and Other Temperature Conditioning Equipment (first edition issued July 2016) as a new IEC-based UL standard, UL 61010-2-012 (IEC 61010-2-012:2016), with no National Differences.

The new requirements are substantially in accordance with Proposal(s) on this subject dated November 25, 2016.

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FEBRUARY 20, 2017



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ANSI/UL 61010-2-012-2017

UL 61010-2-012 (IEC 61010-2-012:2016)

**Standard for Safety Requirements for Electrical Equipment for
Measurement, Control and Laboratory Use – Part 2-012: Particular
Requirements for Climatic and Environmental Testing and Other
Temperature Conditioning Equipment**

First Edition

February 20, 2017

This ANSI/UL Standard for Safety consists of the First Edition dated February 20, 2017.

The most recent designation of ANSI/UL 61010-2-012 (IEC 61010-2-012:2016) as an American National Standard (ANSI) occurred on February 20, 2017. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or the Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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

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PREFACE

This UL Standard is based on IEC Publication 61010-2-012: first edition, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-012: Particular Requirements for Climatic and Environmental Testing and Other Temperature Conditioning Equipment. IEC publication 61010-2-012 is copyrighted by the IEC.

This UL Standard 61010-2-012 Standard for Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-012: Particular Requirements for Climatic and Environmental Testing and Other Temperature Conditioning Equipment, is to be used in conjunction with the third edition of UL 61010-1. The requirements for control equipment are contained in this Part 2 Standard and UL 61010-1.

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

Where a particular subclause of UL 61010-1 is not mentioned in UL 61010-2-012, the UL 61010-1 subclause applies.

The text, figures and tables of IEC Publication Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 2-012: Particular Requirements for Climatic and Environmental Testing and Other Temperature Conditioning Equipment, IEC 61010-2-012, copyright July 2016, are used in this Standard with the consent of the IEC and the American National Standards Institute (ANSI). The IEC copyrighted material has been reproduced with permission from ANSI. ANSI should be contacted regarding the reproduction of any portion of the IEC material. The IEC Foreword and Introduction are not a part of the requirements of this Standard but are included for information purposes only. Copies of IEC Publication 61010-2-012 may be purchased from ANSI, 11 West 42nd Street, New York, New York, 10036, (212) 642-4900.

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL AND LABORATORY USE – Part 2-012: Particular requirements for climatic and environmental testing and other temperature conditioning 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 nongovernmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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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 61010-2-012 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

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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
66/590/FDIS	66/599/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 61010-2-012 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 2-012 supplements or modifies the corresponding clauses in IEC 61010-1 so as to convert that publication into the IEC standard: *Particular requirements for climatic and environmental testing and other temperature conditioning 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,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

This standard, in conjunction with Part 2-010 and Part 2-011, addresses the specific HAZARDS associated with the heating and cooling of materials by equipment and 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 etc.

Guidance for the application of the appropriate 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 result 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 maximum temperature of LOW-PRESSURE SIDE (return temperature) to the MOTOR-COMPRESSOR. 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 maximum pressure of LOW-PRESSURE SIDE at the inlet to the MOTOR-COMPRESSOR. 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 maximum temperature of HIGH-PRESSURE SIDE to the CONDENSER. The temperatures of HIGH-PRESSURE SIDE under most unfavourable conditions may present a temperature HAZARD if the OPERATOR is exposed to or electrical insulation is degraded.

– The maximum pressure of HIGH-PRESSURE SIDE at the outlet to the MOTOR-COMPRESSOR. 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 appropriate safety margin for a pressure vessel.

– The maximum application temperatures, namely, the SOAKED TEMPERATURE CONDITIONS, where the heat is being extracted from, may impact the maximum temperature of LOW-PRESSURE SIDE to the MOTOR-COMPRESSOR as well as present a temperature HAZARD if the OPERATOR is exposed to or electrical 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 favourable NORMAL USE conditions as well as the most unfavourable testing results under SINGLE FAULT CONDITIONS.

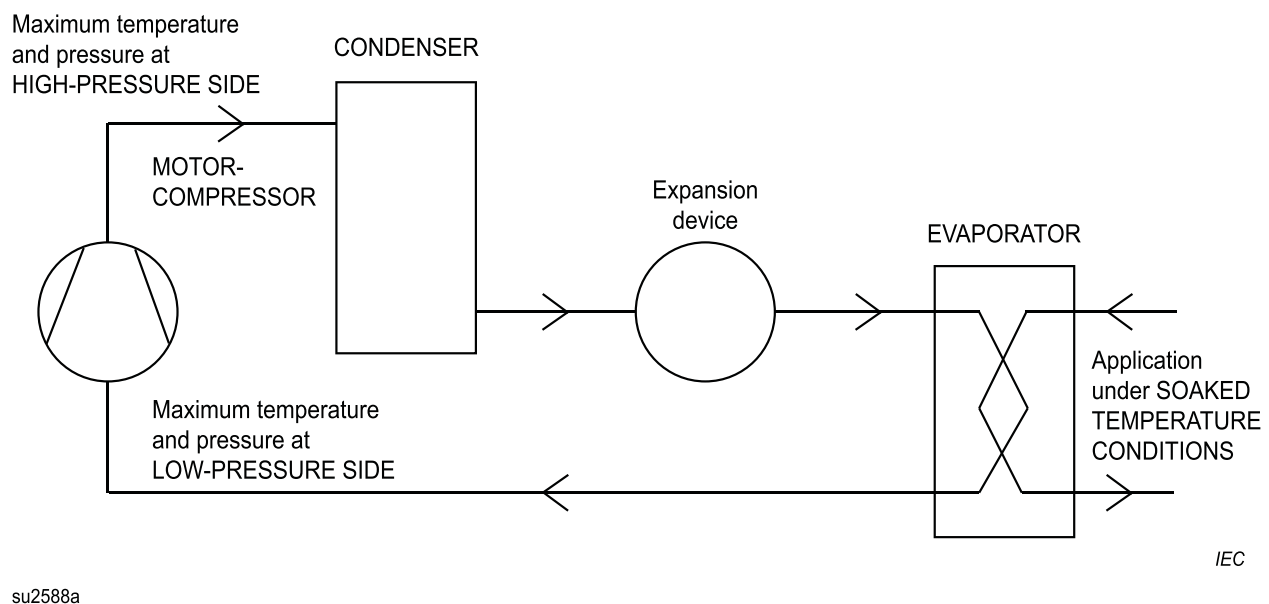
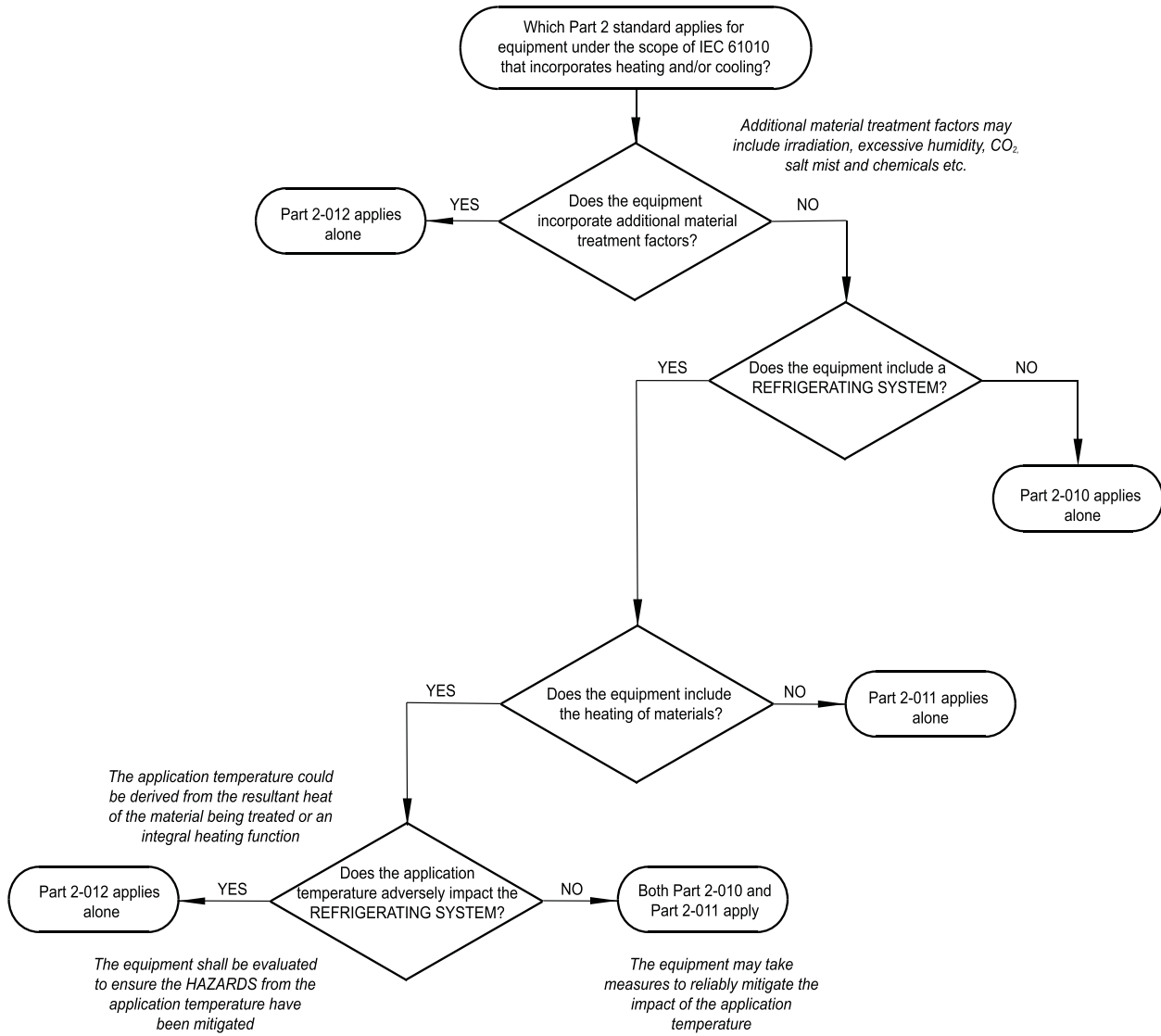


Figure 101 – Schema of a REFRIGERATING SYSTEM incorporating a CONDENSER

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



IEC

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Figure 102 – Flow chart illustrating the selection process

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SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL AND LABORATORY USE – Part 2-012: Particular requirements for climatic and environmental testing and other temperature conditioning 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 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 safety requirements for electrical equipment and their accessories within the categories a) through c), wherever they are intended to be used, whenever that equipment incorporates one or more of the following characteristics:

- A REFRIGERATING SYSTEM that is acted on or impacted by an integral heating function such that the combined heating and cooling system generates additional and/or more severe HAZARDS than those for the two systems if treated separately.
- The materials being treated in the intended application introduce significant heat into the REFRIGERATING SYSTEM that the cooling system in the application yield additional and/or more severe HAZARDS than those for the cooling system if operated at the maximum RATED ambient alone.
- An irradiation function for the materials being treated presenting additional HAZARDS.
- A function to expose the materials being treated to excessive humidity, carbon dioxide, salt mist, or other substances which may result in additional HAZARDS.
- A function of MECHANICAL MOVEMENT presenting additional HAZARDS.
- Provision for an OPERATOR to walk-in to the operating area to load or unload the materials being treated.

Addition:

Add the following text after the last paragraph:

NOTE 101 Examples of such equipment include environmental testing and plant growth TEST CHAMBERS, refrigerating CIRCULATORS which incorporate heating, recirculating coolers for extracting heat.

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 requirements of those other Part 2 standards. However, when the equipment incorporates only a REFRIGERATING SYSTEM or only a heating function or a combination of the two without introducing additional HAZARDS described in the above dashed paragraphs then the application of IEC 61010-2-011 or IEC 61010-2-010 or both, as applicable, shall be considered instead of this Part 2.

See further information in the flow chart for selection process and guidance in the INTRODUCTION.

NOTE 102 Subclause 3.1.107 and Annex BB provides definition and requirements for protection of people who are inside WALK-IN EQUIPMENT.

1.1.2 Equipment excluded from scope

Addition:

Add the following two new items after item j):

- aa) equipment for the heating, cooling, and ventilation of laboratories;
- bb) sterilizing equipment.

1.2 Object

1.2.1 Aspects included in scope

Addition:

Add two new items to the list:

- aa) biohazards (see 13.101);
- bb) hazardous chemical substances (see 13.102).

2 Normative references

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

Additions:

IEC 60079-15:2010, *Explosive Atmospheres – Part 15: Equipment protection by type of protection “n”*

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

IEC 60335-2-24:2010, *Household and similar electrical appliances – Safety – Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice makers*; IEC 60335-2-24:2010/AMD1:2012

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 62471, *Photobiological safety of lamps and lamp systems*

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IEC TR 62471-2, *Photobiological safety of lamps and lamp systems – Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation safety*

ISO 7010:2011, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

3 Terms and definitions

This clause of Part 1 is applicable except as follows:

3.1 Equipment and states of equipment

Addition:

Additional definitions:

3.1.101

BATH

complete device intended for application of controlled temperatures to SPECIMENS by immersion in a temperature-controlled liquid HEAT TRANSFER MEDIUM

3.1.102

CIRCULATOR

equipment intended for application of controlled temperatures to APPLICATION SYSTEM by external circulating of a temperature-controlled liquid HEAT TRANSFER MEDIUM

3.1.103

TEST CHAMBER

ENCLOSURE or space in some part of which specified conditions can be achieved, in particular, temperature, humidity, irradiation, low air pressure, mould growth and salt spray

3.1.104

COMBINED TEST CHAMBER

special TEST CHAMBER combined with function of MECHANICAL MOVEMENT, for example, for vibrating, shocking, impacting and similar dynamic tests

3.1.105

INCUBATOR

special TEST CHAMBER, primarily for incubation of microorganisms and tissue culture

3.1.106

SHAKER

equipment to disperse or dissolve one substance in another by MECHANICAL MOVEMENT without the use of blades or stirrers that might destroy the structure of the substance, in particular, shaking BATH and shaking INCUBATOR

3.1.107

WALK-IN EQUIPMENT

TEST CHAMBER OR INCUBATOR, the door of which allows the OPERATOR to enter and remain inside the equipment even with the door closed

3.1.108

DRYING-OUT

period to wait or a procedure to be carried out before operation to return the equipment to NORMAL CONDITION if it has been transported or stored in humid conditions, or moved from a cold environment to a much warmer one where condensation could occur, and could cause the equipment to then fail to meet all the safety requirements of this standard

3.1.109

STANDSTILL

period to wait or a procedure to be carried before operation to return the equipment to NORMAL CONDITION if it has been transported or moved or shaken or tilted or inverted and which could cause the equipment to fail to meet all the safety requirements of this standard

3.2 Parts and accessories

Addition:

Additional definitions:

3.2.101

RESISTANCE-HEATING DEVICE

part of a resistance-heating equipment, comprising one or more heating resistors, typically composed of metallic conductors or an electrically conductive compound suitably insulated and protected

[SOURCE: IEC 60050-426:2008, 426-08-08, modified – “resistance-heating unit” has been replaced with “resistance-heating equipment”]

3.2.102

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: 1993, 1.3.47]

3.2.103

CASCADE SYSTEM

REFRIGERATING SYSTEM consisting of two or more independent refrigeration circuits where the CONDENSER of one system rejects heat directly to the EVAPORATOR of another

[SOURCE: EN 378-1: 2008, 3.1.12, modified – “REFRIGERATING SYSTEM consisting of” has been included]

3.2.104

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/AMD1:2015, 3.101, modified – “appliance” has been replaced by “refrigerating subassembly”]

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3.2.105

CONDENSER

heat-exchanger in which vaporized REFRIGERANT is liquified by removal of heat

[SOURCE: ISO 5149: 1993, 1.3.11]

3.2.106

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: 1993, 1.3.12, modified – “machine” has been replaced by “subassembly”]

3.2.107

EVAPORATOR

heat-exchanger in which liquid REFRIGERANT is vaporized by absorption of heat

[SOURCE: IEC 60335-2-40: 2009, 3.110]

3.2.108

HIGH-PRESSURE SIDE

part of a REFRIGERATING SYSTEM operating at approximately the CONDENSER pressure

[SOURCE: ISO 5149: 1993, 1.3.24]

3.2.109

LOW-PRESSURE SIDE

part of a REFRIGERATING SYSTEM operating at approximately the EVAPORATOR pressure

[SOURCE: ISO 5149: 1993, 1.3.30]

3.2.110

CIRCULATING PUMP

pressure and/or suction pump transporting the liquid HEAT TRANSFER MEDIUM in a BATH OR CIRCULATOR

3.2.111

CIRCULATING FAN

propeller fan or centrifugal impellor designed to circulate the air in a TEST CHAMBER or an INCUBATOR with or without any air duct

3.2.112

HUMIDIFIER

electric device that generates a water mist or steam and releases it into a room, greenhouse or other ENCLOSURE

3.2.113

BATH TANK

open or enclosed vessel containing the HEAT TRANSFER MEDIUM, in a BATH OR CIRCULATOR

3.2.114

LIQUID CONNECTION

pipe fitting through which liquid is expelled from or discharged into a vessel or a heat exchanger

3.2.115

VENTILATOR

device for replacing air inside a TEST CHAMBER or an INCUBATOR by outside air

3.2.116

TEMPERATURE-LIMITING DEVICE

temperature-actuated device that is designed to prevent unsafe temperatures

[SOURCE: EN 378-1:2008, 3.6.5]

3.2.117

LIQUID LEVEL CUT OUT

liquid level-actuated device designed to prevent unsafe liquid levels

[SOURCE: EN 378-1: 2008, 3.6.12]

3.2.118

PRESSURE-LIMITING DEVICE

pressure-actuated device (for example, a high-pressure switch) which is designed to stop the operation of pressure-imposing element and may also operate an alarm

3.2.119

PRESSURE-RELIEF DEVICE

valve or disc designed to relieve excessive pressure automatically

[SOURCE: ISO 5149: 1993, 1.3.40]

3.2.120

FLAMMABLE LIQUID

liquid capable of producing a flammable gas or vapour which, when mixed with air in certain proportions, will form an EXPLOSIVE GAS ATMOSPHERE under any foreseeable operating conditions

3.2.121

HEAT TRANSFER MEDIUM

medium used to transfer heat to the material being processed

3.2.122

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: 1993, 1.3.45]

3.2.123

FLAMMABLE REFRIGERANT

REFRIGERANT with a flammability classification of group 2 or 3 in accordance with ISO 5149

[SOURCE: IEC 60335-2-24:2010/AMD1:2012, 3.109]

3.2.124

SPECIMEN

any material, substance, or product designated to be processed, for example, in a BATH, TEST CHAMBER or an INCUBATOR

3.2.125

APPLICATION SYSTEM

system or device intended to work with a CIRCULATOR to carry out a functional purpose

3.5 Safety terms*Addition:**Additional definitions:*

3.5.101

SATURATED-VAPOUR PRESSURE (OF REFRIGERANT)

vapour pressure (of REFRIGERANT) at which the liquid and vapour can exist in equilibrium at a given temperature

3.5.102

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: EN 378-1:2008, 3.3.2]

3.5.103

RATED PRESSURE

MAXIMUM ALLOWABLE PRESSURE for pressure components of equipment with regard to their ability to withstand pressures as specified by the manufacturer

3.5.104

ACTIVE COOLING CONTROL RANGE

ACC RANGE

working temperature range that is achieved by an active REFRIGERATING SYSTEM

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

3.5.105

FLASH POINT

lowest liquid temperature at which, under certain standardized conditions, a liquid gives off vapours in quantity such as to be capable of forming an ignitable vapour/air mixture

Note 1 to entry: At the FLASH POINT, the vapour may cease to burn when the ignition source is removed.

[SOURCE: IEC 60050-426:2008, 426-02-14]

3.5.106

FIRE POINT

lowest temperature at which a substance ignites and continues to burn for at least 5 s after a small flame has been applied to its surface under standardized conditions

3.5.107

AUTO IGNITION TEMPERATURE

lowest temperature at which a substance will spontaneously ignite in a normal atmosphere without an external ignition source, such as a flame or spark.

Note 1 to entry: Once ignited, the substance will continue to burn until it is either completely consumed or the temperature of the remainder of the substance is reduced to or below its FIRE POINT.

3.5.108

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]

3.5.109

EXPLOSIVE GAS ATMOSPHERE

mixture with air, under atmospheric conditions, of flammable substances in the form of gas or vapour which, after ignition, permits self sustaining flame propagation

[SOURCE: IEC 60050-426:2008, 426-01-07]

3.5.110

SOAKED TEMPERATURE CONDITION

temperature conditions when the ambient temperature of the equipment under test (EUT) equals to $\pm 2,0^{\circ}\text{C}$ of maximum ambient of 1.4.1 for NORMAL USE, storage or transport, and the operating temperature of the EUT equals to $\pm 2,0^{\circ}\text{C}$ of the maximum ACC RANGE with the MOTOR-COMPRESSOR running or, the maximum RATED operating temperature with the MOTOR-COMPRESSOR off

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

3.5.111

MECHANICAL MOVEMENT

general description for the motion of materials being processed, for example in a SHAKER OR COMBINED TEST CHAMBER

3.5.112

MOVEMENT FREQUENCY

number of complete cycles of MECHANICAL MOVEMENT

3.5.113

MOVEMENT AMPLITUDE

maximum radius, distance, or angle of the MECHANICAL MOVEMENT

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 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 the temperatures, pressures, and current draw for a REFRIGERATING SYSTEM shall be conducted under the following environmental conditions

aa) an ambient temperature of 40 °C, or the maximum RATED operating ambient temperature if higher;

bb) the temperature of water supply being the maximum as specified by the manufacturer (see 5.4.3);

cc) a relative humidity not exceeding the limits of 1.4.1 d), or the maximum RATED operating relative humidity at the maximum RATED operating temperature, if higher;

If, as permitted by note 2 of 1.4.1, a REFRIGERATING SYSTEM has an operating temperature RATING below 40 °C, the NORMAL CONDITION tests shall be performed in an environment that matches the maximum RATED operating temperature, and then repeated at an environmental temperature of 40 °C. See 4.4.2.106.

4.3.2 State of equipment

4.3.2.1 General

Replacement:

Replace the first paragraph and note by the following:

Unless otherwise specified, each test shall be carried out on the equipment assembled for NORMAL USE, and under the least favourable combination of the conditions given in 4.3.2.2 to 4.3.2.13 and 4.3.2.101 to 4.3.2.113 if applicable.

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.

In case of doubt, a test may have to be made with more than one combination of conditions. For example, when the equipment is operated at or cycled in between its maximum and minimum operating temperatures or operated in combination with excessive humidity, low air pressure, radiation, or conditions of precipitation.

Addition:

Add the following subclauses:

4.3.2.101 Heat load

Where the equipment or materials being processed require either the provision or extraction of heat the equipment under test (EUT) shall be loaded with a heat source/sink within the manufacturer's specified conditions of use (including maximum RATED and none).

NOTE DIN 12876 provides procedures for determining cooling capacity and efficient heating capacity of the equipment.

4.3.2.102 Humidity and steam

Where equipment generates humidity or is intended for connection to a steam supply, it shall be set to generate or be supplied with them within the manufacturer's specified conditions of use (including maximum RATED and none).

4.3.2.103 Lamp and lamp systems

Illumination that provides part of the primary function (whether it be integral or an accessory), shall be installed and operated within the manufacturer's specified conditions of use (including maximum, off and cycled).

NOTE An example is Xenon arc lamp used in a weather durability TEST CHAMBER.

4.3.2.104 MECHANICAL MOVEMENT

Equipment with a function of MECHANICAL MOVEMENT (for materials or HEAT TRANSFER MEDIUM) shall be set to expose the equipment and any materials being processed to the worst conditions (including maximum, off and cycled).

4.3.2.105 Spray generating systems

Spray generating systems of equipment shall be operated within the manufacturer's specified conditions of use (including maximum, off and cycled).

4.3.2.106 VENTILATORS

VENTILATORS shall be operated within the manufacturer's specified conditions of use (including maximum, off and cycled).

4.3.2.107 Pressures other than those of REFRIGERANT

Where equipment generates or uses pressures other than local atmospheric it shall be set to generate, or supplied with pressure(s) within the manufacturer's specified conditions of use (including maximum RATED and none).

4.3.2.108 REFRIGERANT pressure

Where a heating system (or HEAT TRANSFER MEDIUM) can apply a temperature to the REFRIGERATING SYSTEM which is outside its ACC RANGE, the equipment shall be set to apply the maximum temperature allowed by the controls or interlocks with the MOTOR-COMPRESSOR off or maximum ACC RANGE with the MOTOR-COMPRESSOR on whichever is least favourable.

Where a heating system (or HEAT TRANSFER MEDIUM) can apply a temperature to the REFRIGERATING SYSTEM which could affect the pressure in the system, the most unfavourable condition for pressure shall be established including:

- MOTOR-COMPRESSOR running throughout;
- MOTOR-COMPRESSOR started during test;
- outside its ACC RANGE with the MOTOR-COMPRESSOR off and the equipment set to apply the maximum temperature allowed by the controls or interlocks.

4.3.2.109 Exhaust and condensate

Least favourable conditions which result in production of exhaust, vapours and/or condensates shall be created (including maximum and cycled).

NOTE The TERMINALS of a RESISTANT-HEATING DEVICE exposed to ambient are easily condensed after HEAT TRANSFER MEDIUM being cooled to below ambient condition for some time.

4.3.2.110 Filling and draining systems

Filling and draining systems shall be operated within the manufacturer's specified conditions of use (including maximum, minimum and intermediate).

4.3.2.111 Circulating system

CIRCULATING PUMP(s), agitator(s) or CIRCULATING FAN(s) shall be operated within the manufacturer's specified conditions of use (including maximum and off).

4.3.2.112 Gas HEAT TRANSFER MEDIUM

The equipment shall be operated with gas HEAT TRANSFER MEDIUM, whether it is air or other designated gases, at the percentage of content and pressure within the manufacturer's specified conditions of use (including maximum, minimum and none).

4.3.2.113 Properties of liquid HEAT TRANSFER MEDIUM

For equipment with wide operating temperature range, effect of contraction, expansion, evaporating, condensing, oxidizing, boiling and freezing of the liquid and its allowable operating temperature range should be considered. HEAT TRANSFER MEDIA which change states during NORMAL USE shall be simulated to generate state change both from solid to liquid and vice versa.

4.4.2 Application of fault conditions

4.4.2.10 Cooling

Addition:

Add the following items and notes after item d):

aa) For an air-cooled CONDENSING UNIT, each CONDENSER fan shall be stalled one at a time unless a single fault could disable all CONDENSER fans simultaneously, and also with the CONDENSER airflow restricted, until maximum stabilized pressure 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 to ensure that peak values are captured. This test is conducted at a room ambient temperature of $25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

bb) For a water-cooled CONDENSING UNIT, the REFRIGERATING SYSTEM shall be operated with the condensing water shut off, and also with the condensing water restricted, until maximum stabilized pressure 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 to ensure that peak values are captured. This test is conducted at a room ambient temperature, and a water temperature of $25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

If a manual reset PRESSURE-LIMITING DEVICE is relied upon to limit the maximum and/or minimum pressure for HIGH-PRESSURE SIDE OR LOW-PRESSURE SIDE, then it shall be reset manually within 6 s of operation for 10 cycles.

NOTE 101 The running state of MOTOR-COMPRESSOR is not relevant after the manual high PRESSURE-LIMITING DEVICE has operated.

If an automatic reset PRESSURE-LIMITING DEVICE is relied upon to limit the maximum and/or minimum pressure for HIGH-PRESSURE SIDE OR LOW-PRESSURE SIDE, then it shall be permitted to cycle automatically until it can be demonstrated that peak temperatures and pressures have been achieved.

NOTE 102 It is possible that a MOTOR-COMPRESSOR designed to be cooled by cycling of the REFRIGERANT would overheat enough to cause HAZARDS, if leakage of REFRIGERANT occurs and the PRESSURE-LIMITING DEVICE for LOW-PRESSURE SIDE is triggered repeatedly.

NOTE 103 The correct specification or appropriate setting of the pressure differential (hysteresis) of an automatic reset PRESSURE-LIMITING DEVICE is important for MOTOR-COMPRESSORS which require a longer standstill (off cycle) period.

If it can be demonstrated that a PRESSURE-LIMITING DEVICE will operate during the tests of PS, the manufacturer may elect to waive the test, but shall set the PS for HIGH-PRESSURE SIDE of the MOTOR-COMPRESSOR to the RATING of the PRESSURE-LIMITING DEVICE.

For equipment with both air-cooled and water-cooled CONDENSERS, faults are applied to only one at a time unless the equipment is designed so that the OPERATOR can select to run either air-cooled or water-cooled CONDENSER (for example, some equipment is equipped with a water-cooled CONDENSER as an auxiliary for the air-cooled CONDENSER).

For a CASCADE SYSTEM, where an EVAPORATOR from the first stage REFRIGERATING SYSTEM acts as a CONDENSER to the second stage REFRIGERATING SYSTEM, the manufacturer may elect to run each CONDENSING UNIT individually under the tests of this subclause. In this case disabling the first REFRIGERATING SYSTEM is considered to simulate the second stage CONDENSING UNIT running under the conditions of aa) and bb) above.

4.4.2.11 Heating devices

Addition:

Add the following second paragraph after item b):

If a HAZARD could be caused by overfilling or under-filling with a liquid HEAT TRANSFER MEDIUM, the equipment shall be tested when empty, partially filled, or overfilled, whichever is least favourable. In case of doubt, the test shall be carried out in more than one condition. The HEAT TRANSFER MEDIUM used for the test shall be of a type specified for NORMAL USE.

Addition:

Add the following new subclauses:

4.4.2.101 MOTOR-COMPRESSOR

Housing and winding temperatures of MOTOR-COMPRESSORS that do not conform with IEC 60335-2-34 (including Annex AA), shall be measured under the conditions of 19.101, 19.102 and 19.103 of IEC 60335-2-34: 2012/AMD1:2015.

Housing and winding temperatures of MOTOR-COMPRESSORS conforming with IEC 60335-2-34 (including its Annex AA), are not measured.

4.4.2.102 Fluid leakage in the equipment

Internal leaks of fluids shall be simulated.

4.4.2.103 Solenoid valve and motorized valve

Equipment where the failure of a solenoid or motorized valve could cause a HAZARD shall be tested with the valve held in the worst likely failed state (including fully open, fully closed, anywhere in-between and changing state at the wrong time).

4.4.2.104 Failure of temperature control

The BATH TANK or other liquid vessel of the equipment shall be filled to its maximum level with HEAT TRANSFER MEDIUM FOR NORMAL USE as specified by the manufacturer. The following faults shall then be applied, fault a) is applied on its own but if the conditions for c) are true then it is applied immediately after b).

a) Uncontrolled heating – For equipment where there is an opening over the BATH TANK and where the boiling of the HEAT TRANSFER MEDIUM could cause a HAZARD, the temperature controllers shall be overridden so that the HEAT TRANSFER MEDIUM is kept boiling until any TEMPERATURE-LIMITING DEVICE for overtemperature protection is triggered, or boiling is terminated by the loss of the liquid.

b) Uncontrolled cooling – Temperature controllers shall be overridden to produce uncontrolled cooling until the HEAT TRANSFER MEDIUM becomes coagulated, solidified or frozen, or until there is no evidence of further increases in the kinematic viscosity of the HEAT TRANSFER MEDIUM, or operation of the MOTOR-COMPRESSOR is automatically terminated by a protective device.

c) Return to control – This test shall be applied to equipment incorporating an immersed or flow-through REFRIGERATING SYSTEM EVAPORATOR and/or a CIRCULATING PUMP and where the HEAT TRANSFER MEDIUM has become frozen, solidified or coagulated and the MOTOR-COMPRESSOR is still operational or could be made operational by resetting its protective device without the use of a TOOL. Under these conditions the MOTOR-COMPRESSOR's protective device shall be reset (if required) and the temperature control shall be reactivated with the temperature set to a value where the HEAT TRANSFER MEDIUM would be a liquid at its normal viscosity. The test terminates when all of the HEAT TRANSFER MEDIUM is at the specified temperature and normal viscosity.

4.4.2.105 HUMIDIFIER

HUMIDIFIERS that are not RATED to operate continuously shall be forced to operate continuously.

The container of an electrode-type HUMIDIFIER shall be filled with a saturated solution of sodium chloride in water, at a temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The HUMIDIFIER shall be supplied at its RATED voltage.

NOTE The solution is saturated when no more salt can be dissolved in the water at a particular temperature.

If flexible tubing or hose is used for the steam or mist outlet, the test shall be performed with the tubing or hose unobstructed, partially blocked, and fully blocked.

If the equipment depends on a differential pressure between the inlet and outlet of the HUMIDIFIER to drive the steam or mist into the equipment, the HUMIDIFIER shall be operated with the equipment running at or cycling between its maximum and minimum working temperatures, whichever is least favourable.

In case of doubt, tests shall be made with more than one combination of conditions.

4.4.2.106 Extreme operating ambient abnormal

For REFRIGERATING SYSTEMS intended to operate in an ambient environment that is more restricted than specified in 1.4.1, this additional abnormal test shall be applied to simulate the failure of the controlled environment in which the equipment is located.

Having determined the least favourable test condition for the temperature and pressure tests under 10.4.1 the equipment is operated under these conditions until a steady state has been achieved. The test environment is then increased to the levels of 1.4.1 (40 °C, 50 % RH) and the equipment is allowed to stabilize before the maximum temperatures and pressures are recorded. Protective devices shall not be bypassed or disabled. If the equipment does not reach steady state due to the operation of protective devices, then the maximum values recorded for this test shall be either:

- a) the maximum temperatures and pressures at the point of operation of non-resettable or manually resettable devices, which do not need to be reset during this test; or
- b) the maximum temperatures and pressures achieved after continued cycling of automatically resetting protective devices, which shall be allowed to cycle until it is clear that successive cycles will not develop higher maximum values.

4.4.2.107 Speed controller

If a HAZARD could arise in case of a single fault of a speed controller, then such faults shall be applied, one at a time.

NOTE As examples, speed controllers are sometimes used to control MOVEMENT FREQUENCY in a SHAKER or COMBINED TEST CHAMBER, and to control pressure and flow rate of a CIRCULATING PUMP. Under a SINGLE FAULT CONDITION of the speed controller, a HAZARD might arise if the pressure developed by the pump exceeds the MAXIMUM ALLOWABLE PRESSURE of an APPLICATION SYSTEM, or if excessive MOVEMENT FREQUENCY of a SHAKER or COMBINED TEST CHAMBER results in loosening, tumbling, ejection, or destruction of the SPECIMEN.

4.4.3 Duration of tests

4.4.3.1 General

Replacement:

Replace the text with the following:

The equipment shall be operated until further change as a result of the applied fault is unlikely. Each test is normally limited to 1 h since a secondary fault arising from a SINGLE FAULT CONDITION will usually manifest itself within that time. If there is an indication that a HAZARD of electric shock, spread of fire or injury to persons may eventually occur, the test shall be continued until it is clear that stable conditions have been maintained for at least 1 h, unless one of these HAZARDS arises before then.

4.4.4 Conformity after application of fault conditions

4.4.4.1 General

Addition:

Add the following text below item c):

Conformity with the requirements for temperature protection of motor-compressors is checked as specified in 4.4.2.101.

5 Marking and documentation

This clause of Part 1 is applicable except as follows:

5.1 Marking

Addition:

Add the following subclauses at the end of subclause 5.1:

5.1.101 Marking for equipment incorporating REFRIGERANT CONDENSING UNIT

For equipment incorporating a REFRIGERANT condensing unit, the following information shall be marked:

- a) THE TOTAL MASS OF REFRIGERANT FOR EACH SEPARATE REFRIGERANT CIRCUIT;
- b) FOR A SINGLE COMPONENT REFRIGERANT, AT LEAST ONE OF THE FOLLOWING:

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