BS EN 61010-2-012:2016

BSI Standards 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

bsi.

National foreword

This British Standard is the UK implementation of EN 61010-2-012:2016. It is identical to IEC 61010-2-012:2016.

The UK participation in its preparation was entrusted to Technical Committee EPL/66, Safety of measuring, control and laboratory equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2016

ISBN 978 0 580 82117 2
ICS 19.080

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2016.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61010-2-012

November 2016

ICS 19.080

English Version

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 61010-2-012:2016)

Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire - Partie 2-012: Exigences particulières pour les appareils d'essais climatiques et d'environnement, et autres appareils de conditionnement de température
(IEC 61010-2-012:2016)

Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 2-012: Besondere Anforderungen an Klima- und Umwelttestgeräte und andere Temperatur-Konditionierungsgeräte
(IEC 61010-2-012:2016)

This European Standard was approved by CENELEC on 2016-08-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 66/590/FDIS, future edition 1 of IEC 61010-2-012, prepared by IEC/TC 66 "Safety of measuring, control and laboratory equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61010-2-012:2016.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017-05-16
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-08-19

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61010-2-012:2016 was approved by CENELEC as a European Standard without any modification.

The Bibliography of EN 61010-1:2010 is applicable except as follows:

In the bibliography of EN 61010-1:2010, the following notes have to be **added** for the standards indicated:

IEC 60068-1:1988+A1:1992	NOTE	Harmonized as EN 60068-1:1994 [1)] (not modified).
IEC 60068-2-1:2007	NOTE	Harmonized as EN 60068-2-1:2007 (not modified).
IEC 60068-2-2:2007	NOTE	Harmonized as EN 60068-2-2:2007 (not modified).
IEC 60068-2-5:2010	NOTE	Harmonized as EN 60068-2-5:2011 (not modified).
IEC 60068-2-10:2005	NOTE	Harmonized as EN 60068-2-10:2005 (not modified).
IEC 60068-2-11:1981	NOTE	Harmonized as EN 60068-2-11:1999 (not modified).
IEC 60068-2-13:1983	NOTE	Harmonized as EN 60068-2-13:1999 (not modified).
IEC 60068-2-14:2009	NOTE	Harmonized as EN 60068-2-14:2009 (not modified).
IEC 60068-2-30:2005	NOTE	Harmonized as EN 60068-2-30:2005 (not modified).
IEC 60068-2-38:2009	NOTE	Harmonized as EN 60068-2-38:2009 (not modified).
IEC 60068-2-39:1976	NOTE	Harmonized as EN 60068-2-39:1999 [2)] (not modified).
IEC 60068-2-40:1976+A1:1983	NOTE	Harmonized as EN 60068-2-40:1999 (not modified).
IEC 60068-2-41:1976+A1:1983	NOTE	Harmonized as EN 60068-2-41:1999 (not modified).
IEC 60068-2-53:2010	NOTE	Harmonized as EN 60068-2-53:2010 (not modified).
IEC 60068-2-66:1994	NOTE	Harmonized as EN 60068-2-66:1994 (not modified).
IEC 60068-2-67:1995	NOTE	Harmonized as EN 60068-2-67:1996 (not modified).
IEC 60068-2-78:2001	NOTE	Harmonized as EN 60068-2-78:2001 [3)] (not modified).
IEC 60068-3-5	NOTE	Harmonized as EN 60068-3-5.
IEC 60335-2-41	NOTE	Harmonized as EN 60335-2-41.

[1)] Superseded by EN 60068-1:2014 (IEC 60068-1:2013).

[2)] Superseded by EN 60068-2-39:2016 (IEC 60068-2-39:2015).

[3)] Superseded by EN 60068-2-78:2013 (IEC 60068-2-78:2012).

IEC 60335-2-73:2002	NOTE	Harmonized as EN 60335-2-73:2003 (modified).
IEC 60335-2-73:2002/A1:2006	NOTE	Harmonized as EN 60335-2-73:2003/A1:2006 (not modified).
IEC 60335-2-74:2002	NOTE	Harmonized as EN 60335-2-74:2003 (not modified).
IEC 60335-2-74:2002/A1:2006	NOTE	Harmonized as EN 60335-2-74:2003/A1:2006 (not modified).
IEC 60335-2-89	NOTE	Harmonized as EN 60335-2-89.
IEC 60335-2-98:2002	NOTE	Harmonized as EN 60335-2-98:2003 (not modified).
IEC 60335-2-98:2002/A1:2004	NOTE	Harmonized as EN 60335-2-98:2003/A1:2005 (not modified).
IEC 61010-2-010	NOTE	Harmonized as EN 61010-2-010.
IEC 61770:2008	NOTE	Harmonized as EN 61770:2009 (not modified).
ISO 4126-1	NOTE	Harmonized as EN ISO 4126-1.
ISO 9227	NOTE	Harmonized as EN ISO 9227.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

Annex ZA of EN 61010-1:2010 is applicable, except as follows:

Publication	Year	Title	EN/HD	Year
Additions:				
IEC 60079-15	2010	Explosive atmospheres - Part 15: Equipment protection by type of protection "n"	EN 60079-15	2010
IEC 60079-20-1	-	Explosive atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data	EN 60079-20-1	-
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	EN 60335-2-24	2010
+A1 (mod)	2012		+A1	2016
IEC 60335-2-34	2012	Household and similar electrical appliances - Safety - Part 2-34: Particular requirements for motor-compressors	EN 60335-2-34	2013
+A1	2015		+A1	2015
IEC 62471	-	Photobiological safety of lamps and lamp systems	EN 62471	-
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	EN ISO 7010	2012

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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

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.
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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 61010-2-012 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
66/590/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.

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 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.

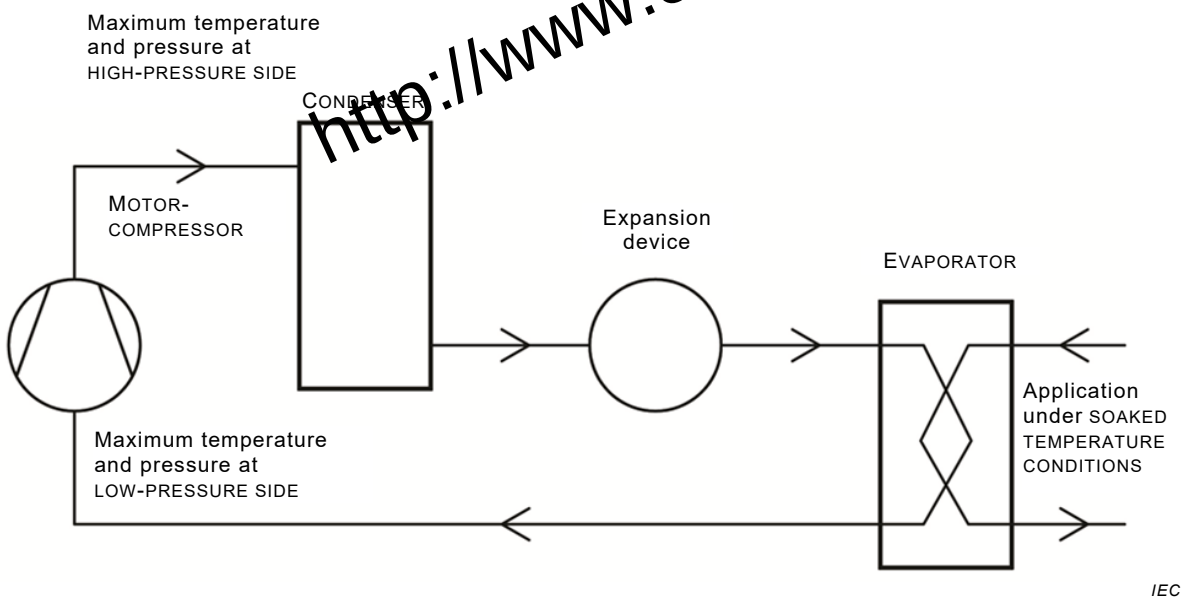


Figure 101 – Schema of a REFRIGERATING SYSTEM incorporating a CONDENSER

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

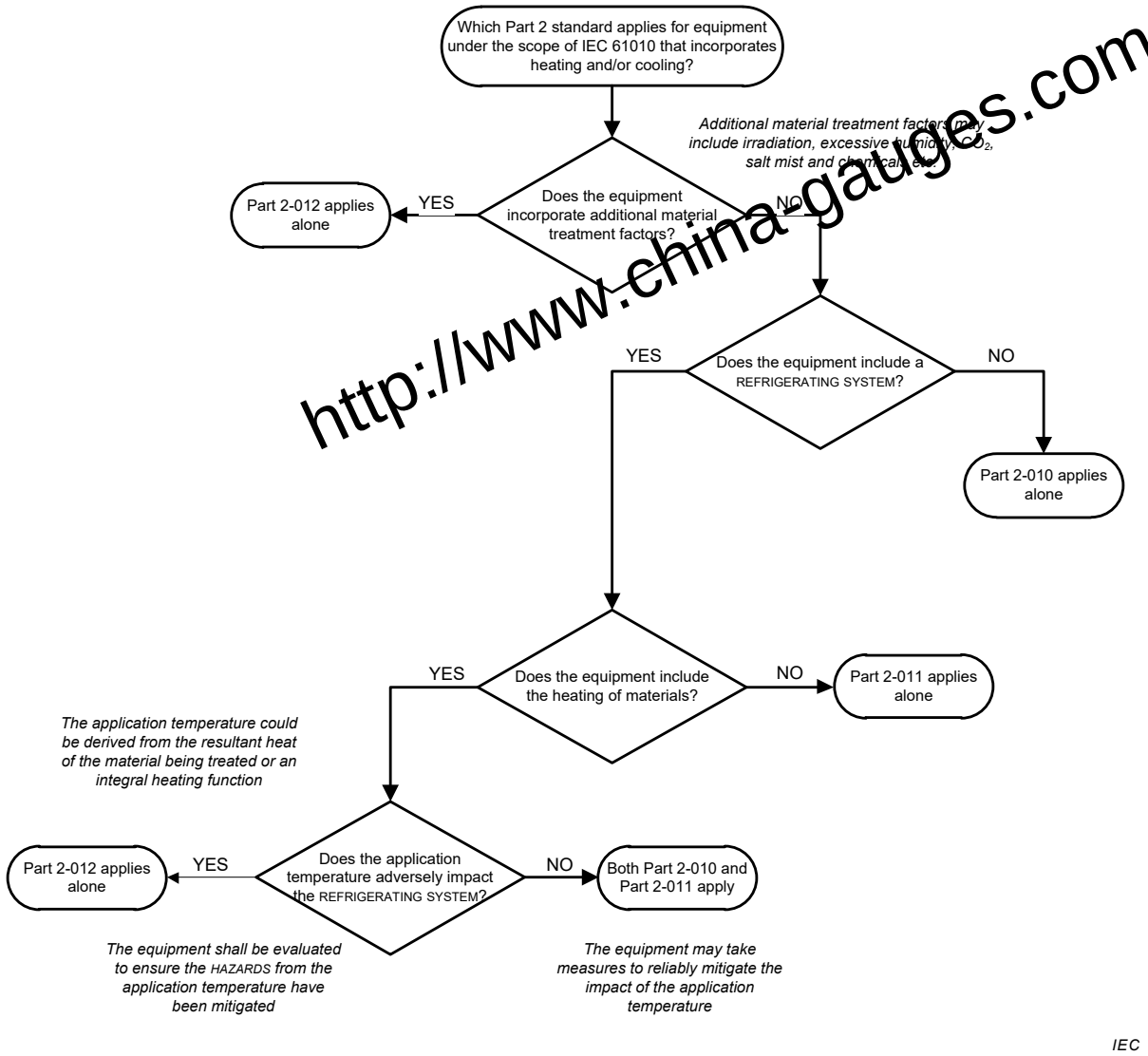


Figure 102 – Flow chart illustrating the selection process

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 (see13.102).

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*

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, 426-08-03, 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 bepermanently sealed, such as by welding or brazing (hermetic MOTOR-COMPRESSOR), or may be sealed by gasketted joints (semi-hermetic MOTOR-COMPRESSOR). A terminal box, a terminal boxcover, and other electrical components or an electronic control system may be included

[SOURCE: IEC 60335-2-34:2012/AMD1:2015, 3.101, modified – "appliance" has been replaced by "refrigerating subassembly"]

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 ±2,0°C of maximum ambient of 1.4.1 for NORMAL USE, storage or transport, and the operating temperature of the EUT equals to ±2,0°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 (±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 °C ± 3 °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 °C ± 3 °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.

NOTE103 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 re-activated 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 °C ± 5 °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:
   1) the chemical name,
   2) the chemical formula,
   3) the REFRIGERANT number;

c) FOR A BLENDED REFRIGERANT, AT LEAST ONE OF THE FOLLOWING:
   1) the chemical name and nominal proportion of each of its components,
   2) the chemical formula and nominal proportion of each of its components,
   3) the REFRIGERANT number and nominal proportion of each of its components,
   4) the REFRIGERANT number of the REFRIGERANT blend;

   NOTE 1 REFRIGERANT numbers are quoted in accordance with ISO 817 or other REFRIGERANT classification standard, e.g. ANSI/ASHRAE 34.

d) MAXIMUM ALLOWABLE PRESSURE (PS), HIGH-PRESSURE SIDE and LOW-PRESSURE SIDE for each REFRIGERANT STAGE.

   NOTE 2 The collation of the test results that define PS is detailed in 11.7.1.

Conformity is checked by inspection.

5.1.102 Marking for equipment incorporating MECHANICAL MOVEMENT

For SHAKERS and COMBINED TEST CHAMBERS incorporating function of MECHANICAL MOVEMENT, the maximum safe load of the SPECIMEN holder shall be marked.

Conformity is checked by inspection.

5.1.5 TERMINALS, connections and operating devices

Addition:

Add the following subclauses:

5.1.5.101 LIQUID CONNECTIONS for HEAT TRANSFER MEDIUM

LIQUID CONNECTIONS for HEAT TRANSFER MEDIUM shall be marked with graphical symbols or text to identify outlet and inlet of the HEAT TRANSFER MEDIUM.

NOTE For refrigerating CIRCULATORS, symbols 107 through 109 can be used and, for refrigerating and heating CIRCULATORS, symbols 110 through 112 can be used.

Additionally, consideration may be given to mark the following:

a) if the outlet pressure of the liquid is greater than 0,03 MPa or, 0,02 MPa with maximum flow rate of more than 10 l/min, the maximum pressure in Pascal in association with symbol 108 or 111;
b) for CIRCULATOR with liquid suction pressure lower than 0,02 MPa, the maximum pressure in Pascal preceded by a minus sign, in association with symbol 109 or 112;
c) for an enclosed CIRCULATOR intended for connection to a sealed APPLICATION SYSTEM, and if the LIQUID CONNECTIONS will need to withstand pressure exceeding 0,03 MPa, the maximum pressure for each LIQUID CONNECTION, in association with symbols 108 and 109, or 111and 112.

Symbols 107 to 112 are found in Table AA.1.

Where there is insufficient space near the LIQUID CONNECTIONS, symbol 14 of Table 1 may be used and explanations shall be detailed in the instructions provided with the equipment.

Conformity is checked by inspection.

5.1.5.102 LIQUID CONNECTION for filling of BATH TANKS with enclosed CIRCULATORS

Where the miss-setting of controls or valves associated with LIQUID CONNECTION for filling of a BATH TANK with an enclosed CIRCULATOR could cause a HAZARD, symbol 14 shall be placed close to the LIQUID CONNECTION and the instructions for use (see 5.4.4) shall clearly explain the necessary settings to ensure safety under different operating conditions.

Conformity is checked by inspection.

5.1.5.103 Other LIQUID CONNECTIONS and exhaust opening

LIQUID CONNECTIONS for filling, water supply, draining, overflowing and exhaust opening shall be marked as follows:

a) for equipment intended for manual filling of liquid, if the area of the opening for the BATH TANK or other liquid vessel is smaller than 80cm^2 or it is not self-evident, a text marking or symbol 116 to indicate the location of the opening for filling;
b) for equipment intended for directly connection to the water supply, a text marking or symbol 113 for each LIQUID CONNECTION for water source, and optionally including, as

applicable, auxiliary text to indicate the RATED pressure, flow rate, and maximum temperature of the water supply;

c) for equipment incorporating a water-cooled CONDENSING UNIT, or LIQUID CONNECTIONS for circulating water, a text marking or symbol 113 to identify the inlet, and a text marking or symbol 114 to identify the outlet, one or both of which also indicate the direction of liquid flow, and including as applicable, auxiliary text to indicate the RATED pressure, flow rate, and maximum temperature of the water supply;

d) for LIQUID CONNECTION for condensate, a text marking or symbol 115;

e) for LIQUID CONNECTION for draining, a text marking or symbol 117;

f) for LIQUID CONNECTION for overflowing, a text marking or symbol 118;

g) markings in association with a VENTILATOR include:

   1) symbol 119 for the adjustment handle or shaft of the VENTILATOR,

   2) symbol 120 for the fresh air inlet accompanied by, where necessary, the following text or its equivalent, “fresh air inlet. Do not block.”;

   3) symbol 121 for the exhaust opening.

NOTE Symbols 113 to 121 can be found in Table AA.1.

Where there is insufficient space near the LIQUID CONNECTIONS and/or exhaust openings, symbol 14 of Table 1 may be used and additional explanation shall be included in the instructions.

Conformity is checked by inspection.

5.1.5.104 Equipotential TERMINALS

Each equipotential TERMINAL shall be marked with symbol for equipotentiality of IEC 60417-5021 (2002-10). The marking shall not be marked on a screw, bolt, removable washer, or any other part removable when a connection is being made to conductors or wires.

Conformity is checked by inspection.

5.1.3 Mains supply

Addition:

Add the following new symbols to Table 1:

Table 1 – Symbols

Number	Symbol	Reference	Description
101		ISO 7010 – W010(2011-06)	Warning; low temperature/freezing conditions, frostbite HAZARD
102		ISO 7010 – W021(2011-06)	Warning; flammable material/FLAMMABLE LIQUID
103		ISO 7010 – W009(2011-06)	Warning; biological HAZARD
104		ISO 7010 – W027(2011-06)	Warning; optical radiation
105		ISO 7010-W011(2011-06)	Warning; slippery surface
106		ISO 7010-W024(2011-06)	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.

Addition:

Add the following text after item b):

Warning markings for particular HAZARDS which exist only when performing equipment maintenance shall be marked so that they are visible only when the particular maintenance is being performed. 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. The symbol 102 of Table 1 shall be at least 15mm in height.

5.4.1 General

Replacement:

Replace item d) by:

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

5.4.2 Equipment RATINGS

Replacement:

Replace the first paragraph by:

Where applicable the documentation shall include the following:

Addition:

Add the following items after f):

aa) the maximum and minimum operating temperatures;

bb) the ACC RANGE and rated cooling capacity for REFRIGERATING SYSTEM;

cc) RATED pressure and flow rate for LIQUID CONNECTIONS between CIRCULATOR and an APPLICATION SYSTEM;

dd) the maximum additive relative humidity;

ee) the minimum air pressure;

ff) the maximum radiation strength;

gg) RATED PRESSURE, flow rate for connections to liquid and air supplies;

hh) maximum MECHANICAL FREQUENCY, MECHANICAL AMPLITUDE versus the mass of the load.

5.4.3 Equipment installation

Replacement:

Replace the items a) to g) in 5.4.3 with the following:

a) assembly, location and mounting requirements. Space requirements, in particular the minimum distance to all the ventilating holes or grid, LIQUID CONNECTIONS and/or exhaust opening; Additional requirements for the rigidity and non-slippery of the floor and/or laboratory bench; If a HAZARD could be caused by hot items falling from the equipment, for example when a door is opened, there shall be a warning that the equipment shall not be mounted on a surface of flammable material; Assembling the equipment away from overhead fire sensors, where opening of the door or lid or, exhausting of the fume is possible for NORMAL USE.

b) for equipment incorporating lockable swivel casters and/or levellers, the requirements to lock the casters and adjust the levellers;

c) ventilation requirements: if the operating of the equipment could lead to liberation of hazardous air or gas mixture, installation instructions shall warn of the need for an extraction system, additional TEMPERATURE-LIMITING DEVICES relating to safe temperatures for the materials, etc.;

d) requirements for liquid filling, draining or overflowing (see 10.1 b));

e) connection to the power source:

   1) instructions for protective grounding;

   2) for equipment intended for WET LOCATIONS (see 1.4.2) and in which HAZARDOUS LIVE parts may need to be ACCESSIBLE (see 6.1.2), warning symbol and statement that power socket with appropriate IP protection is used and whether external residual current circuit breaker (RCD) with RATED breaking capacity is necessary,

   3) warning symbol and statement which are necessary when permanent connection to the supply source is essential,

   4) for PERMANENTLY CONNECTED EQUIPMENT:

      – supply wiring requirements,

– requirements for any external switch or circuit-breaker (see 6.11.3.1) and external over current protection devices (see 9.6.2), and a recommendation that the switch or circuit-breaker be near the equipment;

f) requirements for special services, for example, air, cooling liquid. Characteristics necessary for safety shall be specified, for example, maximum and minimum temperature and pressure for cooling water;

g) requirements for installation of and/or connection to vacuum pump, air compressor and/or steam source;

h) instructions relating to sound pressure level (see 12.5.1): the maximum sound power level produced by equipment which emits sound, if measurement is required by 12.5.1;

i) requirements for DRYING-OUT and/or STANDSTILL (see 5.4.3.101);

j) requirements for connecting a remote CONDENSING UNIT to the equipment, in particular, requirements for location, space and, pipes, tubes, accessories (see 14.101) and, detailed specifications for REFRIGERANT (see 5.1.101) and, ventilation, water mains and detailed procedures for connection and adjustment;

k) requirements for connecting a CIRCULATOR to the APPLICATION SYSTEM, in particular requirements for location, space and, tubes, accessories (see 14.102), insulation and, liquid HEAT TRANSFER MEDIUM and, ventilation, water MAINS and detailed procedures for connection and adjustment;

l) requirements for installing any functional lamp source, in particular recommended lamps and accessories, measures for protection against rupture of the lamp and its disposal, precautions for protection against HAZARDS of possible electric shock, hot surface, excessive optical and/or UV radiations, requirements for ventilation and water source and detailed procedures for installation and adjustment;

m) requirements for connecting HUMIDIFIER or steam source to the equipment, in particular recommended type and specifications of the HUMIDIFIER, equivalent evaporation of the steam source and, requirements for tubes, accessories, insulation, ventilation and water mains and, precautions for protection against HAZARDS of possible electric shock, hot surface, mechanical injury in association with the installation and, detailed procedures for installation and adjustment;

n) requirements for installation and adjustment for the MECHANICAL MOVEMENT.

Conformity is checked by inspection.

Addition:

Add the following subclause:

5.4.3.101 DRYING-OUT and STANDSTILL

The instructions shall include a warning that the equipment cannot be assumed to meet all the safety requirements of this standard during the DRYING-OUT and/or STANDSTILL.

Conformity is checked by inspection.

5.4.4 Equipment operation

Addition:

Add the following items after item j):

aa) requirements for the liquid HEAT TRANSFER MEDIUM and warning against HAZARDS related to improper use of the liquid.

– specifications of the liquid applicable to the equipment, in particular the temperature range, flammability, viscosity, FLASH POINT, FIRE POINT, AUTO IGNITION

TEMPERATURE, specific gravity and specific heat capacity and their effect on applications (see 4.3.2.113);

– procedures and precautions for filling, draining and replacing [see 10.1 b)];
– chemical HAZARD and instructions for disposal and emergency treatment;
– special requirements for HEAT TRANSFER MEDIA which change states during NORMAL USE, in particular the HEAT TRANSFER MEDIA in a salt BATH;

bb) instructions for how to calculate the cooling capacity and/or effective heating capacity for SPECIMEN and APPLICATION SYSTEM;

NOTE 101 Cooling capacity is a measurement of the heat flow that a REFRIGERATING SYSTEM withdraws from the HEAT TRANSFER MEDIUM, as determined according to standard testing procedures, for example, DIN 12876-2.

NOTE 102 Effective heating capacity is a measurement of the heat flow that heating sources radiates to the HEAT TRANSFER MEDIUM.

cc) requirements for SPECIMEN loading, distributing and fixing within the working space for BATH, INCUBATOR or TEST CHAMBER or over the holder of MECHANICAL MOVEMENT;

dd) procedures to be followed to shut down the equipment safely and leave it in a safe state.;

ee) warning against access to WALK-IN EQUIPMENT (see also Annex BB) for untrained personnel or child. Requirements for access to WALK-IN EQUIPMENT, in particular the use of personal protective equipment, presence of a second OPERATOR, unlocking mechanism and clearance of the door, and indicating device when OPERATOR is inside the equipment;

ff) requirements for ventilating device, access port (hatch) and LIQUID CONNECTIONS; Warning against HAZARDS from high and low temperatures (see 10.1), liberated HAZARDOUS gas, liquid or solid (see 13.1);

gg) requirements for regular inspection and its intervals with regard to SPECIMEN fixing and potential HAZARDS during the shaking process;

hh) instructions for proper operation of and warning against HAZARDS from lamp and lamp systems, HUMIDIFIER or steam source and MECHANICAL MOVEMENT;

ii) instructions for use of personal protective equipment, protective measures or requirement for training.

Conformity is checked by inspection.

Addition:

Add the following subclause:

5.4.4.101 Cleaning and decontamination

The instructions shall include conditions and intervals for cleaning and, where necessary, decontamination. The recognized generic names of recommended materials for cleaning and decontamination shall be given as well as an indication of any materials which could be likely to be used but which are incompatible with parts of the equipment or with material contained in it.

The instructions shall also state that the RESPONSIBLE BODY shall ensure that:

a) appropriate decontamination is carried out if HAZARDOUS substance is split onto or into the equipment;

b) no decontamination or cleaning agents are used which could cause a HAZARD as a result of a reaction with parts of the equipment or with material contained in it;

c) the manufacturer or his agent is consulted if there is any doubt about the compatibility of decontamination or cleaning agents with parts of the equipment or with material contained in it.

If a manufacturer claims that an item can be decontaminated by steam sterilization, it shall be capable of withstanding steam sterilization under at least one of the time-temperature conditions given in Table 101.

Manufacturers should be aware of the internationally recognized "Laboratory Biosafety Manual", published by the World Health Organization in Geneva, which gives information on decontaminants, their use, dilutions, properties and potential applications. There are also national guidelines which cover these areas.

Cleaning and decontamination may be necessary as a safeguard when equipment intended for biological application and any accessories are maintained, repaired, or transferred. Manufacturers are required to provide a format for the RESPONSIBLE BODY to certify that such treatment has been carried out.

Table 101 – Time-temperature conditions

Absolute pressure	Corresponding steam temperature		Minimum hold time
	Nominal	Range	
kPa	°C	°C	min
325	136,0	134 to 138	3
250	127,5	126 to 129	10
215	122,5	121 to 124	15
175	116,5	115 to 118	30
NOTE 'Minimum hold time' means the time the containment is at steam temperature.			

Conformity is checked by inspection.

5.4.5 Equipment maintenance and service

Replacement:

Replace the text in 5.4.5 with the following:

Where continued safe operation is dependent on regular scheduled inspection and/or maintenance, the instructions to the RESPONSIBLE BODY shall detail the required inspection and maintenance and, provide information to assist the RESPONSIBLE BODY in determining a suitable maintenance schedule.

In particular the following details shall be included if applicable:

- Detailed specifications for REFRIGERANT (see 5.1.101), HEAT TRANSFER MEDIUM, flexible tubing, hose, fittings, insulation materials, lamps, door gasket which are specific to the equipment.
- Intervals, detailed procedures for checking function of safety related mechanism of MECHANICAL MOVEMENT, specific consumable parts and accessories.
- Intervals, detailed procedures for inspecting function of TEMPERATURE-LIMITING DEVICE, LIQUID LEVEL CUT OUT, PRESSURE-LIMITING DEVICE and similar protective devices.
- Intervals and detailed procedures for cleaning of piezo-electric transducer used in ultrasonic HUMIDIFIER, RESISTANCE-HEATING DEVICE and, water heat exchanger and, filters in the heat exchanging system.

- Statement that maintenance ACCESSIBLE by means of a TOOL shall be made only by trained personnel approved by the manufacturer.
- Where applicable, instructions shall specify procedures for the RESPONSIBLE BODY to check the effective operation of devices or systems for overtemperature protection, liquid level protection, high or low pressure protection and, the unlocking or interlocking mechanism of door or lid for escaping away from within the WALK-IN EQUIPMENT (see Annex BB) which are necessary for safety, and shall state how often the checks need to be made.

If applicable, the manufacturer's documentation shall instruct against replacing detachable MAINS supply cords by inadequately RATED cords.

For equipment using replaceable batteries, the specific battery type shall be stated.

The instructions shall specify any parts which are required to be examined or supplied only by the manufacturer or his agent to ensure that safety is not compromised. Listing the manufacturer's part number is considered sufficient when the manufacturer does not wish to allow alternatives to be used.

The RATING and characteristics of replaceable fuses shall be stated.

Where special procedures are required to prepare equipment for periods of inactivity, storage or for decommissioning these procedures shall be detailed in the instructions.

If the equipment is to be kept idle and/or stored under freezing ambient conditions, instructions for power disruption, liquid draining and DRYING-OUT shall be given,

Precaution statements and warnings against HAZARDS related to procedures for maintenance and inspection shall be given.

Instructions on the following subjects shall be provided for service personnel, as necessary to permit safe servicing and continued safety of the equipment after servicing if the equipment is suitable to be serviced:

a) product-specific RISKS that may affect the service personnel;

b) protective measures for these RISKS;

c) verification of the safe state of the equipment after repair.

Instructions for service personnel need not be supplied to the RESPONSIBLE BODY, but should be made available to service personnel.

Conformity is checked by inspection.

Addition:

Add the following subclauses:

5.4.101 Additional instructions for refrigerating equipment that use FLAMMABLE REFRIGERANT

For refrigerating equipment that use FLAMMABLE REFRIGERANT, the instructions shall include sufficient information to assure the safe handling, servicing and disposal of the equipment.

The instructions shall include the substance of the following warnings as necessary:

– WARNING Keep clear of obstruction all ventilation openings in the ENCLOSURE or in the structure for building-in;

– 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;
– WARNING Do not use electrical appliance within the equipment, other than those recommended by the manufacturer.

NOTE For the US additional marking and informational requirements exist for refrigerating equipment which employ FLAMMABLE REFRIGERANTS. See Annex DD for detailed information.

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

The instructions for equipment incorporating remote REFRIGERANT CONDENSING UNIT that use a FLAMMABLE REFRIGERANT shall include the substance of the following warning:

– WARNING: In order to reduce fire HAZARDS the installation of this equipment shall only be carried out by qualified personnel approved by the manufacturer.

The marking of the type of FLAMMABLE REFRIGERANT and of the flammable gas for insulation blowing, 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, Warning: FLAMMABLE LIQUID shall be placed on the nameplate of the equipment near the declaration of the REFRIGERANT type and charge information. It shall be clearly visible after installation of the equipment.

Conformity is checked by inspection.

5.4.102 Additional instructions for equipment intended for use with FLAMMABLE LIQUID HEAT TRANSFER MEDIUM

For BATHS, CIRCULATORS and shaking BATHS intended for use with FLAMMABLE LIQUID HEAT TRANSFER MEDIUM, the instructions shall include sufficient information to assure the safe handling, servicing and disposal of the equipment.

The instructions shall include the substance of the following warnings as necessary:

– WARNING: Keep clear of obstruction all ventilation openings in the ENCLOSURE, the APPLICATION SYSTEM or in the structure for building-in;
– WARNING: No smoking! No flame! Do not use electrical parts which may produce spark when operating around the equipment and the APPLICATION SYSTEM;
– WARNING: Drain and recover the liquid when the equipment idles, if the liquid HEAT TRANSFER MEDIUM is used with open BATH TANK and, if it is highly volatile at ambient.

A label carrying symbol 102 shall be provided with equipment which can be used with a FLAMMABLE LIQUID HEAT TRANSFER MEDIUM along with instructions for the RESPONSIBLE BODY to affix the label visibly on the equipment if it is to be used with FLAMMABLE LIQUID HEAT TRANSFER MEDIUM.

The instructions shall be provided with detailed information for procedures to reduce the RISK with regard to the use of FLAMMABLE LIQUID HEAT TRANSFER MEDIUM, including how the adjustable TEMPERATURE-LIMITING DEVICE is adequately set so that the surface temperature in contact with the liquid is below the limit of 9.5 a).

Conformity is checked by inspection.

6 Protection against electric shock

This clause of Part 1 is applicable except as follows:

6.1.1 Requirements

Addition:

Add the following after the conformity statement:

If the installation instructions specify a STANDSTILL or DRYING-OUT (see 5.4.3.101), this is carried out before making the measurements of 6.3, 6.7.2.2 and 6.8. STANDSTILL or DRYING-OUT is followed by a rest period of 2 h with the equipment de-energized, before the measurements are taken.

Measurements are made with the equipment at ambient temperature. If there is doubt whether the permissible limits could be exceeded at least favourable combined operating conditions, the relevant measurements are repeated at these conditions and the higher values are used.

6.3.1 Levels in NORMAL CONDITION

Addition:

Add the following second paragraph to item b) 1):

Levels for PERMANENTLY CONNECTED EQUIPMENT are 1,5 times the above values.

6.3.2 Levels in SINGLE FAULT CONDITION

Addition:

Add the following second paragraph to item b) 1):

Levels for PERMANENTLY CONNECTED EQUIPMENT are 1,5 times the above values.

6.7.2.2 Solid insulation

Addition:

Add the following subclause:

6.7.2.2.101 DRYING-OUT

If the performance requirements of the equipment cannot be achieved without the use of hygroscopic heater insulation it is permissible for equipment to require a period of operation to dry out the insulation before meeting the requirements of 6.7.2.2, 6.3.1 and 6.8.2 provided that the OPERATOR is made aware of this (see 5.4.3.101).

Conformity is checked by performing the DRYING-OUT specified in the OPERATOR manual (see 5.4.3.101) before conducting the tests of 6.3.1 and 6.8.2.

6.8.1 General

Addition:

Add the following paragraph after the second paragraph:

If a DRYING-OUT is specified (see 6.7.2.2.101), this is carried out in accordance with the OPERATOR manual (see 5.4.3.101) before the tests of 6.8.3. DRYING-OUT is followed by a rest period of 2 h with the equipment de-energized. The tests are then performed and completed within 1 h at the end of the rest period.

6.8.2 Humidity preconditioning

Addition:

Add the following paragraph to the end of the last paragraph:

Equipment for which a DRYING-OUT is specified (see 5.4.3.101) shall not be subjected to humidity preconditioning.

6.9.1 General

Addition:

Add the following paragraph after the note:

Bare HAZARDOUS LIVE parts and insulated wiring and connections shall be so routed and arranged that the CLEARANCES and CREEPAGE DISTANCES are not reduced below acceptable values by

1) liquids, vapours or impurities condensed, accumulated or leaking inside the equipment;
2) contact with hot or cold parts;
3) mechanical stress or abrasion by sharp edges.

6.10.1 MAINS supply cords

Replacement:

Replace the third and fourth paragraphs as follows:

If a cord is likely to contact hot or cold external parts of the equipment, it shall be made of suitably temperature-resistant material or, alternatively, additional protection shall be provided to prevent the cord contacting the heated or cold surface.

If the cord is detachable, both the cord and the appliance inlet shall have adequate temperature RATINGS. The cord and the appliance inlet shall have a temperature RATING above the maximum temperatures measured under NORMAL CONDITION on any part of the appliance inlet itself.

The appliance coupler shall have a mechanism which prevents the cord of a lower temperature RATING from being inserted into the appliance inlet featuring a higher temperature RATING.

NOTE Appliance coupler in compliance with IEC 60320, such as that with style C15 and C16, or C21 and C22 for hot condition or, C15A and C16A for super hot condition is an example of required mechanism.

7 Protection against mechanical HAZARDS

This clause of Part 1 is applicable except as follows:

7.3.5.1 Gap limitations between moving parts – Access normally allowed

Addition:

Add the following paragraphs after the first paragraph:

If the width of the gap may decrease from a value larger than the minimum gap of Table 13 for that body part to a value smaller than the minimum gap in NORMAL CONDITION and SINGLE FAULT CONDITION, for example the door and/or locking device of TEST CHAMBERS or INCUBATORS, including WALK-IN EQUIPMENT (see Annex BB), the door or locking device shall be provided with handle or shaft so that hand, wrist, fist and fingers are kept away from the moving gap during operation of closing and/or locking the door. If twin doors are used, they may be so constructed that closing and/or locking of one door is possible only after the other door is closed, where the HAZARD of crushing is minimized.

Additional warning marking is necessary in proximity to the moving gap and where the locking device locates by using symbol 106 of Table 1.

Addition:

Add the following subclause:

7.3.101 Warning markings for MECHANICAL MOVEMENT

The MECHANICAL MOVEMENT area in a SHAKER or COMBINED TEST CHAMBER, shall be marked with symbol 14 of Table 1 or the applicable symbol 122 to 127of Table AA.1.

The SPECIMEN holder of the MECHANICAL MOVEMENT shall be marked with symbol 14 of Table 1.

Conformity is checked by inspection.

7.4 Stability

Addition:

Add the following subclauses:

7.4.101 Movement during operation

The equipment shall not change position during NORMAL USE.

Conformity is checked by inspection and test.

The equipment shall be operated according to the manufacture's specifications, at the setting and load condition representing worst case normal operating condition. Operating time is 10 min, or one operation cycle, whichever is shorter.

Movement shall be limited either by design, or by fastening to the mounting surface, or a combination of both, so that no part of the equipment moves outside a clearance envelope extending 5 mm, or less if stated by the manufacturer, in any direction from the outermost parts of the equipment in its original position.

During the tests the equipment shall remain in position. Any flexible tubing or other mechanical connection in between equipment and the APPLICATION SYSTEM shall withstand stress which could cause HAZARD.

For equipment intended for long term continuous operation, the maximum excursion and test period is to be determined through RISK assessment of Clause 17.

7.4.102 Removable SPECIMEN holder for MECHANICAL MOVEMENT

If a HAZARD, such as abnormal noise or mechanical injury from imbalance or uncoupling of the specimen holder for MECHANICAL MOVEMENT during NORMAL USE, could result during the removal or reengagement, removable SPECIMEN holder shall be marked with an appropriate warning symbol in close proximity to the handles of the holder and an explanation shall be included in the documentation.

Conformity is checked by inspection.

7.5 Lifting devices and supporting parts

7.5.1 General

Addition:

Add the following text after the first paragraph:

Where the physical construction is such that parts which are not designed to be used as handles, grips, lifting devices or supporting parts could be mistaken as such, shall

a) have a strength identical to or higher than that required for normal lifting devices or supporting parts or,

b) have a warning marking (see 5.2) that the parts shall not be used as handles, grips, lifting devices or supporting parts adjacent to the part(s). The symbol 14 of Table 1 and additional explanations in the documentation is considered to meet the requirements.

Replacement:

Replace the conformity statement as follows:

Conformity is checked by inspection and as specified in 7.5.2 and 7.5.3.

8 Resistance to mechanical stresses

This clause of Part 1 is applicable except as follows:

8.1 General

Replacement:

Replace the text of 3) by the following:

3) Except for FIXED EQUIPMENT, for equipment with a mass over 100 kg or, for equipment whose size and weight make unintentional movement unlikely and which is not moved in NORMAL USE.

8.2.1 Static test

Replacement:

Replace the second paragraph by the following:

An ENCLOSURE which is non-metallic or has glass as part of its construction is operated until a steady-state condition is reached at the least favourable of the following conditions:

a) at maximum or minimum ambient temperature or;

b) at extended maximum or minimum temperature or;

c) over the maximum or minimum operating temperature or;

d) cycled between the maximum and minimum temperature range or;

e) with all the lamps on and at maximum power input for radiation.

The equipment is disconnected from the supply source before the test is performed.

8.2.2 Impact test

Replacement:

Replace the second paragraph by the following:

An ENCLOSURE which is non-metallic or has glass as part of its construction is operated until a steady-state condition is reached at the least favourable of the following conditions:

a) at maximum or minimum ambient temperature or;

b) at extended maximum or minimum temperature or;

c) over the maximum or minimum operating temperature or;

d) cycled between the maximum and minimum temperature range or;

e) with all the lamps on and at maximum power input for radiation.

The equipment is disconnected from the supply source and, then tested within 10 min.

9 Protection against the spread of fire

This clause of Part 1 is applicable except as follows:

9.5 Requirements for equipment containing or using FLAMMABLE LIQUIDS

Addition:

Add the following text after the first paragraph:

This clause applies to FLAMMABLE LIQUIDS other than FLAMMABLE REFRIGERANT. The requirements for FLAMMABLEREFRIGERANTS are covered in 5.4.101 and 11.7.101.

Replacement:

Replace item a) and note 1 by the following:

a) The equipment shall be so constructed that it complies with items 1, 2 and 3 as follows:

   1) In NORMAL CONDITION and SINGLE FAULT CONDITION, the surface temperature of the FLAMMABLE LIQUID shall not exceed the FLASH POINT of the liquid being exposed to the air.

   2) In NORMAL CONDITION and SINGLE FAULT CONDITION, the surface temperature of any RESISTANCE-HEATING DEVICE at the surface of the FLAMMABLE LIQUID and in contact with air shall not exceed (t – 25) °C, where t is the FIRE POINT of the liquid.

   3) For equipment where a user setting could expose a FLAMMABLE LIQUID to a condition where 1) or 2) could be exceeded in the case of a SINGLE FAULT CONDITION during FORESEEABLE MISUSE, additional measures shall be provided to protect the OPERATOR from this HAZARD.

      – For example, a LIQUID LEVEL CUT OUT that disables the RESISTANCE-HEATING DEVICE before the requirements of 1) or 2) are exceeded is considered to comply with this requirement.

– Consideration should be given to any scenario that may expose any permitted FLAMMABLE LIQUID to a temperature that could exceed t_a – 100°C, where t_a is the AUTO IGNITION TEMPERATURE.

– The use of a FLAMMABLE LIQUID not approved by the manufacturer for use in the equipment is not considered as an OPERATOR setting and is therefore beyond the evaluation of Clause 16.

NOTE 101 Guidance on what is considered REASONABLY FORESEEABLE MISUSE is provided in 16.1.

It is not sufficient to limit the surface temperature of the FLAMMABLE LIQUID and parts in contact with the surface solely by the temperature control system. Over-temperature protection meeting requirements of 10.101 achieved by an independent, adjustable TEMPERATURE-LIMITING DEVICE shall be used.

NOTE 102 The surface temperature of RESISTANCE-HEATING DEVICE used to heat a liquid can be considerably higher than the temperature of the liquid.

NOTE 103 Additional instructions for equipment intended for use with FLAMMABLE LIQUID HEAT TRANSFER MEDIUM are detailed in 5.4.102.

Addition:

Add the following note after item c):

NOTE 104 Where FLAMMABLE LIQUID is present in the equipment, symbol 102 can be used as a warning marking.

Replacement:

Replace the first paragraph of the conformity statement by the following:

Conformity is checked by inspection, including nameplate, documentation and function of the equipment and, if necessary by the tests and measurements of temperature as specified in 10.4,and 10.101.

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 title by the following:

10.1 Surface temperature limits for protection against burns and frostbite

Replace the third 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). Equipment heated by its environment to temperature values exceeding the values in Table 19 in NORMAL CONDITION and 105 °C in SINGLE FAULT CONDITION need not to be marked with symbol 13.

NOTE The limit for maximum surface temperature of the housing of discharge pipe proximity to the MOTOR-COMPRESSORconforming to IEC 60335-2-34 (including its Annex AA) is 150 °C when tested at 43 °C ambient.

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

frostbite (see 5.2). Equipment cooled by its environment to temperature values lower than -30 °C need not to be marked with symbol 101.

Additionally, where the liquid temperature could be higher than +60 °C or lower than –30 °C, or where the temperature of air or gas mixture could be higher than +70 °C or lower than -40 °C, consideration should be given to mark the following for warning against possible burn and/or frostbite HAZARDS:

a) movable immersion CIRCULATOR during movement for NORMAL USE, the surface of the equipment in close proximity to the wetted parts may be marked with symbol 13 and/or symbol 101.

b) LIQUID CONNECTIONS for circulating, draining or overflowing of HEAT TRANSFER MEDIUM may be marked with symbol 13 and/or symbol 101 and/or, the maximum and/or minimum working temperatures of the equipment in association with symbols 108, 111, 117 or 118.

c) exhaust opening may be marked with symbol 13 and/or symbol 101 and/or, the maximum and/or minimum working temperatures of the equipment in association with symbol 121.

d) If an enclosed CIRCULATOR is intended for a hydraulically sealed APPLICATION SYSTEM, the LIQUID CONNECTION for filling of the BATH TANK or exhaust of a PRESSURE-RELIEF DEVICE may be marked with symbol 13 and/or symbol 101 and/or, the maximum and/or minimum working temperatures of the equipment in association with symbol 116.

Addition:

Add the following paragraph after the fourth paragraph:

For TEST CHAMBERS, INCUBATORS, and similar equipment with heating functions for high temperatures, there shall be an indication of the “ON” condition on each side of the equipment which has a door in it or has any other opening intended for loading of SPECIMEN.

Replacement:

Replace the conformity statement with the following:

Conformity is checked by inspection and by measurement as specified in 10.4, and by inspection of barriers to check that protection against accidentally touching surfaces exceeding temperatures above the values of Table 19 is appropriate, and that they cannot be removed without the aid of a TOOL.

10.2 Temperatures of windings

Addition:

Add the following text and table.

Conformity for motor-compressors is checked by measurement as specified in 10.4, in NORMAL CONDITION and in the applicable SINGLE FAULT CONDITIONS of 4.4.2.10, 4.4.2.101and 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 by Table 102. The pressures are recorded for use in 11.7.2.

Table 102 – Maximum temperatures for MOTOR-COMPRESSORS

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

10.4 Conduct of temperature tests

10.4.1 General

Replacement:

Replace the text in 10.4.1 with the following:

Maximum temperature is determined by measuring the temperature rise under reference test conditions defined by clause 4.3.1 of this standard. Linear extrapolation is not permitted. Unless a particular SINGLE FAULT CONDITION specifies otherwise, the NORMAL USE of the equipment as defined in 4.3.2 of this part of the standard and 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.

When measuring temperatures and pressures for REFRIGERATING SYSTEMS the tests shall be started from a SOAKED TEMPERATURE CONDITION when all pressures have been fully equalized. Tests at the extremes of the input voltage (± 10 %) shall start under these voltage conditions and achieve a stable state but need not start from a SOAKED TEMPERATURE CONDITION. 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 the test, 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.

Unless thermocouples are embedding in the windings of the MOTOR-COMPRESSOR, winding temperatures shall be taken using the change of resistance method in accordance with Annex E of IEC 60950 and, should be recorded at initial conditions and at steady-state. All other temperature and pressure measurements shall be taken continuously and the maximum temperatures and pressures recorded.

For MOTOR-COMPRESSORS conforming with IEC 60335-2-34 (including its Annex AA), the temperatures of the following parts are not measured:

– MOTOR-COMPRESSOR *housing;*

– MOTOR-COMPRESSOR *windings and other accessories, such as parts for protection, start-up and, any other parts that are tested with* MOTOR-COMPRESSOR *in accordance with IEC 60335-2-34 (including its Annex AA).*

For MOTOR-COMPRESSORS not conforming with IEC 60335-2-34 (including its Annex AA), the temperatures of the following parts shall not exceed the limits as specified in Table 102:

– *MOTOR-COMPRESSOR housing;*

– *MOTOR-COMPRESSOR windings.*

Addition:

Add the following subclauses:

10.101 Overtemperature protection

When a single fault in the equipment could lead to a HAZARD from overheating of the equipment, or material being processed, a non-self-resetting TEMPERATURE-LIMITING DEVICE or system meeting the requirements of 14.3 shall de-energize the RESISTANCE-HEATING DEVICE and any other parts which could cause a HAZARD.

If an insufficient quantity of liquid HEAT TRANSFER MEDIUM could cause a HAZARD, a self-resetting or non-self-resetting LIQUID LEVEL CUT OUT shall de-energize the RESISTANCE-HEATING DEVICE and any other parts which could cause a HAZARD. When the temperature of a surface in direct contact with the FLAMMABLE LIQUID HEAT TRANSFER MEDIUM exceeds t_a – 100 °C, where t_a = AUTO IGNITION TEMPERATURE, the LIQUID LEVEL CUT OUT shall operate before this surface can be exposed to air.

If a HAZARD could result from an incorrect immersion depth, movable immersion CIRCULATORS, when combined with either an open BATH TANK or a refrigerating BATH resulting in a BATH or CIRCULATOR, shall be marked with the maximum and minimum depth of immersion. These markings may be horizontal lines if additional explanation is included in the documentation.

For equipment designed to contain FLAMMABLE LIQUIDS, either for treatment or for heat-transfer, TEMPERATURE-LIMITING DEVICES or systems shall ensure, when set as directed in the manufacturer's instructions, that the temperature of the liquid shall not exceed the value as specified in 9.5 a) in NORMAL USE or SINGLE FAULT CONDITION.

The equipment as a whole, or the relevant parts, shall be de-energized by one of the following methods:

a) for single-phase equipment, the proposed circuit and physical construction shall be examined to identify possible single faults. The TEMPERATURE-LIMITING DEVICE shall be placed in the pole of the supply that provides the better protection from single faults that could defeat the over-temperature protection in the event of a subsequent failure of the temperature control system. A device which isolates both phase and neutral conductors at the same time may provide double fault protection (depending on application) and should be considered if the residual RISK is unacceptable.

   Conformity is checked by inspection of the circuit diagram, the data sheet for the TEMPERATURE-LIMITING DEVICE, and the method in which it is installed in the equipment, and, if necessary, by the tests specified in 14.3.

b) for polyphase equipment, either one single device or system disconnecting all phases or, an individual device or system for each phase;

c) a device or system providing disconnection from all poles of the supply.

Consideration shall be given to the following:

– In equipment designed for the cooling and/or heating of materials, HAZARDS may arise from overheating of materials being processed or, overheating of the liquid HEAT TRANSFER MEDIUM as well as from over-heating of parts of the equipment itself. For this reason a higher level of safety may be needed to provide in case of a SINGLE FAULT CONDITION in the equipment.

– In some cases a fall in the temperature of a heated medium (for example liquid in a BATH or CIRCULATOR) could cause a HAZARD. If this could occur as a result of the operation of a TEMPERATURE-LIMITING DEVICE or system after failure of the temperature controller, a second temperature controller may be fitted to maintain a safe temperature without the operation of a TEMPERATURE-LIMITING DEVICE.

NOTE NORMAL USE (which is use in accordance with the manufacturer's instructions) includes the correct setting of any adjustable TEMPERATURE-LIMITING DEVICE. If the OPERATOR is instructed to change the set point of the TEMPERATURE-LIMITING DEVICE (including providing the TOOL if required) then the incorrect setting of the

TEMPERATURE-LIMITING DEVICE may be considered REASONABLY FORESEEABLE MISUSE – refer to clause 16.1 for additional guidance.

TEMPERATURE-LIMITING DEVICES necessary for safety shall be separate from any temperature controller. This applies not only to the temperature sensing means but also to all disconnecting devices in the circuits to be de-energized. Whether operated by temperature, pressure, liquid level, airflow or other means, they shall meet the requirements of 14.3.

Adjustable TEMPERATURE-LIMITING DEVICES and system shall be adjustable only with the aid of a TOOL or similar means that prevents unintended adjustment.

Conformity is checked by inspection and during the fault tests specified in 4.4.2.10, 4.4.2.11 and as applicable, tests in 4.4.2.101 to 4.4.2.104.

10.102 Restarting after interruption of cooling and/or heating

According to applications, a HAZARD could arise either by re-starting or by not re-starting after interruption of cooling and/or heating as result of termination of circulating or agitating in a BATH or CIRCULATOR and in an oven or TEST CHAMBER. Equipment shall be incorporated with means and, instructions shall specify whether equipment will re-start or not re-start, both in the case of MAINS interruption and in the case of a SINGLE FAULT CONDITION.

NOTE In some cases, it may be appropriate for an audible or visible signal to warn that an interruption has occurred.

Conformity is checked by inspection and test.

11 Protection against HAZARDS from fluids

This clause of Part 1 is applicable except as follows:

11.1 General

Addition:

Add the following paragraph and note 101 after the conformity statement:

Equipment intended to be connected to the water mains shall be constructed to prevent backsiphonage of non-potable water into the water mains.

NOTE 101 IEC 61770 gives requirements for preventing backsiphonage of non-potable water into the water mains and tests.

Conformity is checked by inspection.

11.3 Spillage

Addition:

Add the following text after the conformity statement:

The construction of a draining valve, nozzle and any other similar device shall be designed to prevent them from being opened or pulled out unintentionally.

Conformity is checked by inspection.

11.4 Overflow

Replacement:

Replace the title and text of 11.4 with the following:

11.4 Overflow and low level

Liquid overflowing from any container in the equipment which can be overfilled or overflowed, whether by the OPERATOR or for functional reasons as part of equipment operation, shall not cause a HAZARD during NORMAL USE or in SINGLE FAULT CONDITION, for example, as a result of the wetting of insulation or of internal un-insulated parts that are HAZARDOUS LIVE.

Equipment likely to be moved while a vessel is full of liquid shall be protected against liquid surging out of the vessel.

Equipment containing liquid, whether as HEAT TRANSFER MEDIUM or as result of treatment, experiencing expansion and contraction, evaporating, spraying, raining or collecting when being heated, cooled, atomized, irrigated or condensed shall be provided with means to protect against any HAZARD associated with the overflow or low level during NORMAL USE or in SINGLE FAULT CONDITION.

Conformity is checked by inspection and by carrying out each of the following treatments and tests, if applicable. Immediately after the treatment, the CLEARANCE and solid insulation shall pass the voltage tests of 6.8 (without humidity preconditioning) applicable to the type of insulation (see 6.7) and ACCESSIBLE parts shall not exceed the limits of 6.3.1 for NORMAL USE and 6.3.2 under SINGLE FAULT CONDITION.

For BATHS, CIRCULATORS and similar equipment incorporating a liquid vessel, operate the equipment as follows:

Fill the bath tank or any other liquid vessel of the equipment to its maximum level with water unless otherwise specified, following instructions of the manufacturer.

a) Spillage from overflow:

The filling is continued for additional amount equal to 20 % of the vessel capacity, not less than 0,25 l, or 1 min after the first evidence of overflow; Where no spillage occurs due to function of the LIQUID CONNECTION for overflow that prevents such spillage, the filling is continued for a further amount equal to 30 % of the vessel capacity, or 5 min following the overflow through the LIQUID CONNECTION.

The LIQUID CONNECTION for overflow if equipped, shall be connected and fitted as instructed in the manual. If not specified by the manufacturer, use a filling rate of 10 l/min.

Take the value resultant from least favourable situation. There shall be no wetting of conductive live parts.

For remotely controlled automatic refill system, a RISK assessment shall be carried out according to Clause 17.

b) Splash from low level

Drain the BATH TANK or any other liquid vessel of the equipment to its minimum level or just prior to the evidence of the triggering of low LIQUID LEVEL CUT OUT if equipped, while keep the equipment running and functional assembly relying on appropriate liquid level operating, for example, the CIRCULATING PUMP and HUMIDIFIER are working.

There shall be no wetting of conductive live parts.

c) Spillage from expansion and contraction

Use HEAT TRANSFER MEDIUM with the widest temperature range and higher coefficient of expansion applicable for the equipment as instructed by the manufacturer.

Set the working temperature of the equipment at ambient and, keep the CIRCULATING PUMP running until the temperature is stabilized and:

1) Set the temperature of the equipment to its minimum, then to its maximum applicable for the same liquid, and finally to ambient. Change the setting only if the temperature is

stabilized at its setting or no evidence of further significant changing. Refill the BATH TANK if necessary with the same liquid to its maximum level for NORMAL USE prior to subsequent tests;

2) *Set the temperature of the equipment to its maximum, then to its minimum, and finally to ambient. Change the setting only if the temperature is stabilized at its setting or no evidence of further significant changing. Refill the BATH TANK if necessary with the same liquid to its maximum level for NORMAL USE prior to subsequent tests;*

3) *Program the setting for the temperatures of the equipment to its maximum, minimum and time for the change that maximum difference of the temperature changing is possible. Run the program with 2 repetitions or until no evidence of more unfavourable situation is expected.*

d) *Surging from movement*

Remove the plug from power supply and operate the equipment as follows:

1) *For equipment with castors, or provided with accessory trolleys specified by the manufacturer:*

   – *The equipment is moved in forward direction on a smooth and solid surface at a speed of 0,5 m/s ± 0,1 m/s for 2 m, and then with one of the castors against a solid vertical plane obstacle. The obstacle shall have a rectangular cross section of 10 mm ± 0,5 mm high and at least 80 mm wide with a radius of 2 mm ± 0,1 mm at the top edges. Unless direction of movement is mechanically restricted or explicitly specified by the manufacturer, the longest side of the equipment should be aligned with the direction of travel.*

   – *Equipment intended to be moved when fluid containing vessel is emptied shall be filled to 50% of the maximum level.*

   – *Operate the equipment with the obstacle against different castors, and repeat each test for 3 times.*

   Take the value resultant from least favourable situation. There shall be no wetting of conductive live parts, or if a HAZARD could result, no wetting of OPERATOR's grips or handles.

   A BATH TANK or any other liquid vessel incapable of sealed operation is left open. Equipment with fully enclosed fluid containing vessels is exempted from this test.

2) *For equipment with lifting devices:*

   – *Equipment up to 18 kg, including liquid, is subjected to a cycling 10° tilt-test as described below, across the short side of the equipment, or;*

   – *Equipment over 18 kg, including liquid, is subjected to a cycling 5° tilt-test as described below, across the long side of the equipment;*

   In either case, the equipment is subjected to 3 tilt-test cycles, where one cycle consists of the positions flat, tilted left, flat, tilted right, cycled within 10 s.

   There shall be no wetting of conductive live parts, and if a HAZARD could result, no spillage outside the equipment or wetting of OPERATOR's grips or handles.

   A BATH TANK or any other liquid vessel incapable of sealed operation is left open. Equipment with fully enclosed fluid containing vessels is exempted from this test.

e) *Spillage from condensate and simulated spraying, irrigating or raining*

For equipment incorporating a drip pan, operate the equipment as follows:

Block the outlet of the drip pan. Fill the pan with water carefully to the brim without splashing. The drip pan is then subjected to a continuous overflow, the rate of which is adjusted to approximately 17 cm^3/s, or to its maximum RATING specified by the manufacturer. Apply an airflow of 1 m^3/s if the overflow is influenced by airflow of cooling or CIRCULATING FAN(S). The test is continued for a period of 30 min, or until water drains from the equipment.

Equipment incorporating a defrosting device is subjected to a complete cycle of defrosting process under the least favourable condition.

Equipment completed with spraying, irrigating or raining device, is subject to a complete cycle of spraying, irrigating or raining process under the most unfavourable condition.

Addition:

Add the following subclauses:

11.4.101 Salt mist, thawing, condensate and spray

Where a HAZARD could result by direct exposure to the spray, the saturated compressed-air for salt solution atomizing of salt spray corrosion TEST CHAMBER shall be designed to be interlocked by mechanism of the cover, so that it stops automatically or it will not start with the cover opened.

It is permissible for the interlock detailed above to be overridden where necessary for operation or maintenance and when spray is desired with the cover opened, only where activation of the spray is controlled by a device that needs to be continuously held in the active state by the OPERATOR and the following warning symbol and statement is placed on the equipment:

HAZARDOUS chemicals, use protective respirator, face mask, coverall or glove!

Conformity is checked by inspection and evaluation of the interlock to Clause 15 if relied upon to mitigate the RISK.

The refrigerating subassembly and piping, where necessary for safety, shall be properly insulated and protected against occurrence of condensate or accumulation of frost for NORMAL USE. Salt mist, thawing, condensing and spraying water shall be collected and discharged, ensuring that no leakage, spillage or overflow occurs.

Conformity is checked by inspection. In case of doubt, the CLEARANCES and solid insulation shall pass the voltage tests of 6.8 (without humidity preconditioning) applicable to the type of insulation (see 6.7) and ACCESSIBLE parts shall not exceed the limits of 6.3.1.

11.4.102 HAZARDS from liquids in relation to SPECIMEN and APPLICATION SYSTEM

Fixing devices, tube racks or insulated vessels, and flexible tubing, clamps, if necessary for safety, shall be provided with the equipment to fix the SPECIMEN or for connection to APPLICATION SYSTEM to protect them from getting in contact with the HEAT TRANSFER MEDIUM.

Where a HAZARD could be caused by excessive torque or pressure applied to high-viscosity liquid HEAT TRANSFER MEDIUM or pressure sensitive APPLICATION SYSTEM, for example through rupture of jacketed glass reactor, CIRCULATOR with discharge pressure exceeding 0.08MPa, shall be incorporated with pressure indicating and adjusting devices. Safety device may be incorporated to interrupt the CIRCULATING PUMP and initiate an alarm signal if the torque or pressure rises above a preset value.

According to applications, a HAZARD could arise either by re-starting or by not re-starting after interruption of liquid circulating. Equipment shall be incorporated with means and, instructions shall specify whether equipment will re-start or not re-start, both in the case of MAINS or mechanical interruption and in the case of a SINGLE FAULT CONDITION.

Conformity is checked by inspection and in case of doubt by measurement of pressure.

11.4.103 HAZARDS from liquids in relation to SHAKER

Safety devices or means shall be provided with the SHAKER to protect against HAZARDS from splash and/or spillage of the liquids, accumulation of released volatile or hazardous

substance or, condensation of the volatile. The safety device shall be independent of the controllers for MECHANICAL MOVEMENT and/or temperature, humidity etc.

Conformity is checked by inspection.

11.4.104 Construction and warning markings related to manual filling or draining

Equipment incorporating a BATH TANK or other liquid container intended for manual filling or incorporating a reservoir for collecting condensate that requires manual draining, if the liquid level is not visible in construction or location, shall be equipped with a clearly visible liquid level indicator. Alternatively, if the liquid level indicator cannot be made available, a warning marking shall be applied and clearly visible in close proximity to the LIQUID CONNECTION for filling or draining. Additional explanations, including instructions for operation and maintenance requirements for the warning marking shall be included in the documentation.

Conformity is checked by inspection.

11.4.105 Movable immersion CIRCULATOR

Movable immersion CIRCULATOR when removed from the BATH TANK and placed horizontally or up-side down or during movement for NORMAL USE, if HAZARDS could arise because of the liquid penetrating or spillage, shall be marked with symbol 12 or symbol 14 of Table 1 for warning of electric or liquid HAZARD.

Conformity is checked by inspection.

11.4.106 Removable SPECIMEN holder for MECHANICAL MOVEMENT

If a HAZARD, such as spillage or overflow of the liquid could result during the removal or re-insertion, removable SPECIMEN holder for MECHANICAL MOVEMENT shall be marked with an appropriate warning symbol and text in close proximity to handles of the holder, and an explanation shall be included in the documentation.

Conformity is checked by inspection or by operation in accordance with instructions.

11.7.1 Maximum pressure

Addition:

Add the following after the conformity statement:

The maximum pressure to which a part of the REFRIGERATING SYSTEM can be subjected to under NORMAL CONDITION or SINGLE FAULT CONDITION shall not exceed the RATED MAXIMUM ALLOWABLE PRESSURE for the part. The RATED MAXIMUM ALLOWABLE 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 11.7.2.

The MAXIMUM ALLOWABLE PRESSURE (PS) of REFRIGERATING SYSTEMS shall be determined by test or by applying the saturated REFRIGERANT pressures at the minimum specified temperatures given in Table 103. When saturated REFRIGERANT pressures are used to define PS, the manufacturer is exempted from recording the pressures during tests for NORMAL USE and under SINGLE FAULT CONDITIONS. If the start-to discharge pressure of a PRESSURE RELIEF DEVICE or the set pressure of a rupture member used in the REFRIGERATING SYSTEM is less than the SATURATED-VAPOUR PRESSURE from Table 103, it can be used to limit PS for that system. 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 test as defined in 10.4;

b) the maximum pressure developed during the test in SINGLE FAULT CONDITION for cooling as specified in4.4.2.10;

c) the maximum pressure developed during the test in SINGLE FAULT CONDITION for extreme operating ambient abnormal in accordance with 4.4.2.106, if applicable;

d) the maximum pressure developed during the temperature test for transportation and storage as defined in 11.7.102;

NOTE 101 For single REFRIGERATING SYSTEM the pressure can be separated into two sections, the HIGH-PRESSURE SIDE and LOW-PRESSURE SIDE of each MOTOR-COMPRESSOR, the PS value can be different for each HIGH-PRESSURE SIDE and LOW-PRESSURE SIDE.

NOTE 102 Equipment meeting the requirements of 11.7 may not 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 103 – 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	Maximum leaving water temperature + 8°C	
HIGH-PRESSURE SIDE with evaporative CONDENSER in a CASCADE SYSTEM	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 those during off cycle of MOTOR-COMPRESSOR. For the LOW-PRESSURE SIDE and/or intermediate pressure side, it is sufficient to base the calculation of pressure on the expected temperature during off cycle of MOTOR-COMPRESSOR. These temperatures are minimum temperatures and thus determine that the system will not be designed for MAXIMUM ALLOWABLE PRESSURE lower than the REFRIGERANTSATURATED-VAPOURPRESSURE corresponding to these minimum temperatures. NOTE 2 The use of specified temperatures does not always result in REFRIGERANT SATURATED-VAPOUR PRESSURE within the system, e.g. a limited-charge REFRIGERATING SYSTEM or a system working at or above critical temperature, CO_2 in particular. NOTE 3 For zeotropic blends the MAXIMUM ALLOWABLE PRESSURE (PS) is the pressure at the bubble point.		

Conformity is checked by inspection of the RATINGS of the parts and, if necessary, by measuring pressures.

11.7.2 Leakage and rupture at high pressure

Addition:

Add the following subclauses:

11.7.2.101 Leakage and rupture of REFRIGERATING SYSTEMS

11.7.2.101.1 General

REFRIGERANT containing parts of a REFRIGERATING SYSTEM shall not cause a HAZARD through rupture or leakage. The specific requirements for REFRIGERATING SYSTEMS using FLAMMABLE REFRIGERANT or FLAMMABLE REFRIGERANT blends are addressed in 11.7.101.

For components subject to the pressure at HIGH-PRESSURE SIDE or LOW-PRESSURE SIDE of the REFRIGERATING SYSTEM, the structural strength of the fluid containing parts shall comply with 3 times the PS as defined in 11.7.1 for the HIGH-PRESSURE SIDE or LOW-PRESSURE SIDE.

Conformity is checked by inspection of the RATINGS of the components exposed to this pressure and, if a HAZARD could arise, by the pressure test in 11.7.2.101.2 and 11.7.2.101.3. Components that are certified to the component requirements in 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 design RATING of the component is different based on safety margin required in the national regulations. For example, in the USA the design RATING for a component complying with 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 5 × the PS measured during normal pressure tests and 3 x the PS measured during abnormal pressure tests, where PS is derived from tests in 10.4 for the HIGH-PRESSURE SIDE or LOW-PRESSURE SIDE and, test in 4.4.2.10 for the HIGH-PRESSURE SIDE only. Note the fact of these certification differences during selection of certified components from North America based on testing conducted in this standard.

11.7.2.101.2 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 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 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 comply with the requirements of this clause if it can withstand the pressure test without rupture. If the EUT does not comply, then an alternate method to demonstrate compliance is to subject the EUT to test in 11.7.2.101.3.

11.7.2.101.3 Fatigue test

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

- *For components at the LOW-PRESSURE SIDE, the maximum PS for the LOW-PRESSURE SIDE shall be applied for the first cycle. For components at the HIGH-PRESSURE SIDE, the maximum PS for the HIGH-PRESSURE SIDE shall be applied for the first cycle.*
- *The pressure for the test cycles shall be as follows:*

– *Upper pressure value shall not be less than 0,7× the PS and, the lower pressure value shall not be greater than 0,7× the PS. The upper pressure shall be 0,9× the PS, for water-cooled* CONDENSERS.

– *For the final test cycle, the test pressure shall be increased to 1,4× the PS (2× of 0,7× PS). The pressure shall be 1,8× PS (2× of 0,9× PS), for water-cooled* CONDENSERS.

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

A strength pressure test at 2× 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.

11.7.3 Leakage from low pressure parts

Addition:

Add the following text after the second paragraph:

For REFRIGERATING SYSTEMS the requirements of 11.7.2 address the low pressure leakage evaluation.

Addition:

Add the following subclauses:

11.7.101 Additional requirements for REFRIGERATING SYSTEMS that use FLAMMABLE REFRIGERANT

11.7.101.1 General

This standard addresses the requirements for REFRIGERATING SYSTEMS which use 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 ISO 5149 or EN 378 are standards that addresses requirements for REFRIGERATING SYSTEMs that utilize greater than 150 g of FLAMMABLE REFRIGERANT and can be used to identify what the additional requirements may be.

11.7.101.2 Protected REFRIGERATING SYSTEM

Equipment with a protected REFRIGERATING SYSTEM are those:

– 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 SYSTEM will not function as in NORMAL USE. The protective ENCLOSURE shall also withstand the test of 11.7.2.101. 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.

Equipment with a protected REFRIGERATING SYSTEM and which use 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 equipment with a protected REFRIGERATING SYSTEM, no additional requirements apply to electrical components located inside OPERATOR access compartments.

An equipment with a protected REFRIGERATING SYSTEM which, when tested, is found not to comply with the requirements specified for a protected REFRIGERATING SYSTEM, may be considered as having an unprotected REFRIGERATING SYSTEM if it is tested in accordance with 11.7.101.5 and found to comply with the requirement for an unprotected REFRIGERATING SYSTEM.

Compliance is checked by inspection and by the tests of 11.7.101.3 and 11.7.101.4.

11.7.101.3 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 fusite are not considered critical points.

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

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

Care should be taken that the installation of the capillary tube does not unduly influence the results of the test and that foreign material does not enter the capillary tube during insulation or assembly for test. The capillary tube may need to be positioned before the equipment is insulated.

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

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

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

If a REFRIGERANT 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 a temperature of:

a) 32 °C ± 2 °C for leakage simulation on LOW-PRESSURE SIDE;

b) 70 °C ± 2 °C for leakage simulation on HIGH- PRESSURE SIDE.

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 USE 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 device that has been tested and found to comply with at least the requirements in Annex EE.*

The instrument 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 104, and shall not exceed 50 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 104 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 a FLAMMABLE REFRIGERANT in question.

11.7.101.4 Scratch test for protected REFRIGERATING SYSTEMS

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

The TOOL is applied using the following parameters:

- *force at right angles to the surface to be tested 35 N ± 3 N;*
- *force parallel to the surface to be tested not exceeding 250 N.*

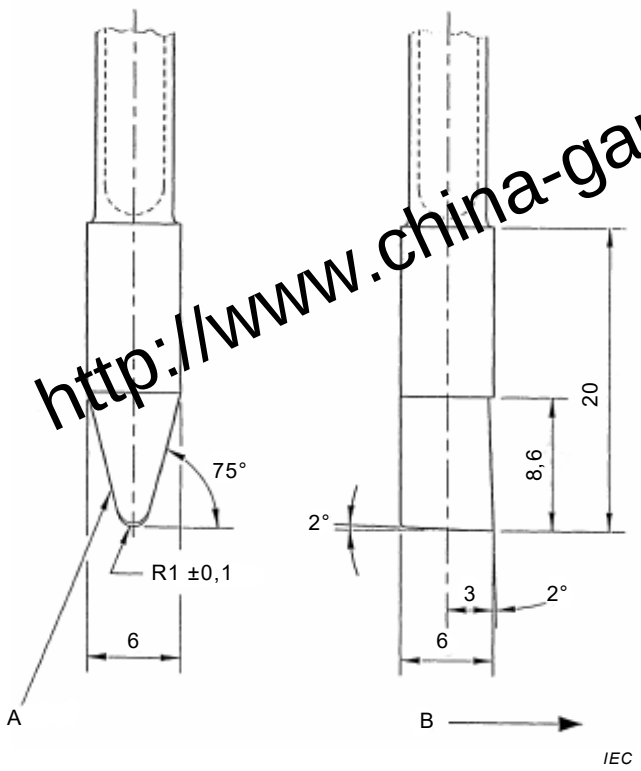
The TOOL is drawn across the surface to be tested at a rate of approximately 1 mm/s.

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

The scratches shall not cross each other.

The appropriate parts of the REFRIGERATING SYSTEM shall withstand the test of 11.7.2.101 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

11.7.101.5 Unprotected REFRIGERATING SYSTEMS

Equipment with an unprotected REFRIGERATING SYSTEM are those where at least one part of the REFRIGERATING SYSTEM is placed inside an OPERATOR ACCESSIBLE compartment or those which do not comply with 11.7.101.2.

For an 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 EE for group IIA gases or 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 GAS ATMOSPHERE outside the OPERATOR ACCESSIBLE compartments in areas where electrical components that produce arcs and sparks during NORMAL USE or abnormal operation, 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 to comply with Annex EE for group IIA gases or 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 device for potentially EXPLOSIVE GAS ATMOSPHERES covered by the IEC 60079 series 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 and by the following test.

The tests contained in Annex EE may be carried out using the stoichiometric concentration of the REFRIGERANT used. However, device which has been independently tested and found to comply with Annex EE using the gas specified for group IIA need not be tested.

Irrespective of the requirement given in 5.1 of IEC 60079-15:2010, surface temperature limits are specified in 11.7.101.7.

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

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

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

Through an appropriate orifice, 80 % of the nominal REFRIGERANT charge ±1,5 g, in the vapour state is injected into an OPERATOR ACCESSIBLE compartment in a time not exceeding 10 min. The orifice is then closed. The injection shall be as close as possible to the centre of the back wall of the compartment at a distance from the top of the compartment approximately equal to one-third of the height of the compartment. 30 min 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 104, and shall not exceed 50 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 104 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.

11.7.101.6 Stagnation of leaked FLAMMABLE REFRIGERANT

Equipment which use 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 USE and which are mounted in the areas under consideration, have been tested and found at least to comply with the requirements in Annex EE for group IIA gases or the REFRIGERANT used.

Irrespective of the requirements given in 5.1 of IEC 60079-15:2010. Surface temperature limits are specified in 11.7.101.7.

Other types of protection for electrical device for potentially EXPLOSIVE GAS ATMOSPHERES covered by the IEC 60079 series are also acceptable.

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

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

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

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

– *pipe-work joints in external parts of the refrigerating 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 components 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 104, and shall not exceed 50 % of the LOWER EXPLOSIVE LIMIT of the REFRIGERANT as specified in Table 104 for a period exceeding 5 min.

11.7.101.7 Surface temperature limits

Temperatures on surfaces that may be exposed to leakage of FLAMMABLE REFRIGERANT shall not exceed the AUTO IGNITION TEMPERATURE of the REFRIGERANT as specified in Table 104, reduced by 100 K.

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

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 104 – REFRIGERANT flammability parameters

REFRIGERANT number	REFRIGERANT name	REFRIGERANT formula	REFRIGERANT AUTO IGNITION TEMPERATURE [a,c] °C	REFRIGERANT LOWER EXPLOSIVE LIMIT [b,c,d,e] % V/V
R50	Methane	CH_4	645	4,9
R170	Ethane	CH_3CH_3	515	3,1
R290	Propane	$CH_3CH_2CH_3$	470	1,7
R600	n-Butane	$CH_3CH_2CH_2CH_3$	365	1,5
R600a	Isobutane	$CH(CH_3)_3$	494	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 60079-20 and IEC 60079-20-1.

[b] Values for other FLAMMABLE REFRIGERANTS can be obtained from IEC 60079-20 and ISO 5149.

[c] IEC 60079-20 is the reference standard. ISO 5149 may be used if the required data is not contained in IEC 60079-20.

[d] Concentration of REFRIGERANT in dry air.

[e] In some standards, the term “flammability limit” is used for “LOWER EXPLOSIVE LIMIT”.

11.7.102 Temperature test for storage and transport

11.7.102.1 General

Pressures developed from SOAKED TEMPERATURE CONDITIONS resulting from the temperatures the REFRIGERATING SYSTEM is exposed to during storage and/or transport shall not cause a HAZARD.

These pressures are used as one input for determining PS (11.7.1) and are derived by test below or from the REFRIGERANT SATURATED-VAPOUR PRESSURES at a storage and/or transport ambient of 55 °C for NORMAL CONDITION or 70 °C for storage and/or transport under tropical conditions.

For pressures in parts protected by a PRESSURE-RELIEF DEVICE, the test pressure shall not exceed 0,9× the setting of that device during storage and/or transport.

For a refrigerating equipment that uses FLAMMABLE REFRIGERANT, the storage and/or transport ambient 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 11.7.2.

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 test methods 11.7.102.2 or 11.7.102.3, or calculation of 11.7.102.4:

11.7.102.2 Test of charge to volume ratio

The steps for test of charge to volume ratio are as follows:

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 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.

11.7.102.3 Test by pressure under SOAKED TEMPERATURE CONDITION

The steps for test by pressure under SOAKED TEMPERATURE CONDITION are as follows:

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

b) use an evacuated cylinder and heat it up to 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 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.

11.7.102.4 Calculation by using the ideal gas law

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.

11.7.103 Internal fluid leaks

Where, in a SINGLE FAULT CONDITION, fluid can leak within the equipment, this shall not cause a HAZARD.

Fluid containing parts meeting the construction requirements of IEC 60079-15 can be assumed not to leak. Other fluid containing parts and seals shall be assumed to leak.

In particular, leaked FLAMMABLE LIQUID shall not come into contact with any ignition sources. Equipment containing no spark generating parts (see Annex EE) and where no surface temperature exceeds t_a–100 K (see 9.5 a) and 11.7.101.7), where t_a is the AUTO IGNITION TEMPERATURE of the liquid are considered to meet this requirement.

Conformity is checked by inspection, by performing the tests of 4.4.2.102 and 10.4.

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

This clause of Part 1 is applicable except as follows:

12.1 General

Replacement:

Replace the text of 12.1 with the following:

The equipment shall provide protection against the effects of internally generated optical, ultraviolet, ionizing and microwave radiation; laser sources, and sonic and ultrasonic pressure.

Conformity tests are carried out if the equipment is likely to cause such hazards.

12.2.1.3 Equipment not intended to emit radiation

Addition:

Add the following paragraph and note 101 after the conformity statement:

The equipment intended for application to radioactive substances, for example, chemicals in a jacketed reactor, plant, seed or insect treated with radioactive chemicals, shall be isolated to provide protection against transmission of ionizing radiation and, the operation of the equipment shall be strictly supervised to follow rules and regulations for radiation laboratories to reduce the amount of ionizing radiation to acceptable level (see also 5.4.4.101). The RESPONSIBLE BODY or the OPERATOR shall apply the symbol 17 of Table 1 with signature of the OPERATOR. At least, the symbol shall be in close proximity to where the SPECIMEN is kept and easily visible for NORMAL USE.

NOTE 101 Examples of such equipment include BATH, CIRCULATOR and climatic TEST CHAMBER for biological applications, etc.

Conformity is checked by inspection.

12.3 Ultraviolet (UV) radiation

Replacement:

Replace the title and text in 12.3 with the following:

12.3 Optical radiation

Equipment with lamp and lamp systems emitting ultraviolet, visible, or infrared radiation, including light emitting diodes, shall not expose the OPERATOR or environment to radiation that could cause a HAZARD.

Where the exposure to hazardous radiation is inevitable for functional reasons, the equipment shall incorporate protective measures to limit exposure to a safe level. Equipment incorporating a lamp and lamp systems that can produce hazardous effects shall be marked with symbol 104 for warning of optical radiation, symbol 13 for warning of a burn HAZARD, or symbol 14 for warning of other HAZARDS, as applicable.

Information on protective measures, restrictions on use and operating instructions that may be necessary shall be provided, including the applicable conditions of use of Table 106.

The radiation sources shall be assessed in accordance with IEC 62471 except for sources considered to be safe (Table 105), or conditionally safe (Table 106). Lamp and lamp systems assessed to be in RISK Groups 1, 2 or 3 of IEC 62471 shall be labeled in accordance with IEC TR 62471-2.

NOTE Additional guidelines or requirements may be specified by national or other authorities.

Conformity is checked by inspection, by review of the technical specifications of the lamp manufacturer, and if necessary by measurement of the optical radiation, followed by determination of the applicable risk groups according to IEC 62471.

Table 105 – Lamp or lamp systems considered photobiologically safe

Lamp or lamp system
Indicator LED's
Personal digital device screens
LCD screens
Computer displays
Photographic flash lamps
Interactive whiteboard presentation equipment
Task lighting with tungsten filament lamps, compact fluorescent tubes, or fluorescent tubes with diffusers

Table 106 – Lamp or lamp systems considered photobiologically safe under certain conditions

Lamp or lamp system	**Conditions of use**
Fluorescent lighting without diffusers over the lamps	Safe at normal illumination levels (~600 lux)
Metal halide/high-pressure mercury flood lights	Safe if the front cover glass is intact and if the lamp is not in line of sight
Desktop projectors	Safe if the beam is not looked into
Low-pressure UVA black-lights	Safe if not in line of sight and hands are not irradiated while holding the black-light
Any Class 1 Laser (to IEC 60825-1)	Safe if covers intact. May be unsafe if covers removed.
Any 'Exempt Group' equipment (to IEC 62471)	Safe if not in line of sight. May be unsafe if covers removed.

13 Protection against liberated gases and substances, explosion and implosion

This clause of Part 1 is applicable except as follows:

13.1 Poisonous and injurious gases and substances

Addition:

Add a new sentence at the end of the first paragraph:

For example, the high temperature decomposition products of oil HEAT TRANSFER MEDIUM.

13.2.1 Components

Replacement:

Replace the title and text in 13.2.1 with the following:

13.2.1 Components of the equipment and materials being treated

If components liable to explode are not provided with a PRESSURE-RELIEF DEVICE or, if the equipment is intended to treat materials in such a way that explosion or implosion may occur, protection for the OPERATOR shall be incorporated with the equipment (see 7.7) or otherwise personal protective measures shall be included in OPERATOR instructions. PRESSURE-RELIEF DEVICES shall be located so that a discharge will not cause HAZARD to the OPERATOR. The construction shall be such that PRESSURE-RELIEF DEVICE cannot be obstructed.

Addition:

Add the following subclauses:

13.2.101 Implosion of low air pressure equipment

Low air pressure TEST CHAMBER or vacuum oven, etc. shall be incorporated with protection for the OPERATOR and surroundings against the effects of implosion.

Conformity is checked by inspection of the equipment and of design information and, in case of doubt, by provoking an implosion.

13.2.102 Explosion and implosion of lamps

The lamps or lamp systems shall be incorporated and constructed to provide protection against explosion and implosion, whether for normal operation or for maintenance, under mechanical and thermal stresses resultant from shaking, vibrating, thermal shocking over the operating temperature range, or unexpected contact with cold liquid.

Lamps liable to explode or implode when vibrated, shaken, heated, cooled or thermal shocked over operating temperature range and, where HAZARD could arise when ruptured, shall be protected with explosion-proof transparent shield which is ACCESSIBLE only with the aid of a TOOL. If glass is used, it shall not get in contact with the surface of the lamps and, it shall be subjected to the tests of 8.2, and meet the pass criteria of 8.1 of this standard.

Conformity is checked by inspection.

Addition:

Add the following subclauses:

13.101 Biohazardous substances

Equipment that can be potentially infectious, whether from SPECIMEN itself or as result of treatment with biohazardous agents or formulations, shall be prominently marked with symbol 103 of Table 1. At minimum, the symbol shall be in close proximity to where the SPECIMEN or biohazardous substance is kept and easily visible during NORMAL USE.

Symbol 103 shall be placed near any biohazardous area accessible during OPERATOR maintenance and visible only during this maintenance.

Where applicable, symbol 103 shall be also attached to disposal bags or containers for biologically hazardous materials removed from the equipment, and to any LIQUID CONNECTIONS or exhaust openings where liberation of biohazardous substances may occur during NORMAL USE.

Equipment that can be hazardous due to the use of hazardous substances shall be marked with appropriate international symbol, or (if none is available) symbol 14 of Table 1.

Also see 5.4.3 c) for details of instructions relating to ventilation requirements.

NOTE Local, national or regional regulations concerning the collection or discharge of biohazardous material can apply.

Conformity is checked by inspection.

13.102 Warning requirements related to chemical HAZARD

Equipment intended for chemical applications, such as BATHS, CIRCULATORS, SHAKERS, climatic TEST CHAMBERS and salt spray corrosion TEST CHAMBERS, and which could present chemical HAZARDS to the OPERATOR and the environment, shall be marked with a symbol or text suitable to the chemical HAZARD. The symbol shall be in close proximity to where the SPECIMEN is kept and easily visible during NORMAL USE. Where applicable, the symbol or text shall be also attached to glassware such as flasks for shaking or immersion applications, APPLICATION SYSTEMS such as jacketed reactors containing hazardous chemicals, or LIQUID CONNECTIONS and exhaust openings where liberating of chemical contaminants may occur during NORMAL USE.

Also see 5.4.3 c) for details of instructions relating to ventilation requirements.

NOTE Examples of chemical HAZARDS presented by these types of equipment are salt mist, salt solutions, SPECIMENS treated with salt spray; pest insects, microorganisms or plants treated with pesticides, radioactive substance and chemical mixtures.

Symbol 102 of Table 1 is used for warnings pertaining to flammable materials. Symbols for other chemical HAZARDS may be selected from ISO 7010, as follows.

a) for explosive materials, W002
b) for radioactive materials, W003,
c) for toxic materials, W016,
d) for corrosive materials, W023,
e) for oxidizing substances, W028,
f) for other chemical HAZARDS, other appropriate symbols from ISO 7010.

If there is no appropriate symbol for the particular chemical HAZARD, symbol 14 of Table 1 shall be used and additional explanations of the chemical HAZARD shall be included in the documentation.

Conformity is checked by inspection.

14 Components and subassemblies

This clause of Part 1 is applicable except as follows:

14.3 Overtemperature protection devices

Replacement:

Replace the text in 14.3 by the following:

TEMPERATURE-LIMITING DEVICES and systems for overtemperature protection, designed to operate in SINGLE FAULT CONDITION shall meet all of the following requirements:

a) be constructed and tested to ensure reliable function; Device of the capillary type shall be so designed that the protection is kept complete in the event of leakage from the capillary tube;

b) be RATED to interrupt the maximum voltage and current of the circuit in which they are employed;

c) do not operate in NORMAL USE.

LIQUID LEVEL CUT OUTS used to protect against overtemperature shall meet the same requirements as TEMPERATURE-LIMITING DEVICES and systems.

Conformity is checked by studying the operating principle of the device or system or, by fracturing the capillary tube and, by performing adequate reliability tests with the equipment operated in SINGLE FAULT CONDITION. Ensure that the capillary tube is not obstructed when being fractured.

The number of operations is as follows:

1) non-resetting devices are caused to operate once;

2) non-self-resetting devices and systems, except thermal fuses, are reset after each operation and thus caused to operate 10 times;

3) self-resetting devices are caused to operate 200 times.

NOTE Forced cooling and resting periods can be introduced to prevent damage to the equipment.

During the test, resetting devices shall operate each time the SINGLE FAULT CONDITION is applied and, non-resetting devices shall operate once to provide expected protection. After the test, resetting devices shall show no sign of damage which could prevent their operation in a further SINGLE FAULT CONDITION.

Addition:

Add the following subclauses:

14.101 Components and subassemblies for REFRIGERATING SYSTEMS

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 the pressure RATING requirements of this standard (see 11.7.2).

Conformity is checked by inspection or as specified in 11.7.2 as applicable.

14.102 Flexible tubing and hose subjected to liquid pressure other than REFRIGERANT

Flexible tubing and hose subjected to the RATED PRESSURE of the equipment shall be of sufficient mechanical strength.

The construction and materials of the flexible tubing and hose, including fittings and thermal insulation for subassemblies if any, shall withstand mechanical, chemical and thermal stresses encountered for NORMAL USE.

Conformity is checked by the following tests and, in case of doubt, by tests repeated at RATED PRESSURE and temperature:

The high pressure flexible tubing and hose for liquid circulating, shall be subjected to a static pressure test of 4× the RATED PRESSURE at room temperature and under maximum operating temperature range of the intended application, whereby the test pressure shall be reached between 15 s and 30 s after starting at zero pressure.

NOTE The PRESSURE-RELIEF DEVICE and/or alternative sensing devices can be rendered inoperative in this test.

Flexible tubing and hose used for water supply, if any, shall be subjected to a static pressure test of 2 times the maximum inlet pressure for 5 min at room temperature.

During the test there shall be no leakage or rupture.

15 Protection by interlocks

This clause of Part 1 is applicable except as follows:

15.1 General

Replacement:

Replace the text of 15.1 with the following:

Interlocks used to protect OPERATORS from HAZARDS shall prevent an OPERATOR from being exposed to the HAZARD before the HAZARD is removed and, shall meet the requirements of 15.2, 15.3 and 15.101 to 15.104 as applicable.

Conformity is checked by inspection and by performing all relevant tests of this standard.

Addition:

Add the following subclauses:

15.101 Mechanism of door and/or lock for WALK-IN EQUIPMENT

It shall be possible to escape the WALK-IN EQUIPMENT at all times.

The door for WALK-IN EQUIPMENT shall be so designed and constructed that the opening is possible both from the outside and within the equipment, with the priority assigned to the unlocking and opening from within the equipment.

NOTE 1 Separate door or exit independent of the main entrance which is locked and opened from outside the equipment, when ACCESSIBLE only from within the equipment and when open to outside, is considered to meet this requirement.

NOTE 2 Additional requirements for WALK-IN EQUIPMENT can apply in accordance with Annex BB.

When the door is closed and/or locked from within the equipment, there shall be an illuminated indication in proximity to the controller outside the equipment, which reads: equipment in operation, OPERATOR inside the room! The indication shall be interlocked to one or more of the following settings ACCESSIBLE from outside:

1) the maximum operating temperature not exceeding: +40 °C
2) the minimum operating temperature not exceeding: –30 °C
3) start the VENTILATOR or any other similar devices;

4) disable the initiation of vacuum pump or any evacuating system;
5) limit the number of lamps or light emitting intensity in accordance with 12.3 and/or, warn the OPERATOR of the HAZARD and necessity for an eyewear, if hazardous optical radiation exists.

Conformity is checked by inspection of the documentation and in accordance with 15.2 and 15.3.

15.102 Interlock between CIRCULATING PUMP, agitator and, heating, cooling, MECHANICAL MOVEMENT and/or operation of APPLICATION SYSTEM

The RESISTANCE-HEATING DEVICE and/or MOTOR-COMPRESSOR of BATH and CIRCULATOR shall be interlocked with its CIRCULATING PUMP, agitator and where applicable, the APPLICATION SYSTEM, if HAZARDS could arise due to one or more of the followings:

– the operating temperature of the equipment deviates from its setting to some extent resulting in over heating or deep cooling of the SPECIMEN or APPLICATION SYSTEM;
– localized overheating or deep cooling of the liquid HEAT TRANSFER MEDIUM happens resultant from termination of the CIRCULATING PUMP or agitator;
– obstruction or leakage of the external liquid circulating occurs between the equipment and the APPLICATION SYSTEM.

Depending on the related HAZARD, RESISTANCE-HEATING DEVICE or the MOTOR-COMPRESSOR, or both of them, shall be de-energized if the CIRCULATING PUMP and/or agitator is interrupted and, if the temperature deviates from its setting to some extent and, the operation of the APPLICATION SYSTEM shall be controlled to prevent the developing of the HAZARD.

NOTE Whether the RESISTANCE-HEATING DEVICE or the MOTOR-COMPRESSOR alone or, both of them shall be de-energized is dependent on the related HAZARD. It is advantageous to provide the equipment with means that either or both of them could be interlocked and available to the OPERATOR with additional instructions for the configuration of the function.

Conformity is checked by inspection and by operating the interlocks as specified in the documentation and, in accordance with15.2 and 15.3.

15.103 Interlock between CIRCULATING FAN, door or lid and, heating, cooling and/or radiation, humidifying and MECHANICAL MOVEMENT

The RESISTANCE-HEATING DEVICE and/or MOTOR-COMPRESSOR, and where applicable, radiation, humidifying, MECHANICAL MOVEMENT, shall be interlocked with its CIRCULATING FAN, if HAZARDS could arise due to one or more of the followings:

– the operating temperature of the equipment deviates from its setting to some extent resulting in over heating or deep cooling of the SPECIMEN;
– where RESISTANCE-HEATING DEVICE and/or EVAPORATOR are located, localized overheating and/or deep cooling happens resultant from termination of the CIRCULATING FAN;
– with the door or lid open, continuous heating and/or cooling, humidifying may happen if the settings are away from ambient temperature and humidity;
– with the door or lid open, the OPERATOR or surroundings may be exposed to excessive optical radiation or any other hazardous radiation;
– with the door or lid open, the OPERATOR may be exposed to mechanical HAZARD if MECHANICAL MOVEMENT continues.

Depending on the related HAZARD, RESISTANCE-HEATING DEVICE or the MOTOR-COMPRESSOR, or both of them, shall be de-energized if the CIRCULATING FAN is interrupted and if the temperature deviates from its setting to some extent. The CIRCULATING FAN shall be switched off while or sometime after the door or lid is opened, while the HUMIDIFIER, lamp or lamp systems (see 12.3) and, MECHANICAL MOVEMENT shall be terminated or reduced to a safe level with the door or lid opened.

NOTE Whether the RESISTANCE-HEATING DEVICE or the MOTOR-COMPRESSOR alone or, both of them shall be de-energized is dependent on the related HAZARD. It is advantageous to provide the equipment with means that either or both of them could be interlocked and available to the OPERATOR with additional instructions for the configuration of the function.

Conformity is checked by inspection and by operating the interlocks as specified in the documentation and, in accordance with15.2 and 15.3.

15.104 Interlock between salt spray and cover of salt spray corrosion TEST CHAMBER

The mechanism of the cover for salt spray corrosion TEST CHAMBER shall meet requirements specified in 11.4.101 of this part of the standard. The activation of the saturated compressed-air for salt solution atomizing shall be interlocked by mechanism of the cover.

Conformity is checked by inspection and by operating the interlocks as specified in the documentation and, in accordance with15.2 and 15.3.

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 standard 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 are set in a way not intended, or not described in the instructions.

Reckless use, unqualified use or use outside the specifications specified by the manufacturer is not considered as part of this standard. Similar, 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 standard.

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

Addition:

Add the following subclause:

16.101 Slip HAZARD

For WALK-IN EQUIPMENT (see Annex BB), where the ground or floor may be slippery when wet or icy, the equipment shall be designed and constructed in such a way as to minimize the RISK of slipping. Where a slip HAZARD remains, appropriate means including personal protective measures which enables the OPERATOR to maintain their stability and safety shall be fitted (for example handholds that are fixed relative to the OPERATOR) and the equipment shall be permanently marked with symbol 105 of Table 1, warning of slippery surface and against

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.

Annex

The annexes of Part 1 are applicable except as follows:

Annex K
(normative)

Insulation requirements not covered by 6.7

K.1.3 Solid insulation for MAINS CIRCUITS

K.1.3.1 General

Addition:

Add the following paragraph after note 1:

If the performance of the equipment requires the use of hygroscopic insulated RESISTANCE-HEATING DEVICE it is permissible for equipment to require a period of operation to dry out the insulation before meeting the requirements of 6.3.1 and 6.8.3, provided that the OPERATOR is made aware of this (see 5.4.3.101).

Addition:

Add the following paragraph after the conformity statement:

If a DRYING-OUT is specified conformity is checked by performing the DRYING-OUT specified in the OPERATOR manual (see 5.4.3.101) before conducting the tests of a) and b) above.

Annex L
(informative)

Index of defined terms

Addition:

Add the following defined terms:

Addition:

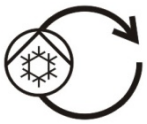
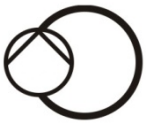
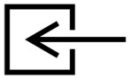
Add the following new annexes:

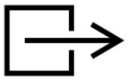
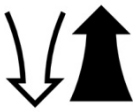
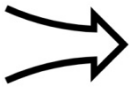
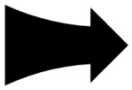
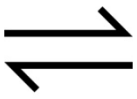
Annex AA
(informative)

Useful symbols

The symbols in the Table AA.1 are useful for identification and documentation related to the safe operation of the equipment. These symbols may be used as specified in 5.1.5.101, 5.1.5.103, 7.3.101 and 10.1.

Table AA.1 – Useful symbols

Number	Symbol	Reference	Description
107		ISO 7000 – 0880 (1989)	Use with refrigerating BATH and CIRCULATOR with a liquid CIRCULATING PUMP and LIQUID CONNECTIONS for external circulating
108		ISO 7000 – 0880 (1989)[a]	LIQUID CONNECTION for CIRCULATING PUMP outlet of the liquid HEAT TRANSFER MEDIUM (coolant only) in refrigerating CIRCULATORS. The minimum temperature of the liquid may be accompanied if they are lower than –30 °C. The maximum exit pressure may also be marked if it is either higher than 0,03<MPa, or 0,02 MPa with flow rate of more than 10 l/min
109		ISO 7000 – 0880 (1989) [a]	LIQUID CONNECTION for return of the liquid HEAT TRANSFER MEDIUM (coolant only) in refrigerating CIRCULATORS For enclosed CIRCULATOR or CIRCULATOR equipped with suction CIRCULATING PUMP and, when the suction pressure is lower than 0,02 MPa, the minimum suction pressure may be marked in association with the symbol
110		ISO 7000 – 0880(1989) [b]	Use with refrigerating and heating BATH and CIRCULATOR with a liquid CIRCULATING PUMP and LIQUID CONNECTIONS for external circulating
111		ISO 7000 – 0880(1989)[b]	LIQUID CONNECTION for CIRCULATING PUMP outlet of the liquid HEAT TRANSFER MEDIUM (both heating and cooling) in refrigerating and heating CIRCULATORS. The maximum and/or minimum temperature(s) of the liquid may be accompanied if they are higher than +60 °C and/or lower than –30 °C. The maximum exit pressure may also be marked if it is either higher than 0,03 MPa, or 0,02 MPa with flow rate of more than 10 l/min
112		ISO 7000 – 0880(1989)[b]	LIQUID CONNECTION for return of the liquid HEAT TRANSFER MEDIUM (both heating and cooling) in refrigerating and heating CIRCULATORS For enclosed CIRCULATOR or CIRCULATOR equipped with suction pump and, when the suction pressure is lower than 0.02 MPa, the minimum suction pressure may be marked in association with the symbol
113		ISO 7000 – 0794 (2004-01)	Input or entrance, for example, LIQUID CONNECTIONS for water-cooled CONDENSER, water supply, salt solution and, connections for steam source, compressed-air, etc. The MAXIMUM ALLOWABLE PRESSURE (PS) in pascal, the maximum and/or minimum temperatures in centigrade, may be accompanied where applicable

Number	Symbol	Reference	Description
114		ISO 7000 – 0795 (2004-01)	Output or exit, for example, LIQUID CONNECTION for water-cooled CONDENSER and connection for vacuum source etc
115		IEC 60417– 5595 (2002-10)	Condensate collector
116		ISO 7000 – 0028 (2015-06)	Filling device
117		ISO 7000 – 0029 (2015-06)	Draining device
118		ISO 7000 – 0030 (2015-06)	Overflow device
119		ISO 7000 – 1604 (2015-06) ISO 7000 – 1605 (2015-06) [c]	VENTILATOR
120		ISO 7000 – 1604 (2015-06)	Intake air
121		ISO 7000 – 1605 (2015-06)	Exhaust gas
122			Orbital movement, maximum MOVEMENT FREQUENCY and MOVEMENT AMPLITUDE may be accompanied where applicable
123			Reciprocating movement, maximum MOVEMENT FREQUENCY and MOVEMENT AMPLITUDE may be accompanied where applicable
124			Hand and wrist movement, maximum MOVEMENT FREQUENCY and MOVEMENT AMPLITUDE may be accompanied where applicable
125			Vortex movement, maximum MOVEMENT FREQUENCY may be accompanied where applicable
126			Rocking movement, maximum MOVEMENT FREQUENCY and MOVEMENT AMPLITUDE may be accompanied where applicable

Number	Symbol	Reference	Description
127			Rotating movement, maximum MOVEMENT FREQUENCY and MOVEMENT AMPLITUDE may be accompanied where applicable

[a] These symbols are created based on ISO 7000 – 0880 (1989) for circulating equipment with coolant pump. The big circle in connection with the coolant pump (ISO 7000 – 0355 (2015-06)) is cut into two parts, with one representing the outlet and the other return of the liquid. An arrow is added to make it clear for identification of liquid outlet or return.

[b] These symbols are created based on those of 107, 108 and 109, by removing the symbol for cooling (ISO 7000 – 0027 (2015-06)).

[c] The symbol is created with combination of symbol for intake air (ISO 7000 – 1604 (2015-06)) and that for exhaust gas (ISO 7000 – 1605 (2015-06)). In avoidance of being confused, the combination is turned at an angle of 90°.

Annex BB
(informative)

Protection for people who are inside WALK-IN EQUIPMENT

BB.1 General

In order to minimize the HAZARD for people who get locked in WALK-IN EQUIPMENT with extreme temperatures, sometimes along with controlled atmospheres, exhausted gas mixtures, fume or mist, suspension of particle or aerosol, excessive optical radiation, measures as described in the following clauses should be taken. Care should be taken to ensure that no personnel are locked in WALK-IN EQUIPMENT at the end of the working day. The Annex is limited to WALK-IN EQUIPMENT operating at temperatures below zero or over 35 °C.

BB.2 Emergency switch or signal

According to the operating conditions, the following devices should be provided with the WALK-IN EQUIPMENT:

1) alarm switch operated by illuminated push buttons near the floor or by chains hanging near the floor, installed in a suitable place in the equipment, the operation of which initiates an audible signal and a visual signal, in a place where the permanent presence of a person is guaranteed. It should not be possible to stop this signal except by means of a specific operation;
2) signal devices connected to an electric circuit with a voltage of at least 12 V. Batteries for this purpose should have an operating time of at least 10 h and be connected to a mains supplied automatic charging device. If a transformer is used, it should be supplied with current from a different circuit to the one used for other equipment inside the WALK-IN EQUIPMENT. Furthermore, the device should be of such design that it does not cease to function due to corrosion, frost or the formation of ice on contact surfaces;
3) light switch inside the WALK-IN EQUIPMENT in parallel with light switches located outside this equipment so that the lighting turned on by means of the inside switch cannot be turned off by means of the outside switch;
4) plug switch or other systems giving the same result for the CIRCULATING FANS located inside the WALK-IN EQUIPMENT in series with the switches located on the outside so that the fans turned off by means of the inside switch cannot be turned on by means of the outside switch;
5) light switches should have permanently illuminated buttons;
6) in the event of failure of the lighting, the routes towards the door which is intended for open from the inside (and/or alarm switch) should be indicated by independent lighting or by other approved means;
7) permanent emergency lighting system.

BB.3 WALK-IN EQUIPMENT with a controlled atmosphere

In WALK-IN EQUIPMENT with a controlled atmosphere (equipment with an atmosphere in which the concentration of oxygen, carbon dioxide and nitrogen are different from those in normal air) the following additional requirements apply:

1) warning that self-contained breathing apparatus should be worn when entering these WALK-IN EQUIPMENT;
2) warning that if a WALK-IN EQUIPMENT with a controlled atmosphere is entered, another person should remain outside the room and in visual contact with those inside through an access door (hatch). The person outside should also have a self-contained breathing

apparatus at his disposal in case he should have to enter the equipment in order to rescue the person inside in an emergency;

3) doors, hatches and other appliances giving access to the WALK-IN EQUIPMENT should be provided with a written warning notice against low oxygen level in the equipment.

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

For USA and Canada, 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 × V (bar × L)	Category/Article
if	**and**	**and**	**and**	**and**	**then**
Group 1	Gas	≤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 ≤ 1 000	≤1	–	III
		≤ 1 000	>1	> 200 and ≤ 1 000	III
				> 1 000	IV
		> 1 000	–	–	IV
	Liquid [d]	≤ 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
Group 2	Gas	≤ 0,5	–	–	Not submitted to PED [b]
		> 0,5 and ≤ 1 000	≤1	–	Art. 3.3 [c]
			>1	≤ 50	Art. 3.3 [c]
				> 50 and ≤ 200	I
				> 200 and ≤ 1 000	II
		> 1 000 and ≤ 3 000	≤ 1	–	III
			>1	> 1 000 and ≤ 3 000	III
		> 0,5 and ≤ 4		> 1 000	III
		> 4		> 3 000	IV
		> 3 000	–	–	IV
	Liquid [d]	≤ 0,5	–	–	Not submitted to PED [b]
		> 0,5 and ≤ 10	–	–	Art. 3.3 [c]
		> 10 and ≤1 000	≤ 10	–	Art. 3.3 [c]
		> 10 and ≤ 1 000	> 10	≤ 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

[c] Art. 3.3 = reference to article 3.3 of the Pressure Equipment Directive

[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 piping 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

[c] Art. 3.3 = reference to article 3.3 of the Pressure Equipment Directive

[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 – Components and piping requirements

Components	Related standards and requirements
Heat exchangers: – pipe coil without air(tube in tube) – multi-tubular(shell and tubes)	EN 14276-1 or EN 13445 if applicable combined with 11.7. 2 of this standard
Plate heat exchangers	EN 14276-1 or EN 13445 if applicable combined with 11.7. 2 of this standard
Headers and coils with air as secondary fluid	EN 14276-2 combined with a production leak tightness test based on guidance from EN 1779:1999
Receiver/accumulator/economizer	EN 14276-1 or EN 13445 if applicable combined with 11.7. 2 of this standard
Oil separator	EN 14276-1 or EN 13445 if applicable combined with 11.7. 2 of this standard
Drier	EN 14276-1 or EN 13445 if applicable combined with 11.7. 2 of this standard
Filter	EN 14276-1 or EN 13445 if applicable combined with 11.7. 2 of this standard
Muffler	EN 14276-1 or EN 13445 if applicable combined with 11.7. 2 of this standard
Hermetic positive displacement compressor	EN 60335-2-34 or prEN 12693
Semi hermetic positive displacement compressor	EN 60335-2-34 or prEN 12693
Open positive displacement compressor	EN 12693
Non positive displacement compressor	EN 14276-1 or EN 13445 if applicable combined with EN 60204-1
Pump General requirements Additional requirements for pumps in REFRIGERATING SYSTEMs and heat pumps with R717	EN 809 combined with EN 60204-1, and combined with a production leak tightness test based on guidance from EN 1779:1999 and the marking requirements from 5.1.101 of this standard
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 1779:1999 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 1779:1999
Safety switching devices for limiting the pressure	EN 12263 combined with a production leak tightness test based on guidance from EN 1779:1999
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 1779:1999
Fusible plug	EN 13136 combined with a production leak tightness test based on guidance from EN 1779:1999 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 1779:1999

Components	Related standards and requirements
Gauges	EN 837-1, EN 837-2 and EN 837-3 combined with a production leak tightness test based on guidance from EN 1779:1999
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 REFRIGERANTS 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 SYSTEM for North America

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

a)	quick freeze switches	300
b)	manual and semi-automatic defrost switches	300
c)	door switches	50 000
d)	on/off switches	300
e)	thermostats which control MOTOR-COMPRESSORS	100 000
f)	temperature limiters which control defrosting heaters	100 000
g)	MOTOR-COMPRESSOR starting relays	100 000
h)	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.

i)	non-self resetting thermal motor-protector for MOTOR-COMPRESSORS	50
j)	other automatic thermal motor-protectors except for fan motors	2 000
k)	other manual reset thermal motor-protectors	30
l)	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)	0,0245	(0,623)	0,0265	(0,673)	0,025	(0,635)
5/16	(7,94)	0,0245	(0,623)	0,0265	(0,673)	0,025	(0,635)
3/8	(9,53)	0,0245	(0,623)	0,0265	(0,673)	0,025	(0,635)
1/2	(12,70)	0,0245	(0,623)	0,0285	(0,724)	0,025	(0,635)
5/8	(15,88)	0,0315	(0,799)	0,0315	(0,799)	0,032	(0,813)
3/4	(19,05)	0,0315	(0,799)	0,0385	(0,978)	0,032	(0,813)
7/8	(22,23)	0,0410	(1,041)	0,0410	(1,041)	0,046	(1,168)
1	(25,40)	0,0460	(1,168)	0,0460	(1,168)	–	–
1-1/8	(28,58)	0,0460	(1,168)	0,0460	(1,168)	0,046	(1,168)
1-1/4	(31,75)	0,0505	(1,283)	0,0505	(1,283)	0,046	(1,168)
1-3/8	(34,93)	0,0505	(1,283)	0,0505	(1,283)	–	–
1-1/2	(38,10)	0,0555	(1,410)	0,0555	(1,410)	0,062	(1,575)
1-5/8	(41,28)	0,0555	(1,410)	0,0555	(1,410)	–	–
2-1/8	(53,98)	0,0640	(1,626)	0,0640	(1,626)	–	–
2-5/8	(66,68)	0,0740	(1,880)	0,0740	(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)

NOTE For the US additional marking and informational requirements exist for refrigerating equipment which utilize FLAMMABLE REFRIGERANTS. The source document reference is included in brackets at the end of each clause.

DD.1.1 Marking

When a FLAMMABLE REFRIGERANT is used, the markings as outlined in DD.1.2 to DD.1.5, or the equivalent shall,

a) be in letters no less than 6.4mm (1/4 inch) high and;

b) be permanently marked on the refrigerating equipment in the indicated locations (SB6.1.1 revised, November 17, 2014).

DD.1.2 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 (SB6.1.2 revised, June 28, 2013).

DD.1.3 Service markings

For a 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 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”.

(SB6.1.3 revised, November 30, 2012)

DD.1.4 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.

DD.1.5 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.

DD.1.6 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 (SB6.1.6 revised, November 17, 2014).

DD.1.7 Symbol for warning of flammable materials

The marking in item DD.1.3 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 15mm (9/16 in). (SB6.1.7 revised, June 28, 2013)

DD.1.8 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 ASHRAE 15”.

DD.1.9 Refrigerating equipment intended for laboratory use

Refrigerating equipment intended for laboratory use that contains an A3 REFRIGERANT shall be marked:

“This unit is intended for use in commercial, industrial, or institutional occupancies as defined in the Safety Standard for Refrigeration Systems, ASHRAE 15”.

(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.

DD.2.2 Packaging markings

The shipping carton of a 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 (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 manufacturer 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 pipework shall be protected from physical damage and, (2) compliance with the installation requirements of ASHRAE 15 shall be observed.

b) The minimum necessary room volume per REFRIGERATING SYSTEM charge allowed. See Table SB6.1. 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.

Annex EE
(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. The clauses and subclauses are applicable except as modified hereafter.

11 Supplementary requirements for non-sparking luminaires

This clause of IEC 60079-15 is applicable, except 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.

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

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

19.1 Non-metallic materials

Replacement:

Seals are tested using 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 producing arcs, sparks or hot surfaces

This clause of IEC 60079-15 is applicable..

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Addition:

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