UL 60335-2-40

STANDARD FOR SAFETY

Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers

UL Standard for Safety for Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers, UL 60335-2-40

Fourth Edition, Dated December 15, 2022

Summary of Topics

This new fourth edition ANSI/UL 60335-2-40 dated December 15, 2022 is an adoption of IEC 60335-2-40, Edition 6.0 issued by the IEC January 2017. Please note that the National Difference document incorporates all of the national differences for UL 60335-2-40.

The new requirements are substantially in accordance with Proposal(s) on this subject dated December 31, 2021 and June 17, 2022.

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CSA Group
CSA C22.2 No. 60335-2-40:22
Fourth Edition

Underwriters Laboratories Inc.
UL 60335-2-40
Fourth Edition

Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers

December 15, 2022

This national standard is based on publication IEC 60335-2-40, edition 6.0 (2018).

Approved American National Standard

ANSI/UL 60335-2-40-2022

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as “CSA Group”) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

ISBN 978-1-4883-4375-9 © 2022 Canadian Standards Association

This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. The technical content of IEC and ISO publications is kept under constant review by IEC and ISO. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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

The most recent designation of ANSI/UL 60335-2-40 as an American National Standard (ANSI) occurred on December 15, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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

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PREFACE

This is the harmonized CSA Group and UL standard for Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers. It is the fourth edition of CSA C22.2 No. 60335-2-40, and the fourth edition of UL 60335-2-40. This edition of CSA C22.2 No. 60335-2-40 supersedes the previous edition published November 1, 2019. This edition of UL 60335-2-40 supersedes the previous edition(s) published on November 1, 2019.

This harmonized standard is based on IEC Publication 60335-2-40: edition 6.0, Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers issued January 2018. IEC publication 60035-2-40 is copyrighted by the IEC.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Subcommittee on Air-Conditioning and Refrigeration (THSC 61D WG10) of the Council on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA) are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Subcommittee on Appliances for Air-Conditioning for Household and Similar Purposes, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This Standard was also reviewed and approved by UL's Standards Technical Panel for Heating and Cooling Equipment – Heat Pumps, Air-Conditioners and Dehumidifiers, STP 60335-2-40. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

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

CSA C22.2 No. 60335-2-40 is to be used in conjunction with the second edition of CAN/CSA-C22.2 No. 60335-1. The requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers are contained in this Part 2 Standard and CAN/CSA-C22.2 No. 60335-1. Requirements of this Part 2 Standard, where stated, amend the requirements of CAN/CSA-C22.2 No. 60335-1. Where a particular subclause of CAN/CSA-C22.2 No. 60335-1 is not mentioned in CSA C22.2 No. 60335-2-40, the CAN/CSA-C22.2 No. 60335-1 subclause applies.

UL Standard 60335-2-40 is to be used in conjunction with the sixth edition of UL 60335-1. The requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers are contained in this Part 2 Standard and UL 60335-1. Requirements of this Part 2 Standard, where stated, amend the requirements of UL 60335-1. Where a particular subclause of UL 60335-1 is not mentioned in UL 60335-2-40, the UL 60335-1 subclause applies.

Level of Harmonization

This standard adopts the IEC text with national differences.

This standard is published as an equivalent standard for CSA Group and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

All national differences from the IEC text are included in the CSA Group and UL versions of the standard. While the technical content is the same in each organization's version, the format and presentation may differ.

Reasons for Differences From IEC

Differences from the IEC are being added in order to address safety and regulatory situations present in the US and Canada.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

IEC Copyright

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 60335-2-40, Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers, copyright 2018, are used in this standard with the consent of the International Electrotechnical Commission. The IEC Foreword and Introduction are not a part of the requirements of this standard but are included for information purposes only.

NATIONAL DIFFERENCES

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60335-2-40, Household and similar electrical appliances – Safety – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers, copyright 2018, are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

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

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

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

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

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

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

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

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

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

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

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

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

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

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

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

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

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

International Standard IEC 60335-2-40 has been prepared by subcommittee 61D: Appliances for air-conditioning for household and similar purposes, of IEC technical committee 61: Safety of household and similar electrical appliances.

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

FDIS	Report on voting
61D/386/FDIS	61D/391/RVD

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

This sixth edition cancels and replaces the fifth edition published in 2013 and its Amendment 1:2016. This edition constitutes a technical revision.

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

– Clause 1 – limiting A2L refrigerants to those of a molar mass of more than or equal to 42 kg/kmol;
– Clause 7 – added requirements for A2L refrigerants,
– Clause 7 – added requirement for pre-charge pipe sets, detection systems, ventilation and the resulting charge;
– Clause 7 – added requirements for UV-C systems;
– Clause 7 – added requirements for transcritical refrigerating systems;
– Subclause 19.7 – amended text to match the intention of the subclause;
– Clause 21 – added requirements for transcritical refrigerating systems;
– Subclause 22 – added requirements for A2L refrigerants;
– Subclause 22– added detection systems;
– Subclause 22 – added new requirements for enhanced tightness refrigerating systems;
– Subclause 22 – added new requirements for UV-C;
– Clause 23 – added new requirements for UV-C;Clause
– Clause 24 – added requirements for transcritical refrigerating systems;
– Subclause 24 – added requirements for detection systems and airflow;
– Clause 32 added new requirements for UV-C;
– Annex BB – revised to add surface temperatures;
– Annex DD – added requirements for A2L refrigerants and amended requirements for flammable refrigerants to exempt A2L refrigerants;
– Annex GG – added requirements for A2L refrigerants;
– Annex GG.1 – amended Table GG.1 and related wording
– Annex GG.7 – added requirement to test;
– Annex GG.8 to GG.13 – new coverage for A2L refrigerants;
– Annex HH – revised to take into account A2L refrigerants;
– Annex JJ – new coverage of allowable opening of relays and similar components to prevent ignition of A2L refrigerants;
– Annex KK – new coverage of test method for hot surface ignition temperature for A2L;
– Annex LL – new coverage of refrigerant detection systems for A2L Refrigerants;
– Annex MM – new coverage of refrigerant sensor location confirmation test;
– Annex NN – new coverage of flame arrest enclosure verification test for A2L refrigerants;
– Annex OO – new coverage of UV radiation conditioning
– Bibliography – added new references.

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

This part 2-40 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of IEC 60335-1:2010, its Amendment 1:2013 and its Amendment 2:2016.

NOTE 1 When “Part 1” is mentioned in this standard, it refers to IEC 60335-1.

This part 2-40 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Safety requirements for electrical heat pumps, air-conditioners and dehumidifiers.

When a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. When this standard states "addition", "modification" or "replacement", the relevant text in Part 1 is to be adapted accordingly.

NOTE 2 The following numbering system is used:

• subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;

• unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;

• additional annexes are lettered AA, BB, etc.

NOTE 3 The following print types are used:

• requirements: in roman type;

• *test specifications: in italic type;*

• notes: in small roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and associated noun are also in bold.

The following differences exist in the countries indicated below:

• 6.1: Class 0I appliances are allowed (Japan).

• 11.8: The temperature of the wooden walls in the test casing is limited to 85 °C (Sweden).

A list of all parts of the IEC 60335 series, under the general title: *Household and similar electrical appliances – Safety*, can be found on the IEC website.

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

• reconfirmed,

• withdrawn,

• replaced by a revised edition, or

• amended.

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

101DV D2 ***Modify the first sentence of the 7th paragraph after item 9 in the Part 2 IEC Foreword by replacing it with the following paragraph:***

This Part 2-40 is intended to be used in conjunction with the second edition of CAN/CSA-C22.2 No. 60335-1 and the sixth edition of UL 60335-1. All references in this standard to IEC 60335-1 shall be replaced by the second edition of CAN/CSA-C22.2 No. 60335-1 and the sixth edition of UL 60335-1.

102DV DE ***Modify the paragraph following NOTE 3 in the Part 2 IEC Foreword by replacing it with the following:***

Words in SMALL ROMAN CAPS in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and the associated noun are also in SMALL ROMAN CAPS.

103DV DE ***Modify by adding the following text at the end of the Part 2 IEC Foreword:***

The numbering system in this Standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

INTRODUCTION

It has been assumed in the drafting of this International Standard that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the instructions. It also covers abnormal situations that can be expected in practice.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the appliance is connected to the supply mains. However, national wiring rules may differ.

If an appliance within the scope of this standard also incorporates functions that are covered by another part 2 of IEC 60335, the relevant part 2 is applied to each function separately, as far as is reasonable. If applicable, the influence of one function on the other is taken into account.

When a part 2 standard does not include additional requirements to cover hazards dealt with in Part 1, Part 1 applies.

NOTE 1 This means that the technical committees responsible for the part 2 standards have determined that it is not necessary to specify particular requirements for the appliance in question over and above the general requirements.

This standard is a product family standard dealing with the safety of appliances and takes precedence over horizontal and generic standards covering the same subject.

NOTE 2 Horizontal and generic standards covering a hazard are not applicable since they have been taken into consideration when developing the general and particular requirements for the IEC 60335 series of standards. For example, in the case of temperature requirements for surfaces on many appliances, generic standards, such as ISO 13732-1 for hot surfaces, are not applicable in addition to Part 1 or part 2 standards.

An appliance that complies with the text of this standard will not necessarily be considered to comply with the safety principles of the standard if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

An appliance employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY – Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers

1 Scope

This clause of Part 1 is replaced by the following.

This part of IEC 60335 deals with the safety of electric HEAT PUMPS, including SANITARY HOT WATER HEAT PUMPS, AIR CONDITIONERS, and DEHUMIDIFIERS incorporating motor-compressors and HYDRONIC FAN COILS UNITS, their maximum RATED VOLTAGES being not more than 250 V for single phase appliances and 600 V for all other appliances. PARTIAL UNITS are within the scope of this International Standard.

Appliances not intended for normal household use but which nevertheless may be a source of danger to the public, such as appliances intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

The appliances referenced above may consist of one or more factory-made assemblies. If provided in more than one assembly, the separate assemblies are to be used together, and the requirements are based on the use of matched assemblies.

NOTE 101 A definition of 'motor-compressor' is given in IEC 60335-2-34, which includes the statement that the term motor-compressor is used to designate either a hermetic motor-compressor or semi-hermetic motor-compressor.

NOTE 102 Requirements for refrigerating safety are covered by ISO 5149-1, ISO 5149-2, and ISO 5149-3. Requirements for containers intended for storage of the heated water included in sanitary hot water heat pumps are, in addition, covered by IEC 60335-2-21.

This standard does not take into account refrigerants other than group A1, A2L, A2 and A3 as defined by ISO 817 classification, A2L REFRIGERANTS are limited to those of a molar mass of more than or equal to 42 kg/kmol based on WCF – Worst Case Formulation as specified in ISO 817.

This standard specifies particular requirements for the use of FLAMMABLE REFRIGERANTS. Unless specifications are covered by this standard, including the annexes, requirements for refrigerating safety are covered by ISO 5149.

The parts of ISO 5149 of particular concern to this standard are as follows:

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

• ISO 5149-2, Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation;

• ISO 5149-3:2014, Refrigerating systems and heat pumps – Safety and environmental requirements – Part 3: Installation site.

SUPPLEMENTARY HEATERS, or a provision for their separate installation, are within the scope of this standard, but only heaters which are designed as a part of the appliance package, the controls being incorporated in the appliance.

NOTE 103 Attention is drawn to the fact that

• for appliances intended to be used in vehicles or on board ships or aircraft, additional requirements may be necessary;

• for appliances subjected to pressure, additional requirements may be necessary;

• in many countries, additional requirements are specified, for example, by the national health authorities responsible for the protection of labour and the national authorities responsible for storage, transportation, building constructions and installations.

NOTE 104 This standard does not apply to

• humidifiers intended for use with heating and cooling equipment (IEC 60335-2-88);

• appliances designed exclusively for industrial processing;

• appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

1DV.1 DR *Modification by replacing the second paragraph of Clause 1 as follows:*

This part of IEC 60335 deals with the safety of electric heat pumps, including hot water heat pumps, air conditioners, and dehumidifiers incorporating motor-compressors, and hydronic fan coils units, their maximum rated voltages being not more than 300 V for single phase appliances and 15 000 V for all other appliances. Partial units are within the scope of this Standard.

1DV.2 D1 *Modification of the sixth paragraph of this Part 2 by replacing it with the following:*

This standard does not take into account refrigerants other than refrigerant safety groups as defined by ISO 817 or ANSI/ASHRAE 34 as follows:

a) A1; and

b) B1, B2L, B2, B3 [(for use in appliances installed in machinery rooms as defined in accordance with ANSI/ASHRAE 15 (USA) or CSA B52 (Canada), or outdoors only)]; and

c) A2L, A2, and A3, refrigerants with a molar mass not less than 42 kg/kmol based on nominal composition.

1DV.3 DR *Modification of the eighth paragraph of Clause 1 as follows:*

Replace “ISO 5149” with “ANSI/ASHRAE 15 (USA) and CSA B52 (Canada)”.

1DV.4 DR *Modification of Clause 1 of the Part 2 by adding the following paragraph:*

All references to ISO 817 in this Part 2 also apply to ANSI/ASHRAE 34. ANSI/ASHRAE 34 shall take precedence over ISO 817.

1DV.5 D1 ***Modification of NOTE 104 of Clause 1 of the Part 2 by deleting the 2nd bullet point.***

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60068-2-52, *Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution)*

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

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

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

IEC 60335-2-51, *Household and similar electrical appliances – Safety – Part 2-51: Particular requirements for stationary circulation pumps for heating and service water installations*

IEC 60730-2-6, *Automatic electrical controls – Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

IEC 61032, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

ISO 817, *Refrigerants – Designation and safety classification*

ISO 1302, *Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-4, *Plastics – Methods of exposure to laboratory light sources – Part 4: Open-flame carbon-arc lamps*

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

ISO 5149-2, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 2: Design, construction, testing, marking and documentation*

ISO 5149-3:2014, *Refrigerating systems and heat pumps – Safety and environmental requirements – Part 3: Installation site*

ISO 5151, *Non-ducted air conditioners and heat pumps – Testing and rating for performance*

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

ISO 13253, *Ducted air-conditioners and air-to-air heat pumps – Testing and rating for performance*

ISO 13256 (all parts), *Water-source heat pumps – Testing and rating for performance*

ISO 14903, *Refrigerating systems and heat pumps – Qualification of tightness of components and joints*

ISO 15042, *Multiple split-system air-conditioners and air-to-air heat pumps – Testing and rating for performance*

ASTM D4728-06:2012, *Standard Test Method for Random Vibration Testing of Shipping Containers*

CAN/CSA-C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

UL 746A, *Standard for Polymeric Materials – Short Term Property Evaluations*

UL 746B, *Standard for Polymeric Materials – Long Term Property Evaluations*

2DV DR *Modification of Clause 2 in the Part 2 to add the following references:*

UL 60335-1 6th Edition / CAN/CSA-C22.2 No. 60335-1:16, *Safety of Household and Similar Appliances – Part 1: General Requirements*

AHRI 210/240, *Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment*

AHRI 340/360, *Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment*

AHRI 700, *Specifications for Refrigerants*

AHRI 13256, *Water-source heat pumps – Testing and rating for performance – Part 1: Water-to-air and brine-to-air heat pumps*

AHRI 1230, *Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment*

ANSI/ASHRAE 15, *Safety Standard for Refrigeration Systems*

ANSI/ASHRAE 34, *Designation and safety classification of refrigerants*

ANSI/ASHRAE 62.1, *Ventilation for Acceptable Indoor Air Quality*

ANSI/NEMA WD 6, *Wiring Devices – Dimensional Specifications*

ANSI/NFPA 70, *National Electrical Code*

ANSI/NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*

ANSI/NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*

ANSI S12.31, ***Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms***

ANSI S12.31, ***Precision Methods for the determination of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms***

ASME VIII, ***Unfired Pressure Vessel Code***

ASTM A90/A90M, ***Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings***

ASTM B344, ***Standard Specification for Drawn or Rolled Nickel-Chromium and Nickel-Chromium-Iron Alloys for Electrical Heating Elements***

ASTM D56, ***Standard Test Method for Flash Point by Tag Closed Cup Tester***

ASTM D93, ***Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester***

ASTM D6668, ***Standard Test Method for Discrimination Between Flammability Ratings of F = 0 and F = 1***

ASTM D8211, ***Standard Test Method for Hot Surface Ignition Temperature of Gases on Flat Surface***

ANSI Z83.11 • CSA 1.8, ***Gas food service equipment***

CSA B51, ***Boiler, pressure vessel, and pressure piping code***

CSA B52, ***Mechanical refrigeration code***

CSA C22.1, ***Canadian Electrical Code, Part I***

CSA C22.2 No. 0, ***General requirements – Canadian Electrical Code, Part II***

CSA C22.2 No. 0.3, ***Test methods for electrical wires and cables***

CSA C22.2 No. 0.8, ***Safety functions incorporating electronic technology***

CSA C22.2 No. 14, ***Industrial control equipment***

CSA C22.2 No. 29, ***Panelboards and enclosed panelboards***

CSA C22.2 No. 41, ***Grounding and Bonding Equipment***

CSA C22.2 No. 42, ***General use receptacles, attachment plugs, and similar wiring devices***

CSA C22.2 No. 55, ***Special use switches***

CSA C22.2 No. 66.1, ***Low voltage transformers – Part 1: General requirements***

CSA C22.2 No. 66.3, ***Low voltage transformers – Part 3: Class 2 and Class 3 transformers***

CSA C22.2 No. 77, ***Motors with inherent overheating protection***

CSA C22.2 No. 100, ***Motors and generators***

CSA C22.2 No. 107.1, ***Power conversion equipment***

CSA C22.2 No. 110, ***Construction and test of electric storage-tank water***

CSA C22.2 No. 140.3, ***Refrigerant-containing components for use in electrical equipment***

CSA C22.2 No. 144.1, ***Ground-fault circuit-interrupters***

CSA C22.2 No. 155, ***Electric duct heaters***

CSA C22.2 No. 197, ***PVC insulating tape***

CSA C22.2 No. 198.1, ***Extruded insulating tubing***

CSA C22.2 No. 203.1, ***Manufactured wiring systems***

CSA C22.2 No. 236, ***Heating and cooling equipment***

CSA C22.2 No. 250.0, ***Luminaires***

CSA C22.2 No. 274, ***Adjustable speed drives***

CSA C22.2 No. 286, ***Industrial control panels and assemblies***

CSA C22.2 No. 292, ***DC arc fault protection for photovoltaic applications***

CSA C22.2 No. 330, ***Photovoltaic rapid shutdown systems***

CAN/CSA-C22.2 No. 60335-2-34, ***Safety of household and similar electrical appliances – Part 2-34: Particular requirements for motor-compressors***

CSA C22.2 No. 60947-4-1, ***Low-voltage switchgear and control gear – Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters***

CSA C22.2 No. 61730-1, ***Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction***

CSA C22.2 No. 61730-2, ***Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing***

CSA C22.2 No. 62109-1, ***Safety of power converters for use in photovoltaic power systems – Part 1: General requirements***

CSA C22.2 No. 62109-2, ***Safety of power converters for use in photovoltaic power systems – Part 2: Particular requirements for inverters***

CSA E60730-1, ***Automatic electrical controls – Part 1: General requirements***

IAPMO, ***Uniform Mechanical Code***

ICC, ***International Mechanical Code***

IEC 60695-1-10, ***Fire hazard testing – Part 1-10: Guidance for assessing the fire hazard of electrotechnical products – General guidelines***

IEC 60695-11-20, ***Fire hazard testing – Part 11-20: Test flames – 500 W flame test methods***

IEC 60990:2016, ***Methods of measurement of touch current and protective conductor current***

ISO 1043-1, ***Plastics – Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics***

UL 67, ***Panelboards***

UL 94, ***Tests for Flammability of Plastic Materials for Parts in Devices and Appliances***

UL 174, ***Household Electric Storage Tank Water Heaters***

UL 183, ***Manufactured Wiring Systems***

UL 207, ***Refrigerant-Containing Components and Accessories, Nonelectrical***

UL 224, ***Extruded Insulating Tubing***

UL 353, ***Limit Controls***

UL 429, ***Electrically Operated Valves***

UL 498, ***Attachment Plugs and Receptacles***

UL 508, ***Industrial Control Equipment***

UL 508A, ***Industrial Control Panels***

UL 510, ***Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape***

UL 723, ***Test for Surface Burning Characteristics of Building Materials***

UL 746C, ***Polymeric Materials – Use in Electrical Equipment Evaluations***

UL 867, ***Electrostatic Air Cleaners***

UL 900, ***Air Filter Units***

UL 943, ***Ground-Fault Circuit-Interrupters***

UL 1310, ***Class 2 Power Units***

UL 1004-9, ***Form Wound and Medium Voltage Rotating Electrical Machines***

UL 1441, ***Coated Electrical Sleeving***

UL 1453, ***Electric Booster and Commercial Storage Tank Water Heaters***

UL 1581, ***Reference Standard for Electrical Wires, Cables, and Flexible Cords***

UL 1598, ***Luminaires***

UL 1694, ***Tests for Flammability of Small Polymeric Component Materials***

UL 1699B, ***Photovoltaic (PV) DC Arc-Fault Circuit Protection***

UL 1703, ***Flat-Plate Photovoltaic Modules and Panels***

UL 1741, ***Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources***

UL 1995, ***Heating and Cooling Equipment***

UL 1996, ***Electric Duct Heaters***

UL 2043, ***Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces***

UL 2395, ***Adhesives for Use in Heating and Cooling Appliances to Secure Thermal Insulation Materials***

UL 2703, ***Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels***

UL 5085-1, ***Low Voltage Transformers – Part 1: General Requirements***

UL 5085-3, ***Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers***

UL 9703, ***Outline of Investigation for Distributed Generation Wiring Harnesses***

UL 60079-2, ***Explosive Atmospheres – Part 2: Equipment Protection by Pressurized Enclosure***

UL 60730-1, ***Automatic Electrical Controls – Part 1: General Requirements***

UL 60730-2-6, ***Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements***

UL 60730-2-9, ***Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls***

UL 60947-4-1, ***Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters***

UL 60950-1, ***Information Technology Equipment – Safety – Part 1: General Requirements***

UL 61800-5-1, ***Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy***

UL 61800-5-2, ***Adjustable Speed Electrical Power Drive Systems – Part 5-2: Safety Requirements – Functional***

UL 61730-1, ***Photovoltaic (PV) Module Safety Qualification – Part 1: Requirements For Construction***

UL 61730-2, ***Photovoltaic (PV) Module Safety Qualification – Part 2: Requirements For Testing***

UL 62109-1, ***Power Converters for use in Photovoltaic Power Systems – Part 1: General Requirements***

UL 62109-2, ***Safety of power converters for use in photovoltaic power systems – Part 2: Particular requirements for inverters***

UL 62368-1, ***Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements***

UL 121201, ***Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations***

ULC/ORD C1703, ***Flat-plate photovoltaic modules and panels***

CAN/ULC-S102, ***Standard method of test for surface burning characteristics of building materials and assemblies***

CAN/ULC-S111, ***Standard method of fire tests for air filter units***

3 Terms and definitions

This clause of Part 1 is applicable except as follows.

3.1.4 *Addition:*

Note 101 to entry: If the appliance comprises electrical accessories, including fans, the RATED POWER INPUT is based upon the total maximum ELECTRICAL POWER INPUT with all accessories energized, when operating continuously under the appropriate environmental conditions. If the HEAT PUMP can be operated in the heating or cooling mode, the RATED POWER INPUT is based upon the input in the heating or in the cooling mode, whichever is the greater.

3.1.9 *Replacement:*

NORMAL OPERATION
conditions that apply when the appliance is mounted as in normal use and is operating under the most severe operating conditions specified by the manufacturer

3.4.2DV D1 ***Modification by replacing Clause 3.4.2DV in the Part 1 with the following:***

SAFETY EXTRA-LOW VOLTAGE
(SELV)
Voltage between any accessible part and earth, not exceeding 30 V AC (RMS), 42,4 V AC (peak), or 60 V DC (ripple free) under normal and single-fault conditions, which is provided by an independent source (such as safety isolating transformers, motor generators, and batteries) or, when obtained from higher voltage, is obtained by a safety isolating transformer or a converter with separate windings providing equivalent insulation (USA Only)

NOTE 1DV to entry: For equipment NOT ACCESSIBLE TO THE GENERAL PUBLIC, see Annex 101.DVH.

NOTE 2DV to entry: NFPA 70, Article 725 (NEC), class 2 meets this requirement.

3.5.4DV D1 ***Modify Clause 3.5.4 in the Part 1 by adding the following NOTE:***

Note 101 to entry: Appliances connected to water pipes or refrigerant pipes are also fixed appliances.

3.8.101DV D1 ***Add the following definition to Clause 3.8 in the Part 1:***

PARTICLE FOAM MATERIAL
closed cell material moulded from thermoplastic particles (e.g., beads) with an expanding agent

3.101
HEAT PUMP
appliance which takes up heat at a certain temperature and releases heat at a higher temperature

Note 1 to entry: When operated to provide heat (e.g., for space heating or water heating), the appliance is said to operate in the heating mode; when operated to remove heat (for example, for space cooling), it is said to operate in the cooling mode.

Note 2 to entry: A HEAT PUMP can contain a combination of CONDENSING UNIT OR CONDENSER UNIT and an EVAPORATING UNIT or EVAPORATOR UNIT and can be equipped to operate in a reverse cycle mode.

3.102
SANITARY HOT WATER HEAT PUMP
HEAT PUMP intended to transfer heat to water suitable for human consumption

3.103
AIR CONDITIONER
encased assembly or assemblies designed as an appliance to provide delivery of conditioned air to an enclosed space, room or zone

Note 1 to entry: It includes an electrically operated REFRIGERATING SYSTEM for cooling and possibly dehumidifying the air.

Note 2 to entry: It may have means for heating, circulating, cleaning and humidifying the air.

Note 3 to entry: An AIR CONDITIONER can contain a combination of CONDENSING UNIT or CONDENSER UNIT and an EVAPORATING UNIT or EVAPORATOR UNIT.

3.104
DEHUMIDIFIER
encased assembly designed to remove moisture from its surrounding atmosphere

Note 1 to entry: It includes an electrically operated REFRIGERATING SYSTEM and the means to circulate air. It also includes a drain arrangement for collecting and storing and/or disposing of the condensate.

3.108
WET-BULB TEMPERATURE
WB
temperature indicated when the temperature-sensitive element in a wetted wick has reached a state of constant temperature (evaporative equilibrium)

3.109
DRY-BULB TEMPERATURE
DB
temperature indicated by a dry, temperature-sensitive element shielded from the effects of radiation

3.110
EVAPORATOR
HEAT EXCHANGER in which refrigerant liquid is vaporized by absorption of heat

3.111
HEAT EXCHANGER
device specifically designed to transfer heat between two physically separated fluids

3.112
INDOOR HEAT EXCHANGER
HEAT EXCHANGER designed to transfer heat to the indoor parts of the building or to the indoor hot water supplies (e.g. sanitary water) or to remove heat therefrom

3.113
OUTDOOR HEAT EXCHANGER
HEAT EXCHANGER designed to remove or release heat from the heat source (for example, ground water, outdoor air, exhaust air, water or brine)

3.114
SUPPLEMENTARY HEATER
electric heater provided as part of the appliance to supplement or replace the output of the refrigerant circuit of the appliance by operation in conjunction with, or instead of, the refrigerating circuit

3.114ADV D1 ***Add the following definitions to Clause 3 of the Part 2:***

3.114ADV.1
ELECTRIC HEATER
heater provided as part of the appliance for the purpose of conditioning air or water

3.114ADV.2
SUPPLEMENTARY WATER HEATER
heater provided specifically for the purpose of heating water

3.114ADV.3
SUPPLEMENTARY AIR HEATER
heater provided specifically for the purpose of heating air by operation in conjunction with, or instead of, the refrigerating circuit

3.114ADV.4
CENTRAL WARM AIR FURNACE
heating appliance that consists of an electric heating element or elements with an air-circulating fan or blower, is provided with appropriate integral operating and temperature-limiting controls, and is housed in an enclosure designed to be connected to ductwork for the distribution of the heated air

3.114ADV.5
ADD-ON ELECTRIC HEATER KIT
auxiliary electric heat assembly comprised of electric resistance heating elements with integral operating and temperature-limiting controls for attachment in the field to an enclosure with an air-circulating fan designed to be connected to ductwork for the distribution of the heated air

3.115
PRESSURE-LIMITING DEVICE
mechanism that automatically responds to a predetermined pressure by stopping the operation of the pressure-imposing element

3.116
PRESSURE-RELIEF DEVICE
pressure actuated valve or rupture member which functions to relieve excessive pressure automatically

3.116DV D1 ***Modification by adding the following note to Clause 3.116 of the Part 2:***

Note 1DV to entry: A hermetic compressor's internal pressure-relief valve (bypass valve) is not considered a pressure relief device.

3.117
APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC
appliances intended to be located in residential buildings or in commercial buildings

3.118
APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC
appliances which are located either in a secured location with restricted access (e.g. machine rooms, rooftop and the like) or at a level not less than 2,5 m or in secured rooftop areas

3.119
HYDRONIC FAN COIL UNIT
factory-made assembly which provides the function of forced circulation of air for heating and/or cooling, which may also include the function of DEHUMIDIFICATION and/or filtering of air, but which does not include the source of cooling or heating

Note 1 to entry: HYDRONIC FAN COIL UNITS can include provision for electric resistance heating. HEAT EXCHANGER coils are intended for hydronic heating and cooling only.

3.120
FLAMMABLE REFRIGERANT
refrigerant classified as class A2L, A2 or A3 according to ISO 817

3.120DV D1 ***Modification of Clause 3.120 of the Part 2 by replacing it with the following:***

FLAMMABLE REFRIGERANT
refrigerant classified as safety group A2L, A2 or A3 according to ANSI/ASHRAE 34 or ISO 817

3.121
REFRIGERATING SYSTEM
combination of interconnected refrigerant containing parts constituting one closed refrigerant circuit in which refrigerant is circulated for the purpose of extracting heat at the low temperature side to reject heat at the high temperature side by changing the state of the refrigerant

3.122
MAXIMUM ALLOWABLE PRESSURE
limit to the REFRIGERATING SYSTEM operating pressure, generally the maximum pressure for which the equipment is designed, as specified by the manufacturer

Note 1 to entry: MAXIMUM ALLOWABLE PRESSURE constitutes a limit to the operating pressure whether the equipment is working or not, see Clause 21.

3.123
LOW-PRESSURE SIDE
part(s) of a REFRIGERATING SYSTEM operating at the EVAPORATOR pressure

3.124
HIGH-PRESSURE SIDE
part(s) of a REFRIGERATING SYSTEM operating at the CONDENSER pressure

3.125
SERVICE PORT
means to access the refrigerant in a REFRIGERATING SYSTEM for the purpose of charging or servicing the system, typically a valve, tube extension or entry location

3.125DV D1 ***Modification of Clause 3.125 of this Part 2 by deleting "typically a valve, tube extension or entry location"***

3.126
FACTORY SEALED SINGLE PACKAGE UNIT
factory assembly of components of REFRIGERATING SYSTEM fixed on a common mounting to form a discrete unit in which all REFRIGERATING SYSTEM parts have been sealed tight by welding, brazing or a similar permanent connection during the manufacturing process

3.126DV D1 ***Modification of Clause 3.126 of this Part 2 by adding the following at the end of the sentence:***

“and does not include service ports, other than appliances with A1 and A2L refrigerants”

3.127
PRE-CHARGED PIPE SETS
interconnecting refrigerant lines which are supplied with the unit and supplied with a REFRIGERANT CHARGE for the purpose of completing the REFRIGERATING SYSTEM in the field for appliances that are made up of more than one subassembly and are assembled in the field to complete the REFRIGERATING SYSTEM

3.128
CONDENSER
HEAT EXCHANGER in which refrigerant vapour is condensed by removal of heat

3.129
CONDENSING UNIT
factory-made assembly that includes one or more motor-compressors, CONDENSER in cooling mode and motor-driven fan, blower or pump to circulate the heat transfer fluid through the CONDENSER with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to an EVAPORATOR UNIT. A CONDENSING UNIT can also be equipped to operate in the reverse cycle mode. A CONDENSING UNIT can include expansion device(s).

3.130
CONDENSER UNIT
factory-made assembly that includes one or more CONDENSERS in cooling mode and motordriven fan, blower or pump to circulate the heat transfer fluid through the CONDENSER with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to an EVAPORATING UNIT. A CONDENSER UNIT can also be equipped to operate in the reverse cycle mode.

Note 2 to entry: A CONDENSER UNIT does not include a motor compressor or expansion device.

3.131
EVAPORATING UNIT
factory-made assembly that includes one or more motor-compressors, EVAPORATOR in cooling mode, expansion device(s), and motor-driven fan, blower or pump to circulate fluid through the EVAPORATOR with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to a CONDENSER UNIT. An EVAPORATING UNIT can also be equipped to operate in the reverse cycle mode and can include provision for electric resistance heating or similar sources of auxiliary heat.

3.132
EVAPORATOR UNIT
factory-made assembly that includes one or more EVAPORATORS in cooling mode, and may include a motor-driven fan, blower or pump to circulate fluid through the EVAPORATOR with associated operational controls in addition to the necessary wiring

Note 1 to entry: These units are intended for field connection to a CONDENSING UNIT. An EVAPORATOR UNIT can also be equipped to operate in the reverse cycle mode and can include provision for electric resistance heating or similar sources of auxiliary heat. An EVAPORATOR UNIT can include expansion device(s).

Note 2 to entry: An EVAPORATOR UNIT does not include a motor compressor.

3.133
PARTIAL UNIT
CONDENSING UNIT, EVAPORATING UNIT, CONDENSER UNIT, or EVAPORATOR UNIT which are part of a total assembly of a heat pump, air-conditioner, or SANITARY HOT WATER HEAT PUMPS where not all assemblies to create the complete REFRIGERATING SYSTEM are specified by the manufacturer

Note 1 to entry: PARTIAL UNITS are evaluated for safety as stand-alone.

3.134
INSTALLED HEIGHT
h_{inst}
height of the bottom of the appliance relative to the floor of the room after installation

Note 1 to entry: The INSTALLED HEIGHT is given in meters.

3.135
RELEASE OFFSET
h_{rel}
distance from the bottom of the appliance to an opening where refrigerant can leave the appliance in the event of a refrigerant leak

Note 1 to entry: The RELEASE OFFSET is given in meters.

3.136
REFRIGERANT CHARGE
m_c
actual REFRIGERANT CHARGE of a single REFRIGERATING SYSTEM

Note 1 to entry: The REFRIGERANT CHARGE is expressed in kg.

3.137
MAXIMUM REFRIGERANT CHARGE
m_{max}
MAXIMUM REFRIGERANT CHARGE for a single REFRIGERATING SYSTEM as result from a calculation for room area or similar

Note 1 to entry: The MAXIMUM REFRIGERANT CHARGE is expressed in kg.

3.138
REFRIGERANT DETECTION SYSTEM
sensing system which responds to a pre-set concentration of refrigerant in the environment

Note 1 to entry: A REFRIGERANT DETECTION SYSTEM may have multiple sensing elements.

3.138DV D1 ***Modification Clause 3.138 of the Part 2 by replacing it with the following:***

REFRIGERANT DETECTION SYSTEM
sensing system with one or more REFRIGERANT SENSORS interconnected with electronic circuitry that determines if a SYSTEM RESPONSE is required based on a comparison of a sensed refrigerant gas concentration to the DETECTION THRESHOLD LIMIT VALUE

3.139
AUTO IGNITION TEMPERATURE
AIT
lowest temperature at or above which a chemical can spontaneously ignite in a normal atmosphere, without an external source of ignition, such as a flame or spark

[SOURCE: ISO 5149-1:2014, definition 3.7.7]

3.140
HOT SURFACE IGNITION TEMPERATURE
HSIT
highest temperature at which a refrigerant does not ignite when tested in accordance with Annex KK

3.140DV D1 ***Modification of Clause 3.140 of the Part 2 by adding "or ASTM D8211" after "Annex KK"***

3.141
A2L REFRIGERANT
refrigerant classed as A2L according to ISO 817

3.141DV DR ***Modification of Clause 3.141 of the Part 2 by replacing it with the following:***

A2L REFRIGERANT
refrigerant classified as safety group A2L according to Clause 1DV.2 of this standard

Note 1 to entry: Safety group is listed in Annex BB.

3.142
LOWER FLAMMABILITY LIMIT
LFL
LOWER FLAMMABILITY LIMIT according to ISO 817

3.143
ENHANCED TIGHTNESS REFRIGERATING SYSTEM
REFRIGERATING SYSTEM in which the indoor units are designed and fabricated to ensure a high level of confidence that large refrigerant leak rates will not occur in normal and abnormal operation

3.144
REFRIGERANT DISTRIBUTION ASSEMBLY
separate refrigerant assembly which is installed in the interconnecting refrigerant lines for the purpose of distributing refrigerant flow to one or more indoor units

3.145
POTENTIAL IGNITION SOURCE
PIS
hot surfaces, flames and current carrying devices which can be the source of arcing or sparking

Note 1 to entry: Examples of POTENTIAL IGNITION SOURCES are UV lights, electric heaters, pilot flames, brushed motors and similar devices.

3.146
CIRCULATION AIRFLOW
mechanically induced airflow movement within the space or duct connected spaces

3.146DV D1 ***Modification of Clause 3.146 of the Part 2 by adding the following note:***

Note 1DV to entry: Circulation airflow is not ventilation. Ventilation is the act of supplying airflow to a space or duct connected spaces from an outside source or a separate room and exhausting air from the space.

3.147
ULTRAVIOLET RADIATION
OPTICAL RADIATION for which the wavelengths are shorter than those for VISIBLE RADIATION

Note 1 to entry: For ultraviolet (UV) radiation, the range between 100 nm and 400 nm is commonly subdivided into: UV-A, from 315 nm to 400 nm; UV-B, from 280 nm to 315 nm; and UV-C, from 100 nm to 280 nm.

[SOURCE: IEC 60050-845:1987, 845-01-05]

3.148
OPTICAL RADIATION
electromagnetic radiation at wavelengths between the region of transition to X-rays (λ ≈ 1 nm) and the region of transition to radio waves (λ ≈ 1 mm)

[SOURCE: IEC 60050-845:1987, 845-01-02]

3.149
VISIBLE RADIATION
any OPTICAL RADIATION capable of causing a visual sensation directly

Note 1 to entry: There are no precise limits for the spectral range of VISIBLE RADIATION since they depend upon the amount of radiant power reaching the retina and the responsivity of the observer. The lower limit is generally taken between 360 nm and 400 nm and the upper limit between 760 nm and 830 nm.

[SOURCE: IEC 60050-845:1987, 845-01-03]

3.150
UV-C LAMP
source made to produce OPTICAL RADIATION for which the wavelengths are shorter than those for VISIBLE RADIATION and in the range of 100 nm to 280 nm wavelengths including GERMICIDAL LAMPS

Note 1 to entry: There are several types of such lamps used for photobiological, photochemical and biomedical purposes

3.150DV D1 ***Modification of Clause 3.150 of the Part 2 by replacing "100 nm" with "200 nm"***

3.151
GERMICIDAL LAMP
low pressure mercury vapour lamp with a bulb which transmits the bactericidal ultraviolet-C radiation

[SOURCE: IEC 60050-845:1987, 845-07-53]

3.151DV D1 ***Modification of Clause 3.151 of the Part 2 by replacing it with the following:***

low pressure mercury vapor lamp or a LED array which transmits the bactericidal ultraviolet-C radiation

[SOURCE: Adapted from IEC 60050-845:1987, 845-07-53]

3.152
UV-C GERMICIDAL LAMP SYSTEM
auxiliary device which utilizes GERMICIDAL LAMPS that directly generate UV-C germicidal ULTRAVIOLET RADIATION typically used to supplement the normal unit air filters for enhanced air purification and surface cleaning of the EVAPORATOR coil and surrounding area

3.153
UV-C SPECTRAL IRRADIANCE
measured electromagnetic radiation power density at a particular wavelength of 254 nm at a specified distance

Note 1 to entry: The spectral irradiance E_{254} is measured in $\mu W/cm^2$

3.153DV D1 ***Modification of Clause 3.153 of the Part 2 by deleting "at a particular wavelength of 254 nm"***

3.154
UV-C BARRIER
additional guard or shield that prevents UV-C light from exiting the unit or damaging internal non-metallic materials

3.155
TRANSCRITICAL REFRIGERATING SYSTEM
REFRIGERATING SYSTEM where evaporation occurs below the critical point and heat rejection may occur above the critical point of the refrigerant (e.g. R744)

3.156DV D1 ***Add the following definitions to Clause 3 of the Part 2:***

3.156DV
AFCI (ARC FAULT CIRCUIT INTERRUPTER)
a device intended to mitigate the effects of arcing faults by functioning to de-energize the circuit where an arc fault is detected

3.157DV
LCDI (LEAKAGE CURRENT DETECTION INTERRUPTER)
a device provided in a power supply cord that senses leakage current flowing between or from the integral cord conductors and interrupts the circuit at a predetermined level of leakage current

3.158DV
ADD ON HEAT PUMP
a heat pump that normally consists of an outdoor section, one or more indoor sections (without circulating fan), and related control devices

Note 1 to entry: Add on heat pumps include cooling only and heating only appliances.

3.159DV
EXTRA HARD USAGE CORD
a cord intended for use with heavy equipment, classified as the highest grade in mechanical serviceability

3.160DV
HARD USAGE CORD
a cord intended for use with moderately heavy equipment, classified as the medium grade in mechanical serviceability

3.161DV
TAPPED CONTROL CIRCUIT
a control circuit that is tapped within the equipment from the load side of the overcurrent device for the controlled load

3.162DV
ELECTRICAL CONNECTION
the physical interface between two points in a circuit, such as spade terminals, pin terminals, micro switch contacts, relay contacts, timer contacts, crimped connections, and connections that are welded or soldered

3.163DV
MULTI-SPLIT SYSTEM
a split system air conditioner or heat pump having two or more independently controlled indoor units on a single refrigeration system

3.164DV
SAFETY SHUT-OFF VALVE
an automatically controlled refrigerant valve for the purpose of limiting the amount of refrigerant released into a space when a refrigerant leak is detected

3.165DV
RELEASABLE CHARGE (m_{REL})
the mass of refrigerant that can be released into the indoor space from a refrigerating system in the event of a leak

Note 1 to entry: The part of the refrigerant charge that leaks to the outdoors is excluded from the releasable charge.

3.166DV
PRESSURE-RELIEF VALVE
a pressure-actuated valve held shut by a spring or other means and designed to relieve excessive pressure automatically under abnormal conditions

3.167DV
FACTORY SEALED APPLIANCE
a factory charged appliance in which all refrigerating system parts have been sealed tight by welding, brazing, or a similar permanent connection during the manufacturing process and does not include service ports

3.168DV
THERMOELECTRIC HEAT PUMP
a solid-state heat pump, activated by an electric current, that takes in heat at a certain temperature and releases heat at a higher temperature

Note 1 to entry: A Peltier element is an example of such technology.

3.169DV
FUSIBLE PLUG
a fitting made with a metal of a known low melting temperature; it is used as safety device to release pressures in case of fire

3.170DV
INTERLOCK
a control to prove the physical state of a required condition, and to furnish that proof to a primary safety-control circuit

3.171DV
HOT WATER HEAT PUMP
a heat pump intended to transfer heat to water

3.172DV
HEAT RECOVERY UNIT
a system used in conjunction with air conditioning or refrigeration equipment for the purpose of extracting heat from the refrigerant to heat water

Note 1 to entry: These products include a heat exchanger and water temperature control components, and can also include additional components such as hot water storage tanks, electric heaters, and water circulating pumps.

3.173DV
HEAT PUMP POOL HEATER
a hot water heat pump intended to transfer heat to pool or spa water

3.174DV
SANITARY WATER
water suitable for human consumption

3.175DV
NON-INTEGRAL UV-C GERMICIDAL LAMP SYSTEM
an unspecified, field installed UV-C germicidal lamp system intended for installation external to the appliance in the connected ductwork and which is not specified by the appliance manufacturer for use with the appliance

3.176DV
FIELD INSTALLATION ACCESSORY
a packaged assembly of all components, instructions, warning labels, and wiring diagrams needed for field installation of an accessory or option

3.177DV
LEAK DETECTION SYSTEM
a sensing system that responds to refrigerant leaking from a refrigerating system

Note 1 to entry: A leak detection system may include gas sensing, ultrasonic, or other such methods demonstrated to be sufficiently effective.

Note 2 to entry: A refrigerant detection system is an example of a leak detection system.

3.178DV
PHOTOVOLTAIC CELL
the basic photovoltaic device that generates electricity when exposed to sunlight

3.179DV
CONVERTER
a device that accepts ac or dc power input and converts it to another form of ac or dc power

3.180DV
PHOTOVOLTAIC MODULE
a complete, environmentally protected unit consisting of solar cells, optics, and other components, exclusive of a solar tracker mechanism, designed to generate dc power when exposed to sunlight

3.181DV
SOLAR PHOTOVOLTAIC SYSTEM
the total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to a utilization load

3.182DV
STAND-ALONE SOLAR PHOTOVOLTAIC SYSTEM
a solar photovoltaic system that supplies power only to electric loads within the appliance and is not exporting to the electrical utility distribution network

3.183DV
UTILITY-INTERACTIVE SOLAR PHOTOVOLTAIC SYSTEM
a solar photovoltaic system providing power to a utilization load and operating in parallel with, and that can deliver power to, an electrical production and distribution network

3.184DV
PHOTOVOLTAIC CIRCUIT COMBINER
a product that connects the outputs of multiple photovoltaic source circuits into a combined output circuit or circuits

Note 1 to entry: These devices are commonly referred to as a "PV combiner box" or "PV string combiners". These products will be referred to as "combiner unit(s)" to minimize text.

3.185DV
INVERTER
an electronic device that changes dc power to ac power

3.186DV
PHOTOVOLTAIC RAPID SHUTDOWN EQUIPMENT (PVRSE)
equipment intended to be used in a PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM to initiate, disconnect, isolate, or attenuate the controlled conductors of a SOLAR PHOTOVOLTAIC SYSTEM

3.187DV
PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM (PVRSS)
a system consisting of PHOTOVOLTAIC RAPID SHUTDOWN EQUIPMENT intended to initiate, in addition to disconnect, isolate, or attenuate, the controlled conductors of a SOLAR PHOTOVOLTAIC SYSTEM

3.188DV
SENSING ELEMENT
a part of the refrigerant sensor that varies electronically or otherwise based on the presence of a concentration of the gas or vapor to be measured

3.189DV
REFRIGERANT SENSOR
a SENSING ELEMENT, combined with electronic circuitry, that provides a digital output or an analog signal output that corresponds to the sensed refrigerant gas concentration

3.190DV
LIMITED LIFE REFRIGERANT SENSOR
a REFRIGERANT SENSOR which has a known end of life from its date of manufacture and is expected to be replaced within the expected life of the appliance

Note 1 to entry: The REFRIGERANT SENSOR functions as an open sensor when the end of life has been reached.

3.191DV
NON-FIXED FACTORY SEALED SINGLE PACKAGE UNIT
a FACTORY SEALED SINGLE PACKAGE UNIT that is not intended to be used while fastened to a support or while secured in a specific location

NOTE 1 to entry: Portable appliances and cord-connected appliances that may be periodically or seasonally relocated by the end user are types of NON-FIXED FACTORY SEALED SINGLE PACKAGE UNITS.

3.192DV
DETECTION THRESHOLD LIMIT VALUE
the minimum refrigerant gas concentration that results in the REFRIGERANT DETECTION SYSTEM initiating a SYSTEM RESPONSE

3.193DV
SYSTEM RESPONSE
one or more actions initiated either by the REFRIGERANT DETECTION SYSTEM when the refrigerant gas concentration is above the DETECTION THRESHOLD LIMIT VALUE, or by a LEAK DETECTION SYSTEM when responding to refrigerant leaking from a REFRIGERATING SYSTEM

3.194DV
MECHANICAL VENTILATION
external air, delivered to a space via mechanical methods, that is intended to dilute released refrigerant

3.195DV
COMPUTER ROOM
a room or portions of a building serving an ITE load less than or equal to 10 kW, or 215 W/m^2 (20 W/ft^2) or less of conditioned floor area

3.196DV
DATA CENTER
a room or building, or portions thereof, including computer rooms, being served by the data center systems, serving a total ITE load greater than 10 kW and 215 W/m^2 (20 W/ft^2) of conditioned floor area

3.197DV
INFORMATION TECHNOLOGY EQUIPMENT (ITE)
equipment that includes computers, data storage, servers, and network/communication equipment

3.198DV
INFORMATION TECHNOLOGY EQUIPMENT FACILITIES (ITEF)
data centers and computer rooms used primarily to house information technology equipment

3.199DV
GROUP CONTROLLER or GROUP CONTROL
an electrical or electronic control system that monitors and responds to multiple distinct inputs from more than one appliance or unit

3.200DV
PRESSURE VESSEL
any refrigerant-containing receptacle in a refrigerating system. This does not include evaporators where each separate evaporator section does not exceed 0.014 m^3 (0.5 ft^3) of refrigerant-containing volume, regardless of the maximum inside dimension. This also does not include evaporator coils, compressors, condenser coils, controls, headers, pumps, and piping

3.201DV
WARM-UP TIME
the time interval, with the equipment in a stated atmosphere, between the time when the equipment is switched on and the time when the indication or output reaches and remains within the stated tolerances to the indication or output expected for the atmosphere

Note 1 to entry: The stated atmosphere may be clean air or a test gas with known volume fraction.

Note 2 to entry: The stated tolerances include the calibration accuracy for shift and drift.

3.202DV
ITE AREA
an area of a building consisting of one or more rooms where the ITE is located, including support rooms served by the same special air-conditioning/air handling equipment as an ITE ROOM

3.203DV
ITE ROOM
a room within the ITE AREA that contains the ITE

3.204DV
ITE ENCLOSURE
a rack, cabinet, or chassis that is designed to mount and enable appropriate ventilation of ITE

3.205DV
ITE COOLING APPLIANCE or SYSTEM
an appliance or equipment that is designed specifically for the cooling of ITE, ITE ROOMS, and ITE AREAS such as DATACENTERS or COMPUTER ROOMS. An ITE COOLING APPLIANCE may be considered a PARTIAL UNIT if it is configured with refrigerant-containing components (other than piping) and does not encompass a complete refrigerant system

3.206DV
EFFECTIVE DISPERSAL VOLUME
the volume of the space or connected spaces in which leaked refrigerant will disperse

3.207DV
MAXIMUM RATED CURRENT (MRC)
the current resulting when a hermetic refrigerant motor-compressor and an ELECTRONIC CIRCUIT are operated under any conditions such as maximum speed/maximum load, maximum speed/minimum load, minimum speed/minimum load, and minimum speed/maximum load, including locked-rotor, such that current to the motor-compressor and ELECTRONIC CIRCUIT is at a maximum. The MRC is the current at the output of the ELECTRONIC CIRCUIT controlling device

3.208DV
TOUCH CURRENT
the electric current through a human body or through an animal body when it touches one or more accessible parts of an installation or of equipment

[SOURCE: IEC 60050-195, 195-05-21]

3.209DV
POTENTIAL LEAK POINT
any point in the REFRIGERATING SYSTEM that can be a weak point due to manufacturing processes, exposure to damage, sharpness of a bend, or similar stresses

Note 1 to entry: POTENTIAL LEAK POINTS can include parts under stress or vibration.

3.210DV
CONTROL PANEL ENCLOSURE
a surrounding case for electrical components constructed to provide a degree of protection to personnel against access to hazardous parts, and to provide a degree of protection to the enclosed equipment against specified environmental conditions

4 General requirement

This clause of Part 1 is applicable.

4DV.1 D2 *Modification of Clause 4 of this Part 2 by addition of the following:*

References to "REFRIGERANT DETECTION SYSTEM" in this Part 2 shall be replaced with "LEAK DETECTION SYSTEM", unless the context is specific to REFRIGERANT DETECTION SYSTEMS.

Alternative technologies for leak detection may be applied in place of REFRIGERANT DETECTION SYSTEMS if shown to provide equivalent performance relative to safety.

All references to *LFL* in this standard shall be taken as *LFL* at sea level, unadjusted for altitude

***LFL* and molar mass (M) for refrigerant blends shall be based on the worst case of formulation for flammability (WCF) composition. Data for *LFL* and molar mass (M) shall be as published in ANSI/ASHRAE 34 and addenda, or if not available in ANSI/ASHRAE 34, then as published in ISO 817 and amendments. If not available in either, then the data shall be as determined per tests in accordance with ANSI/ASHRAE 34.**

Note: Data are listed in Annex BB.

The refrigerant used for all tests shall meet the purity and composition specifications of AHRI 700. Any refrigerant blends used for tests shall be within the composition tolerances from the nominal composition as published in ANSI/ASHRAE 34 and addenda, or if not available in ANSI/ASHRAE 34, then as published in ISO 817 and amendments.

All references to "water" in a secondary loop system shall include all types of heat transfer liquids.

4DV.2 DC *Modification of Clause 4 in the Part 2 by adding the following:*

In Canada, general requirements applicable to these products are provided in CSA C22.2 No. 0.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.2 *Addition:*

The testing of Clause 21 may be carried out on separate samples. The testing of Clauses 11, 19 and 21 shall require that pressure measurements be made at various points in the REFRIGERATING SYSTEM.

At least one additional specially prepared sample is required for the tests of Annex FF (Leak simulation tests), if that test option is selected.

The temperatures on the refrigerant piping should be measured during the test of Clause 11.

If the tests of Annex LL are carried out, at least two additional sensors are needed.

If the test of Annex NN has to be carried out, an additional appliance may be used.

Due to the potentially hazardous nature of the tests of Clause 21 and Annexes EE and FF, special precautions need to be taken when carrying out the tests.

5.2DV D2 *Modification of Clause 5.2 in Part 1 by adding the following:*

The tests of Clauses 15 and 16 may be conducted on separate samples.

The tests shall be carried out in the order of the clauses. However, the tests of Clauses 15 and 16 may be carried out at any time.

The tests of Clause 21 may be carried out on separate samples. The tests of Clauses 11, 19 and 21 shall require that pressure measurements be made at various points in the refrigerating system.

NOTE 1DV For reference purposes, the temperatures on the refrigerant piping can be measured during the test of Clause 11.

If the tests of Annex FF (leak simulation tests) and Annex 101.DVQ (test method for determining releasable charge) are carried out, at least one additional specially prepared sample is required.

If the tests of Annex LL are carried out, additional refrigerant sensors are needed.

If the test of Annex NN has to be carried out, an additional appliance may be used

The test of Clauses 19.104 may be run in any sequence within Clause 19.

5.3DV D2 *Modification of Clause 5.3 in the Part 1 by adding the following:*

The test of Clauses 19.101 through 19.105DV may be run in any sequence within Clause 19.

5.6 *Addition:*

Any controls which regulate the temperature or humidity of the conditioned space are rendered inoperative during the test.

5.7 *Replacement:*

The tests and test conditions of Clauses 10 and 11 are carried out under the most severe operating conditions within the operating temperature range specified by the manufacturer. Annex AA provides examples of such temperature conditions.

5.7ADV D1 *Add Clause 5.7ADV.1 to Clause 5.7 of the Part 2:*

5.7ADV.1 See normative Annex 101.DVA for the minimum test conditions.

5.10 *Addition:*

For split-package units, the refrigerant lines shall be installed in accordance with the installation instructions. The length of pipe shall be between 5 m and 7,5 m. The thermal insulation of the refrigerant lines shall be applied in accordance with the installation instructions.

5.10DV D2 ***Modification by replacing the second sentence of Clause 5.10 of this Part 2 with the following:***

The line length shall be not less than 5 m but may be greater than 7,5 m. Where the installation instructions specify a maximum pipe length of less than 5 m, the length of pipe shall be the maximum length specified in the installation instructions. Where the installation instructions specify a minimum pipe length of more than 7,5 m, the length of pipe shall be the minimum length specified in the installation instructions.

5.101 *Motor-compressors are also subjected to the relevant test of Clause 19 of IEC 60335-2-34:2012, unless the motor-compressor complies with that standard, in which case it is not necessary to repeat these tests.*

5.101DV D1 ***Modification of Clause 5.101 of this Part 2 as follows:***

Replace "IEC 60335-2-34:2012" with "UL 60335-2-34:2017 and CAN/CSA 60335-2-34:17".

5.102 *Motor compressors that are tested and comply with IEC 60335-2-34 need not be additionally tested for Clause 21.*

5.102DV D1 ***Modification of Clause 5.102 of this Part 2 as follows:***

Replace "IEC 60335-2-34" with "UL 60335-2-34 and CAN/CSA 60335-2-34".

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 *Modification:*

Appliance shall be of CLASS I, CLASS II or CLASS III.

6.2 *Addition:*

Appliances shall be classified according to degree of protection against harmful ingress of water in accordance with IEC 60529:

• appliances or parts of appliances intended for outdoor use shall be at least IPX4;

• appliances intended only for indoor use (excluding laundry rooms) may be IPX0;

• appliances intended to be used in laundry rooms shall be at least IPX1.

6.2DV D1 ***Modification of the first bullet point in Clause 6.2 of the Part 2 by adding "or classified "For Outdoor Use" according to Annex 101.DVO."***

6.101 Appliances shall be classified according to the accessibility either as APPLIANCE ACCESSIBLE TO THE GENERAL PUBLIC or as APPLIANCE NOT ACCESSIBLE TO THE GENERAL PUBLIC.

Compliance is checked by inspection and the relevant tests.

6.102DV D1 ***Add the following subclause to Clause 6 of the Part 2:***

Appliances shall be classified according to the methods of shipping.

The method of shipping can be utilized for testing in Clause 21.2DV.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 *Modification:*

Replace the second dash by:

– symbol for nature of supply including number of phases, unless for single phase operation;

Addition:

– RATED FREQUENCY;

– REFRIGERANT CHARGE for each REFRIGERATING SYSTEM;

– refrigerant number in accordance with ISO 817;

– permissible excessive operating pressure for the storage tank (for SANITARY HOT WATER HEAT PUMPS);

– MAXIMUM ALLOWABLE PRESSURE in the water and/or brine circuit for the HEAT EXCHANGER for HYDRONIC FAN COIL UNITS;

– MAXIMUM ALLOWABLE PRESSURE for the refrigerant circuit; if the permissible excessive operating pressure for the suction and discharge side differ, a separate indication is required;

– for PRE-CHARGED PIPE SETS

- refrigerant number in accordance with ISO 817;
- the REFRIGERANT CHARGE in the line set;
- MAXIMUM ALLOWABLE PRESSURE;

– ratings in watts and voltage of a UV-C GERMICIDAL LAMP SYSTEM if employed.

Appliances shall be marked with all of the designations and the rated inputs of the SUPPLEMENTARY HEATERS for which they are intended to be used, and shall have provision for identifying the actual heater that is field installed.

Unless it is evident from the design, the enclosure of the appliance shall be marked, by words or by symbols, with the direction of the fluid flow.

For appliances using FLAMMABLE REFRIGERANTS, the flame symbol ISO 7010-W021 (2011-05) and the operator's manual symbol described in 7.6 shall be visible when viewing the appliance after it has been installed. The marking may be behind a detachable part that has to be detached before maintenance or repair work. The perpendicular height of the triangle used for the symbol shall be at least 30 mm. For appliances that are not single packaged units, the required markings shall be provided on all indoor and outdoor units which complete the REFRIGERATING SYSTEM when installed. When an A2L REFRIGERANT is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

If a FLAMMABLE REFRIGERANT is used, the symbols for "read operator's manual", "operator's manual; operating instructions" and "service indicator; read technical manual" (symbols ISO 7000-0790 (2004-01), and ISO 7000-1659 (2004-01)) including colour and format shall be placed on the appliance in a location visible to the persons required to know the information. The perpendicular height of the symbol shall be at least 10 mm.

If a FLAMMABLE REFRIGERANT is used, an additional warning symbol (flame symbol: ISO 7010-W021 (2011-05)) shall be placed on the nameplate of the unit near the declaration of the refrigerant type and charge information. The perpendicular height of the symbol shall be at least 10 mm, and the symbol need not be in colour. When an A2L REFRIGERANT is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

The following warning shall also be applied to the non-fixed appliance when a FLAMMABLE REFRIGERANT is employed. The warning shall be placed on the outside of the appliance such that it is visible when in service for NON-FIXED APPLIANCE.

WARNING Appliance shall be installed, operated and stored in a room with a floor area larger than 'X' m^2.

The minimum room size X shall be specified on the appliance. The X in the marking shall be determined in m^2 according to Annex GG; the marking shall not be required if the REFRIGERANT CHARGE (m_c) of the appliance is up to m_1 according to GG.1.2.

NOTE 101 For the REFRIGERATING SYSTEM, if the MAXIMUM ALLOWABLE PRESSURE of the LOW-PRESSURE SIDE and the HIGH-PRESSURE SIDE is the same, a single indication is permitted.

If not already visible when accessing a SERVICE PORT and if a SERVICE PORT is provided, the SERVICE PORT shall be marked to identify the type of refrigerant. If the refrigerant is flammable, symbol ISO 7010-W021 (2011-05) shall be included, without specifying the colour. When an A2L REFRIGERANT is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the A2L symbol described in 7.6.

Appliances employing REFRIGERATING SYSTEMS with MAXIMUM ALLOWABLE PRESSURES greater than 7 MPa shall be marked with symbol ISO 7000-1701 (2004-01) followed by the text "(X) MPa" and the Operator's manual; operating instructions symbol ISO 7000-1641 (2004-01).

Where: "X" is not less than the MAXIMUM ALLOWABLE PRESSURE as determined in Annex EE.

7.1DV.1 DR *Modification of Clause 7.1 of the Part 1 by adding the following to the third dashed item:*

Only applies to cord connected appliances;

7.1DV.2 DR *Modification of Clause 7.1 of the Part 2 by adding the following dashed items after the first dashed item in the "Addition":*

– motor [full load amps (FLA) and horsepower (Hp)]

For motors controlled by adjustable speed drive, FLA shall be replaced with either the motor's maximum operating current (MOC) or the rated input current of the power conversion equipment. When there is bypass utilized, the FLA shall be replaced with the largest of the motor's MOC, the rated input current to the power conversion equipment, or the FLA of the motor.

– total input current (cord connected units);

– minimum circuit ampacity (MCA) (permanently connected equipment only);

– motor compressor ratings rated load amps (RLA) as determined in Annex 101.DVB, and locked rotor amps (LRA);

For motor-compressors controlled by adjustable speed drive, RLA and LRA shall be replaced with the rated input current of the power conversion equipment.

– rating of overcurrent protective device (MOP) (permanently connected equipment only);

– branch circuit selection current (BCSC)

– if the motor-compressor maximum continuous current (MCC) exceeds 1.56 of the marked equipment nameplate RLA, or MRC;

– the short-circuit current rating (SCCR) as determined in Annex 101.DVB for motor controllers, equipment control panels, overall equipment panels, or industrial control panels when employed with multiple motor load and combination load equipment;

The short-circuit current rating of motor controllers, overall equipment panels, equipment control panels, or industrial control panels shall include the following marking or the equivalent as specified for the motor controllers, equipment control panels, overall equipment panels, or industrial control panels: "Short-circuit current: ____kA rms symmetrical, ___V maximum".

Equipment intended for use in one- and two-family dwellings, cord- and attachment plug–connected equipment, or equipment supplied from a branch circuit protected at 60 A or less is not required to be marked with a short-circuit current rating.

– manufacturing date or date code and location if the product is produced in more than one location;

– units with hot water coils shall be marked with the maximum inlet water temperature;

– units with steam coils shall be marked with the MAXIMUM ALLOWABLE PRESSURE at which the steam coil is intended to be used;

7.1DV.3 DR *Modification of Clause 7.1 of the Part 2 by replacing the third dashed item in the "Addition" with the following:*

– refrigerant or refrigerants as designated under ISO 817. A means shall be provided to permanently identify the refrigerant installed. Appliances using flammable refrigerants shall not be marked with alternative refrigerants of different classification per ISO 817;

7.1DV.4 DR *Modification of Clause 7.1 of the Part 2 by replacing the seventh dashed item in the "Addition" with the following:*

– for pre-charged pipe sets

- refrigerant number in accordance with ISO 817;
- the refrigerant charge in the line set;
- maximum allowable pressure;
- symbol ISO 7010-W021. When an A2L refrigerant is used, the flame symbol ISO 7010-W021 shall be replaced with the A2L symbol described in Clause 7.6.

7.1DV.5 DR *Modification of the paragraph above Note 101 in Clause 7.1 of the Part 2 by adding the following:*

The value of "X" in the warning for non-fixed appliances with flammable refrigerants shall be provided in both m^2 and ft^2.

For ITE COOLING APPLIANCES complying with Annex 101.DVN, which are not FIXED APPLIANCES, the following warning shall be applied when an A2L refrigerant is employed. The warning shall be placed on the outside of the appliance such that it is visible when it is not in use.

WARNING

Appliance shall be installed and operated in a room with an EFFECTIVE DISPERSAL VOLUME larger than 'A' m^3 ('B' ft^3).

When stored in an unpowered state, the appliance must be stored in a room with a floor area larger than 'X' m^2 ('Y' ft^2).

The minimum EFFECTIVE DISPERSAL VOLUME 'A' and the minimum room size 'X' shall be specified on the appliance. The 'A' in the marking shall be determined in m^3 (ft^3) according to Clause 101.DVN.8. The 'X' in the marking shall be determined in m^2 (ft^2) according to Annex GG. The marking shall not be required if the refrigerant charge (m_c) of the appliance is less than or equal up to m_1 according to Clause GG.1.2.

7.1DV.6 DR *Modification of Clause 7.1 of the Part 2 to add the following at the end:*

A PARTIAL UNIT or auxiliary devices that cannot be marked or provided with a nameplate, such as uncased coils, shall be provided with a distinctive model, part number, or type designation or the equivalent legibly marked on a tag attached to the partial unit or device.

7.1DV.7 DR *Modification of Clause 7.1 of the Part 2 to add the following at the end:*

If an A2 or A3 flammable refrigerant is used, the air conditioning equipment shall have red [Pantone® Matching System (PMS) #185] marked service ports, pipes, hoses, and other devices through which the refrigerant is serviced. This color shall be present at all service ports and where service puncturing or otherwise creating an opening from the refrigerant circuit to the atmosphere might be expected (e.g., process tubes). The color mark shall extend at least 25 mm (1 in) from the refrigerant servicing point and shall be replaced if removed.

7.1DV.8 D1 *Modification of Clause 7.1 of the Part 2 to add the following at the end:*

If the refrigerant is flammable, the symbol of the United Nations GHS or a combination of the United Nations GHS and ISO 7010-W021 symbols, including the refrigerant class per ISO 817, shall be visible when accessing a SERVICE PORT and where service puncturing or otherwise creating an opening from the refrigerant circuit to the atmosphere might be expected (e.g., process tubes). The symbol shall be in color.

7.1DV.9 D1 *Modification of Clause 7.1 of the Part 2 by addition of the following at the end:*

Where alternative refrigerants are marked on the nameplate, all markings and instructions shall be provided for each of the refrigerants marked on the nameplate.

7.1DV.10 D1 *Modification of Clause 7.1 of the Part 2 by addition of the following at the end:*

Appliances using flammable refrigerants shall also comply with Annex 101.DVF.

7.1DV.11 D1 *Modification of Clause 7.1 of the Part 2 by adding the following at the end:*

The marking symbol ISO 7000-1701 shall be visible within sight of the refrigerant service ports.

7.1DV.12 D1 *Modification of Clause 7.1 of the Part 2 by adding the following at the end:*

In all cases in Clause 7.1, where reference is made to ISO 7010-W021, it shall be replaced with "ISO 7010-W021 including the refrigerant class per ISO 817". All references in Clause 7.1 to the A2L symbol in Clause 7.6 do not apply. This applies to all flammable refrigerants. All references in Clause 7.1 stating the essence of "when an A2L refrigerant is used, the flame symbol ISO 7010-021 shall be replaced with the A2L symbol in Clause 7.6" do not apply.

7.1DV.13 D1 ***Modification of Clause 7.1 of the Part 2 by adding the following at the end:***

Refrigerant to water heat exchangers intended to heat water not intended for human consumption shall be marked with "Not Suitable for Potable Water Connection" at the point of the water connections.

For refrigerant to water heat exchangers intended to heat water, the water inlet and outlet, or the direction of flow, shall be marked.

7.1DV.14 D1 ***Modification of Clause 7.1 of the Part 2 by addition of the following at the end:***

Note 101DV: Note 101 does not apply.

Appliances classified according to Clause 6.101 as APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC, shall be marked "For Installation Only in Locations Not Accessible to the General Public".

NOTE 102DV: Additional requirements, such as those in Clause 7.112DV.1, may also apply to these appliances.

7.1DV.15 D1 ***Modification of Clause 7.1 of the Part 1 by adding the following to the seventh dashed item:***

or "For Outdoor Use" per Annex 101.DVO;

7.1DV.16 D1 ***Modification of Clause 7.1 of the Part 2 by replacing the sixth dashed item with the following:***

– maximum allowable pressure for the refrigerant circuit; if the maximum allowable pressure for the suction and discharge side differ, both suction and discharge pressures shall be marked;

7.1DV.17 D1 ***Modification of Clause 7.1 of the Part 2 by replacing the fourth paragraph with the following:***

For appliances using FLAMMABLE REFRIGERANTS, the flame symbol of the United Nations GHS and the operator's manual symbol described in Clause 7.6 shall be visible when viewing the appliance after it has been installed. The marking may be behind a detachable part that has to be detached before maintenance or repair work. The perpendicular height of the diamond used for the symbol shall be at least 30 mm. For appliances that are not single packaged units, the required markings shall be provided on all indoor and outdoor units complete the REFRIGERATING SYSTEM when installed. When an A2L REFRIGERANT is used, the flame symbol ISO 7010-W021 (2011-05) shall be replaced with the United Nations GHS symbol described in Clause 7.6.

7.1DV.18 DR ***Modification of Clause 7.1 of the Part 2 by adding the following to the end:***

For units evaluated to Annex 101.DVN, there shall be a marking on the nameplate stating the following:

“For use in ITE cooling applications only.”

7.1DV.19 DR *Modification of Clause 7.1 of the Part 2 by adding the following to the end:*

Pressurized control panels used for Clause 22.116DV.2 but not complying with ANSI/NFPA 496 or UL 60079-2 shall be marked with the following:

− intended external area classification for the protected enclosure (either the class and division or the zone); and

− pressurization type.

7.1DV.20 DR *Modification of Clause 7.1 of the Part 2 by replacing the sixth paragraph of with the following:*

If a flammable refrigerant is used, a warning symbol [flame symbol: ISO 7010-W021 (2011-05)] including the safety group per ISO 817, as described in Clause 7.6, shall be placed within sight of the marking of the refrigerant designation on the appliance. The height of the symbol shall be at least 10 mm.

NOTE 103DV The refrigerant designation is typically found on the nameplate of the appliance.

7.2DV D1 *Modification of Clause 7.2 of the Part 1 by replacing it with the following:*

Appliances shall be marked in letters not less than 3.2 mm (1/8 in) high on all panels providing access to hazardous voltage uninsulated live parts with the substance of the following:

“WARNING: RISK OF ELECTRIC SHOCK. CAN CAUSE INJURY OR DEATH. DISCONNECT All REMOTE ELECTRIC POWER SUPPLIES BEFORE SERVICING”, or the equivalent.

For equipment with multiple hazardous voltage power supplies, this marking shall be located on all panels providing access to hazardous voltage uninsulated live parts.

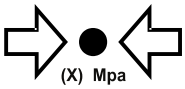
7.4DV D1 *Modification of Clause 7.4 of the Part 1 by replacing it with the following:*

For FIXED APPLIANCES, a wiring diagram shall be provided on the unit.

For any appliance that can be adjusted for different RATED VOLTAGES or RATED FREQUENCIES, the voltage or the frequency to which the appliance is adjusted shall be clearly discernible. If frequent changes in voltage setting or frequency setting are not required, this requirement is considered to be met if the RATED VOLTAGE or RATED FREQUENCY to which the appliance is to be adjusted can be determined from a wiring diagram affixed to the appliance.

NOTE The wiring diagram may be on the inside of a cover that has to be removed to connect the supply conductors. Material may be paper or the equivalent.

7.6 *Addition:*

	[symbol ISO 7010-W021 (2011-05)]	warning; flammable materials
	[symbol ISO 7000-1659 (2004-01)]	service indicator; read technical manual
	A2L symbol	warning; low burning velocity material
	[symbol ISO 7000-1701 (2004-01)]	pressure
	[symbol IEC 60417-6040 (2010-08)]	ultraviolet radiation, instructional safeguard
	[symbol ISO 7000-1641 (2004-01)]	operator's manual; operating instructions

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7.6DV D1 ***Modification of Clause 7.6 of the Part 2 by addition of the following:***

Replace symbol ISO 7010-W021 with the UN GHS (Globally Harmonized System of Classification and Labeling of Chemicals) flame symbol or a combination of the modified ISO 7010-W021 and the UN GHS flame symbols as shown below:

su4470a

Refrigerant Safety Group AXX

or

Refrigerant
Safety Group
AXX

The refrigerant safety group shall be listed in alphanumeric form, as designated in ISO 817.

Note 1DV: The UN GHS flame symbol is a red bordered diamond symbol, and the ISO 7010-W021 symbol is the yellow triangle.

The safety group shall be in text not less than 1/3 the height of the symbol.

The size of the UN GHS and the ISO flame symbols shall be a minimum of 15 mm in height.

7.12 *Addition:*

For APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC, the classification according to 6.101 shall be included.

For appliances using FLAMMABLE REFRIGERANTS, an installation, service and operation manual, either separate or combined manuals, shall be provided and include the information given in Annex DD.

7.12.1 *Addition:*

In particular, the following information shall be supplied:

• that the appliance shall be installed in accordance with national wiring regulations;

• the dimensions of the space necessary for correct installation of the appliance including the minimum permissible distances to adjacent structures;

• for appliances with SUPPLEMENTARY HEATERS, the minimum CLEARANCE from the appliance to combustible surfaces;

• a wiring diagram with a clear indication of the connections and wiring to external control devices and SUPPLY CORD;

• the range of external static pressures at which the appliance was tested (add-on HEAT PUMPS and ducted appliances with SUPPLEMENTARY HEATERS only);

• the method of connection of the appliance to the electrical supply and interconnection of separate components;

• indication of which parts of the appliance are suitable for outdoor use, if applicable;

• details of type and rating of fuses, or rating of circuit breakers;

• details of supplementary heating elements that may be used in conjunction with the appliance, including fitting instructions either with the appliance or with the SUPPLEMENTARY HEATER;

• maximum and minimum water or brine operating temperatures;

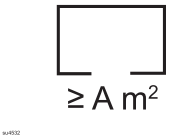
• maximum and minimum water or brine operating pressures;

• instructions on charging of refrigerants when addition of charge is required by the manufacturer for completing the REFRIGERATING SYSTEM.

Open storage tanks of HEAT PUMPS for water heating shall be accompanied by an instruction sheet which shall state that the vent shall not be obstructed.

7.12.1DV D1 ***Modification of Clause 7.12.1 of the Part 2 by adding the following:***

• when the symbol IEC 60417-6412 (2019-03) is used, a warning that the appliance shall be installed, operated and stored in a room with a floor area not less than the minimum room area.



7.12.9DV DR ***Add the following subclauses to Clause 7.12 of the Part 1:***

7.12.9DV.1 For each language, the instructions specified in Clause 7.12 and from Clauses 7.12.1 to 7.12.8 shall be in hard copy format and shall appear together before any other instructions supplied with the appliance. Alternatively, these instructions may be supplied with the appliance separately from any functional use booklet. They may follow the description of the appliance that identifies parts, or follow the drawings/sketches common to the languages of the instructions.

Compliance is checked by inspection.

7.12.9DV.2 For appliances using FLAMMABLE REFRIGERANTS, an installation manual, a service, maintenance and repair manual, and a decommissioning manual (either as separate or combined manuals) shall be made available and include the information given in Annex DD.

Compliance is checked by inspection.

Additional guidance on transportation, marking and storage for units that employ FLAMMABLE REFRIGERANTS is given in Annex CC.

7.15 *Addition:*

A marking may be located on a panel that can be removed for installation or service, providing that the panel shall be in place for the intended operation of the appliance.

7.101 A marking shall be provided for a replaceable fuse or a replaceable overload PROTECTIVE DEVICE provided as a part of a product or remote control assembly. It shall be visible when the cover or door of the compartment is open. This marking shall specify

• the rating of the fuse in amperes, the type and voltage rating, or

• the manufacturer and model designation of the replaceable overload protective device.

Compliance is checked by inspection.

7.101DV D1 ***Modification of Clause 7.101 of the Part 2 by replacing the second sentence with the following:***

The marking shall be visible when the cover or door of the compartment is open, or on the electrical wiring diagram or nameplate.

7.102 If the product is intended for permanent connection to fixed wiring with aluminium wires, the marking shall so state.

Compliance is checked by inspection.

7.103 For appliances made up of more than one factory made assembly specified by the manufacturer to be used together, instructions shall be provided for completing the assembly to ensure compliance with the requirements.

7.103DV D1 ***Modification of Clause 7.103 of the Part 2 by adding the following:***

Compliance is checked by inspection.

7.104 For PARTIAL UNITS, the instructions or markings shall include the following additional information.

• For EVAPORATING UNITS and CONDENSING UNITS, the instructions or markings shall include a wording to assure that the maximum operating pressure is considered when connecting to any CONDENSER UNIT or EVAPORATOR UNIT.

• For EVAPORATING UNITS, CONDENSING UNITS and CONDENSER UNITS, the instructions or markings shall include refrigerant charging instructions.

• A warning to assure that PARTIAL UNITS shall only be connected to an appliance suitable for the same refrigerant.

• This unit <model xxx> is a PARTIAL UNIT AIR CONDITIONER, complying with PARTIAL UNIT requirements of this International Standard, and must only be connected to other units that have been confirmed as complying to corresponding PARTIAL UNIT requirements of this International Standard.

• The electrical interfaces shall be specified with purpose, voltage, current, and safety class of construction.

• The SELV connection points, if provided, are to be clearly indicated in the instructions. The connection point should be marked with the “read the instructions” symbol per ISO 7000-0790 (2004-01) and the Class III symbol according to IEC 60417-5180 (2003-02).

7.104DV D1 ***Modification of Clause 7.104 of the Part 2 by replacing the fourth bullet with the following:***

• This unit <model xxx> is a PARTIAL UNIT AIR CONDITIONER, complying with PARTIAL UNIT requirements of this Standard, and must only be connected to other units that have been confirmed as complying to corresponding PARTIAL UNIT requirements of this Standard, UL 60335-2-40/CSA C22.2 No. 60335-2-40, or UL 1995/CSA C22.2 No 236.

7.105 For appliances using FLAMMABLE REFRIGERANTS that have safety features depending upon the proper function of a REFRIGERANT DETECTING SYSTEM, the instructions or unit markings shall contain the substance of the following:

“This unit is equipped with a refrigerant leak detector for safety. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.”

If any supplemental unit is employed to detect leaked refrigerant, such unit shall also apply this marking or be accompanied by such instructions.

Compliance is checked by inspection.

7.105DV D1 ***Modification of Clause 7.105 of the Part 2 by replacing it with the following:***

For appliances using FLAMMABLE REFRIGERANTS with safety features that depend upon the proper function of a leak detection system used for leak mitigation, the instructions and unit markings shall contain the substance of the following:

"LEAK DETECTION SYSTEM installed. Unit must be powered except for service." If any remote located REFRIGERANT SENSOR is employed to detect leaked refrigerant, such a remote located REFRIGERANT SENSOR shall also apply to this marking or be accompanied by such instructions.

For appliances using FLAMMABLE REFRIGERANTS with safety features that depend upon continuous air circulation, the instructions and unit markings shall contain the substance of the following:

"Continuous air circulation required for proper functioning. Unit must be powered except for service."

Compliance is checked by inspection.

7.106 For appliances using FLAMMABLE REFRIGERANTS that have safety features depending upon the proper function of ventilation, the instructions or unit markings shall contain the substance of the following:

“This unit is equipped with electrically powered safety measures. To be effective, the unit must be electrically powered at all times after installation, other than when servicing.”

If any supplemental unit is employed to dilute leaked refrigerant, such unit shall also apply this marking or be accompanied by such instructions.

Compliance is checked by inspection.

7.106DV D1 ***Modification of Clause 7.106 of the Part 2 by adding the following:***

The marking shall be applied to the indoor unit and any partial unit which must be powered to activate the detection system. It shall be visible after installation without the removal of panels.

7.107 For FLAMMABLE REFRIGERANTS, when addition of charge is required by the manufacturer installation instructions for completing the REFRIGERATING SYSTEM, the manufacturer shall provide a label that allows the installer to note the resulting total REFRIGERANT CHARGE for each REFRIGERATING SYSTEM. See Figure 101 for an example of label for field charged units.

7.107DV D1 ***Modification of Clause 7.107 of the Part 2 by adding the following:***

The label or other marking shall be applied as part of or adjacent to the nameplate of the compressor bearing unit.

Compliance is checked by inspection.

7.108 For appliances using FLAMMABLE REFRIGERANTS, the flame symbol described in 7.6 shall be visible in each of the following conditions:

– on the packaging of the appliance if the appliance is charged with refrigerant excluding appliances with A2L REFRIGERANT CHARGE not exceeding m_1;

– when viewing the appliance on display for sale. This does not apply to appliances using A2L REFRIGERANTS.

For appliances that are not FACTORY SEALED SINGLE PACKAGED UNITS, the required markings shall be provided on all indoor and outdoor units which complete the REFRIGERATING SYSTEM.

7.108DV D1 ***Modification of Clause 7.108 of the Part 2 by adding the following:***

The perpendicular height of the symbol shall be at minimum of 30 mm.

Compliance is checked by inspection.

For appliances using FLAMMABLE REFRIGERANTS, excluding appliances with A2L REFRIGERANT CHARGE not exceeding m_1, the flame symbol UN GHS or the combination of UN GHS flame symbol and the ISO 7010-W021 (2011-05) symbol including the safety group per Annex BB described in Clause 7.6 shall be visible on the packaging of the appliance if the appliance is charged with refrigerant.

7.109 Appliances employing UV-C GERMICIDAL LAMP SYSTEMS shall be marked with ULTRAVIOLET RADIATION hazard symbol IEC 60417-6040 (2010-08) and the Read operator's manual symbol ISO 7000-0790 (2004-01) in the following locations:

– doors and access panels that provide direct access to an area within the appliance where the measured UV-C SPECTRAL IRRADIANCE is greater than 1,7 μW/cm^2;

– USER MAINTENANCE access panels,

– UV-C BARRIERS.

Compliance is checked by inspection.

7.110 For appliances that employ UV-C GERMICIDAL LAMP SYSTEMS, the instructions shall include the substance of the following:

– this appliance contains a UV-C LAMP;

– read the maintenance instructions before opening the appliance;

– details for cleaning and other USER MAINTENANCE of the appliance. They shall state that prior to cleaning or other maintenance, the appliance must be disconnected from the supply mains;

– the method, frequency of cleaning, and necessary precautions to be taken;

– precautions to be taken when replacing UV-C emitters and starters, if applicable;

– unintended use of the appliance or damage to the housing may result in the escape of dangerous UV-C radiation. UV-C radiation may, even in small doses, cause harm to the eyes and skin;

– appliances that are obviously damaged must not be operated;

– the appliance must be disconnected from the supply before replacing the UV-C LAMP;

– doors and access panels bearing the ultraviolet radiation hazard symbol which may have UV-C SPECTRAL IRRADIANCE greater than 1,7 μW/cm^2 are provided with an interlock switch to interrupt the power to the UV-C LAMPS for your safety. Do not over-ride;

– before opening doors and access panels bearing the ULTRAVIOLET RADIATION hazard symbol for the conducting USER MAINTENANCE, it is recommended to disconnect the power;

– UV-C BARRIERS bearing the ULTRAVIOLET RADIATION hazard symbol should not be removed;

– for appliances with UV-C LAMPS, information on the replacement of UV-C LAMPS shall be given, including the model and/or part number;

– if field installed, the factory specified UV-C GERMICIDAL LAMP SYSTEMS approved for use with the subject product shall be specified in the instructions by the specific model number;

– do not operate UV-C LAMPS outside of the appliance.

Compliance is checked by inspection

7.111 For appliances employing REFRIGERATING SYSTEMS with MAXIMUM ALLOWABLE PRESSURES greater than 7 MPa, the instructions shall include the substance of the following:

– WARNING: System contains refrigerant under very high pressure. The system must be serviced by qualified persons only.

7.111DV D1 ***Modification of Clause 7.111 of the Part 2 by replacing it with the following:***

An appliance employing REFRIGERATING SYSTEMS with MAXIMUM ALLOWABLE PRESSURE greater than 7 MPa shall be marked within sight of the refrigerant service ports with the following:

a) WARNING: System contains refrigerant under very high pressure. The system must be serviced by qualified persons only. This warning shall also be included in the instructions.

b) With the symbol ISO 7000-1701 (2004-01), including the text "(X) MPa", where "X" is not less than the MAXIMUM ALLOWABLE PRESSURE as determined in EE.2DV.

Compliance is checked by inspection

7.112DV DR ***Add subclauses 7.112DV.1 to 7.112DV.6 to of Clause 7 of the Part 2:***

7.112DV.1 Appliances that meet the exception of Clause 20.2DV of the Part 1 shall be marked with the following where readily visible after installation:

"CAUTION: Mount with the lowest moving parts at least 2.5 m (8.2 ft) above floor or grade level."

7.112DV.2 All indoor units meeting the requirements of Clause 22.125DV as ENHANCED TIGHTNESS REFRIGERATING SYSTEMS shall be marked with "ETRS" enclosed in a box on the unit rating plate, with the font size no less than 5,0 mm.

7.112DV.3 For appliances incorporating the construction described in the second item of Clause 13.2DV.1, the instructions shall include the substance of the following:

– WARNING: RISK OF ELECTRIC SHOCK. CAN CAUSE INJURY OR DEATH: System contains oversize protective earthing (grounding) terminal which shall be properly connected

7.112DV.4 For appliances incorporating the construction described in the third item of Clause 13.2DV.1, the instructions shall include the substance of the following:

– WARNING: RISK OF ELECTRIC SHOCK. CAN CAUSE INJURY OR DEATH: System contains two independent protective earthing (grounding) terminals which both shall be properly connected and secured

7.112DV.5 Equipment intended to utilize a TRANSCRITICAL REFRIGERATING SYSTEM and required to include pressure regulating relief valves per Item a) of Clause 22.131DV.2 shall provide instructions that indicate the following:

a) If the system is de-energized, venting of the refrigerant through the pressure-regulating relief valves on the equipment can occur. In such cases, the system might need to be recharged with refrigerant, but in any case, the pressure-regulating relief valve(s) shall not be defeated or capped. The relief setting shall not be altered.

b) A sufficient number of pressure-relief and pressure-regulating relief valves might need to be provided based on the system capacity and located such that no stop valve is provided between the relief valves and the parts or section of the system being protected.

c) If the equipment contains a pressure vessel but the pressure-regulating and -relief valves are not installed as part of the equipment as permitted by Clauses 22.131DV.3 and 22.131DV.4, the instructions shall specify

1) the method for installing the valves within the fittings, and

2) that the equipment shall be provided with an adequate number of pressure regulating and relief valves based on the system capacity and located such that no stop valve(s) are provided between the relief valve(s) and the parts or section of the system being protected.

7.112DV.6 If the equipment contains a pressure vessel within a TRANSCRITICAL REFRIGERATING SYSTEM, but pressure relief valves and pressure-regulating relief valves are not provided as part of the equipment as permitted by Clause 22.131DV.3, a marking shall be located where visible to the installer indicating that pressure-relief valves or pressure-regulating relief valves are not installed on the equipment and that a sufficient number of valves having capacity deemed adequate shall be field-installed on the system.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

8.1.1DV.2 D1 *Modification to replace Clause 8.1.1DV.2 of the Part 1 with the following:*

In addition, test probe 18 and test probe 19 of IEC 61032 shall be applied as described for test probe B (IEC 61032) to APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC.

8.1.5 *Addition:*

As regards the products which have a dedicated installation panel or cover and which cannot be installed without them, compliance is checked according to 5.10 (after the installation as instructed in the installation manual).

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

9DV DR *Modification by replacing Clause 9 of the Part 2 with the following:*

This clause of Part 1 is applicable only for cord-connected appliances.

10 Power input and current

This clause of Part 1 is applicable.

10.101DV D1 *Modification by replacing Clause 10 of the Part 2 with the following:*

This clause of Part 1 is applicable except as follows:

For appliances other than cord connected, the rated power of Clause 10.1 or rated current of Clause 10.2 is to be measured separately for each motor load where the motor nameplate power or current is not used to determine the appliance ratings. Appliance provided with multiple supply connections to building mains for electric resistance heaters with subdivided loads shall take separate measurements for power or current for each divided load.

11 Heating

This clause of Part 1 is replaced by the following.

11.1 Appliances and their surroundings shall not attain excessive temperatures in normal use.

Compliance is checked by determining the temperatures of the various parts under the conditions specified in 11.2 to 11.7. Nevertheless, if the temperature of the motor winding exceeds the value specified in Table 3 or if there is doubt with regard to the classification of the insulation system employed in a motor, compliance is checked by the tests of Annex C.

11.1DV DR *Modification of Clause 11.1 of the Part 2 by adding the following:*

Appliances are operated until steady conditions are established. Steady conditions are established when all temperatures are constant. A temperature shall be considered constant when three successive measurements taken at 10 min intervals, at the same point of any operating cycle, do not differ by more than a 3 K which increase indicate that stabilized temperatures have been established.

In addition, the polymeric materials that enclose or support LIVE PARTS shall not exceed their relative thermal index determined in accordance with the standards in Annex DVA of the Part 1 and the Part 2.

11.2 *Appliances are installed in a test room in accordance with the installation instructions. In particular,*

• *CLEARANCES to adjacent surfaces specified by the manufacturer shall be maintained;*

• *flow rates for liquid source or sink equipment shall be the minimum specified in the instructions except for HYDRONIC FAN COIL UNITS where the flow rates and liquid temperatures shall be the maximum specified in the instructions;*

• *the outlet duct connected to the appliance shall be subjected to the maximum static pressure given in the instructions;*

• *for appliances provided with means of adjusting the flow, the flow for the tests shall be the minimum obtainable;*

• *adjustable limit controls are set at the maximum cut-out setting and the minimum differential permitted by the control adjusting means.*

For appliances provided with SUPPLEMENTARY HEATERS, an additional test casing as described in 11.9 is used.

11.2DV.1 D1 *Modification of Clause 11.2 of the Part 2 by replacing the third and fourth bullets with the following:*

1) the outlet duct connected to the appliance shall be subject to the maximum static pressure given in the instructions in heating mode and the minimum static pressure given in the instructions in cooling mode;

2) for appliances provided with means of adjusting the conditioned airflow, the initial airflow for the test shall be the minimum obtainable in heating mode and the maximum obtainable in cooling mode per the manufacturer's instructions.

11.2DV.2 D1 *Modification of Clause 11.2 of the Part 2 by adding the following bullet:*

1) appliances with air filters that are not factory provided and not specified for field installation shall be tested with 2 mm water column added to the manufacturer's maximum specified external static pressure.

11.2.1 *For heating tests of ducted appliances with SUPPLEMENTARY HEATERS, an inlet duct is connected to the inlet air opening of the appliance (assuming that the appliance is intended to be so applied). The duct shall be the same size as the flanges, if flanges are provided. If flanges are not provided, the duct is the same size as the inlet opening.*

An appliance that includes or has provision for SUPPLEMENTARY HEATER is fitted with a metal outlet duct in accordance with Figure 102a) or Figure 102b), depending on the direction of the airflow.

The inlet duct is provided with an adjustable restricting means by which the airflow can be reduced.

The restriction should be uniform across the duct's cross sectional area, so that the full heating coil surface will be exposed to the airflow except when the restriction is closed.

11.2.1DV.1 DE *Modification of Clause 11.2.1 in the Part 2 to add a note as follows:*

NOTE 1DV For horizontal ducted products, reference Figure 102a, rotated 90 degrees counterclockwise.

11.2.1DV.2 D2 *Modification of Clause 11.2.1 in the Part 2 by adding the following:*

For the tests of Clause 11 and Clause 19, the distance from the air outlet opening of the appliance to the furthest point on the test duct, perpendicular to the outlet opening, shall be no more than

a) for upflow appliances $(AB)^{1/2}$, as shown in Figure 102 a), or the minimum distance specified by the manufacturer, whichever is lower; and

b) for downflow appliances [300 + $(AB)^{1/2}$], as shown in Figure 102 b), or the minimum distance specified by the manufacturer, whichever is lower.

NOTE 2DV Appliances may be specified by the manufacturer for use in applications with limited space for the appliance and connected ducts. For example:

– For upflow appliances intended for use in manufactured (mobile) homes, the combined height of the appliance and ducts are typically limited to 2.1 m (7 ft) minus the specified clearance to combustible material.

– For downflow appliances intended for use in manufactured (mobile) homes, the distance from the air outlet opening to the furthest point on the test duct, perpendicular to the outlet opening, is typically reduced to not less than [25.4 + (AB)$^{1/2}$].

11.2.1DV.3 D2 *Modification of Clause 11.2.1 in the Part 2 by adding the following:*

For appliances with water heat exchangers intended to heat water and that are provided with storage tanks, after a full tank of water has been heated to the temperature at which the temperature-regulating thermostats open, one-fourth of the water shall be drawn off and replaced promptly with cold water. The cold water entering temperature shall be 15 °C (59 °F). The appliance shall then be allowed to heat again until the thermostats open, at which time temperatures shall be observed immediately.

The temperature of the water at the water outlet shall be measured as water is drawn off immediately following the second opening of the temperature-regulating control.

For appliances with water heat exchangers intended to heat water and that are not provided with storage tanks, the water flow rate through the unit shall be reduced until a temperature-regulating control operates, at which time the control shall be bypassed and the water temperature is maintained within 2 K of temperature-regulating control. The unit shall then be operated continuously until temperatures have stabilized.

11.2.2 *A ducted appliance which does not include* SUPPLEMENTARY HEATERS *is fitted with an outlet duct sized to fit the casing flanges, or opening without flanges, or locations marked for flanges, and arranged to discharge away from the return air inlet.*

The outlet duct is provided with a restricting means to obtain the maximum static pressure given in the instructions.

11.2.3 For the evaluation and testing of PARTIAL UNITS, the following test setup and conditions are to be applied.

• EVAPORATOR UNITS and CONDENSER UNITS are tested as individual units at the maximum ambient temperature stated in the instructions. If not stated in the instructions, these units shall be tested at an ambient temperature that is equal to the saturated temperature of the refrigerant at the marked MAXIMUM ALLOWABLE PRESSURE (± 0,1 MPa) minus 10 K (± 1 K).

• CONDENSING UNITS are tested in the cooling mode only, at the maximum specified ambient temperature with 9 K (± 1 K) sub-cooling and the maximum specified evaporating pressure with 11 K (± 1 K) superheat. For CONDENSING UNITS provided with expansion device(s), the superheat/sub-cooling is to be as under the normal control of the expansion device(s).

• EVAPORATING UNITS, intended for cooling only, are tested in the cooling mode only with a condensing pressure that is equal to the marked MAXIMUM ALLOWABLE PRESSURE (± 0,1 MPa) with 9 K (± 1 K) sub-cooling.

• EVAPORATING UNITS that are intended for reverse cycle operation are tested in the heating mode only, at the maximum specified evaporating pressure.

NOTE 101 Testing for CONDENSING UNITS and EVAPORATING UNITS requires connection to calorimeter stand or similar device capable of controlling the refrigerant entering and leaving conditions as specified in the test above. CONDENSER UNITS and EVAPORATOR UNITS do not require a calorimeter stand or similar device.

11.2.3DV DE *Modification of Clause 11.2.3 in the Part 2 by replacing the first bullet with the following and by adding the following note:*

1) EVAPORATOR UNITS are tested as individual units at the maximum ambient temperature stated in the instructions. If not stated in the instructions, these units shall be tested at the conditions listed in Table 101.DVA.1.

2) CONDENSER UNITS are tested as individual units at the maximum ambient temperature stated in the instructions. If not stated in the instructions, these units shall be tested at an ambient temperature that is equal to the saturated temperature of the refrigerant at the MAXIMUM ALLOWABLE PRESSURE (± 0,1 MPa) minus 10 K (± 1 K).

NOTE 102DV For PARTIAL UNITS, it may not be necessary to operate the refrigeration system during the test of Clauses 10 and 11 if all of the following apply:

– the motor-compressor is in compliance with UL 60335-2-34,

– the motor-compressor RLA marked on the appliance is not less than 64 % of the motor-compressor MCC, and

– the control box is externally loaded at not less than the marked compressor RLA or MRC and the marked motor rated current or MOC.

11.3 *Temperatures other than those of windings are determined by means of fine-wire thermocouples so chosen and positioned that they have the minimum effect on the temperature of the part under test.*

NOTE 101 Thermocouples having wires with a diameter not exceeding 0,3 mm are considered to be fine-wire thermocouples.

Thermocouples used for determining the temperatures of the surface of walls, ceiling and floor are embedded in the surface or attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick, which are flush with the surface.

So far as is possible, the appliance is positioned so that parts likely to attain the highest temperatures touch the disks.

In determining the temperatures of handles, knobs, grips and the like, consideration is given to all parts which are gripped in normal use and, if of insulating material, to parts in contact with hot metal.

The temperature of electrical insulation, other than that of windings, is determined on the surface of the insulation, at places where failure could cause a short circuit, contact between LIVE PARTS and ACCESSIBLE metal PARTS, bridging of insulation or reduction of CLEARANCES and CREEPAGE DISTANCES below the values specified in Clause 29.

Temperatures of windings are determined by the resistance method unless the windings are non-uniform or severe complications are involved in order to make the necessary connections, in which case the temperatures are determined by means of thermocouples.

The temperatures in the duct are to be measured by means of a thermocouple grid consisting of nine thermocouples of identical length, wired in parallel to form a grid with a thermocouple located centrally in each of nine equal duct areas in a plane perpendicular to the axis of the airflow.

11.3DV D2 *Modification of NOTE 101 in Clause 11.3 of the Part 2 by adding the following:*

Larger-diameter thermocouples may be used if there is minimum effect on the temperature of the part under test.

11.4 *Appliances are operated under NORMAL OPERATION at a supply voltage between 0,94 times the lowest RATED VOLTAGE and 1,06 times the highest rated voltage, the voltage chosen being that which gives the most unfavourable result. Heating elements shall be energized at a voltage which gives an electrical input of 1,15 times the maximum RATED POWER INPUT.*

11.4DV D2 *Modification of Clause 11.4 of the Part 2 by replacing the last sentence with the following:*

Single-phase equipment with a rating of 240 V / 60 Hz are allowed to be tested at +6 % and –5 %.

11.5 *Where an appliance can be operated in the cooling mode as well as the heating mode, a test is conducted in each mode.*

For appliances with SUPPLEMENTARY HEATERS or provision for SUPPLEMENTARY HEATERS, an additional test is conducted with all the heating elements operative by short circuiting THERMOSTATS or by reducing, if necessary, the air temperature to a value which causes all the elements to switch on.

11.5DV.1 D2 *Modification of Clause 11.5 of the Part 2 by deleting the second paragraph.*

11.5DV.2 D2 *Modification of Clause 11.5 of the Part 2 by adding the following:*

For appliances with supplementary heaters or provision for supplementary heaters capable of simultaneous operation of the supplementary heat and refrigeration circuit, the unit shall be operated under the following conditions:

a) for a unit with an air-cooled outdoor heat exchanger, 8,3 °C DB / 6,1 °C WB outdoor air and 21,1 °C DB indoor air or not to exceed the manufacturer's declared conditions; or

b) for a unit with a water-cooled outdoor heat exchanger, 21,1 °C entering water temperature at rated flow or not to exceed the manufacturer's declared conditions.

NOTE 1DV: The manufacturer's declared conditions are referenced because the manufacturer may declare higher or lower maximum conditions for simultaneous refrigerant and electric heat operation to be tested.

11.6 *Appliances with defrost facilities are additionally submitted for a defrost test in the most unfavourable conditions.*

11.6DV D1 *Modification of Clause 11.6 of the Part 2 by adding the following:*

For appliances with supplementary heaters or provision for supplementary heaters capable of simultaneous operation of the supplementary heat and refrigeration circuit, the unit shall be operated under the following conditions:

a) For heating mode, a unit with air cooled outdoor heat exchanger shall be operated at 8,3 °C DB / 6,1 °C WB outdoor air and 21,1 °C DB indoor air. A unit with a water-cooled outdoor heat exchanger shall be operated at 21,1 °C entering water temperature at rated flow.

b) For cooling mode, the conditions of Clause 11 apply.

11.7 *All appliances are operated continuously until steady conditions are achieved except for defrost tests.*

11.8 *During the test, the temperatures are monitored continuously and shall not exceed the values shown in Table 3,* PROTECTIVE DEVICES *shall not operate and sealing compound shall not flow out.*

The temperature of the air in the outlet duct shall not exceed 90 °C.

The value of the temperature of a winding shall be calculated from the formula:

$$T = \frac{R_2}{R_1}(k + T_1) - k$$

where

T is the temperature of the copper winding at the end of the test;

R_1 is the resistance at the beginning of the test;

R_2 is the resistance at the end of the test;

T_1 is the ambient temperature at the beginning of the test;

k is equal to 234,5 for copper windings and 225 for aluminium windings.

At the beginning of the test, the windings shall be at ambient temperature.

It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

11.8DV D1 ***Modification of Clause 11.8 of the Part 2 by replacing the first paragraph with the following:***

During the test, the temperatures are monitored continuously and shall not exceed the values shown in Table 3, PROTECTIVE DEVICES other than motor compressors shall not operate and sealing compound shall not flow out. However, components in PROTECTIVE ELECTRONIC CIRCUITS are allowed to operate provided they are tested for the number of cycles of operation specified in Clause 24.1.4.

Table 3
Temperature limits

Parts	Temperature °C
Windings of sealed motor-compressors [a]	
– with synthetic insulation	*140*
– with other insulation	*130*
External enclosure of appliances with or without SUPPLEMENTARY HEATERS	*85*
Windings [b] *if the winding insulation is (other than motor-compressors):*	
– of class 105 (A) material [c]	*100 (90)*
– of class 120 (E) material [c]	*115 (105)*
– of class 130 (B) material [c]	*120 (110)*
– of class 155 (F) material [c]	*140*
– of class 180 (H) material [c]	*165*
– of class 200 material [c]	*185*
– of class 220 material [c]	*205*
– of class 250 material [c]	*235*
Terminals, including earthing terminals, for external conductors of STATIONARY APPLIANCES, unless they are provided with a SUPPLY CORD	*85*
Ambient of switches, and THERMOSTATS and TEMPERATURE LIMITERS [d]	
– without T marking	*55*
– with T marking	*T*
Rubber or polyvinyl chloride insulation of internal and external wiring, including SUPPLY CORD:	
– without temperature rating [e]	*75*
– with temperature rating (T)	*T*
Cord sheaths used as SUPPLEMENTARY INSULATION	*60*
Rubber, other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:	
– when used as SUPPLEMENTARY INSULATION or REINFORCED INSULATION	*65*
– in other cases	*75*
Lampholders with T-marking[j]	
– B15 and B22 marked T1	*165*
– B15 and B22 marked T2	*210*
– other lampholders	*T*
Lampholders without T-marking[j]	
– E14 and B15	*135*
– B22, E26 NS E27	*165*
– other lampholders and starter holders for fluorescent lamps	*80*
Material used as insulation other than that specified for wires and windings:	
– impregnated or varnished textile, paper or press board	*95*
– laminated bonded with:	
• melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins	*110*
• urea-formaldehyde resin	*90*
– printed circuit boards bonded with epoxy resin	*145*
– moulding of:	

Table 3 Continued on Next Page

Table 3 Continued

Parts	Temperature °C
• phenol-formaldehyde with cellulose fillers	*110*
• phenol-formaldehyde with mineral fillers	*90*
• melamine-formaldehyde	*110*
• urea-formaldehyde	*90*
– polyester with glass-fibre reinforcement	*135*
– silicone rubber	*170*
– polytetrafluoroethylene	*290*
– pure mica and tightly sintered ceramic material, when such materials are used as SUPPLEMENTARY INSULATION or REINFORCED INSULATION	*425*
– thermoplastic material[f]	*–*
Wood, in general[g]	*90*
Wooden walls of the test casing	*90*
Outer surfaces of capacitors[h]*:*	
– with marking of maximum operating temperature (T)[i]	*T*
– without marking of maximum operating temperature:	
• small ceramic capacitors for radio and television interference suppression	*75*
• capacitors complying with IEC 60384-14	*75*
• other capacitors	*45*
Handles, knobs, grips and the like and all parts which are gripped in normal use:	
– of metal	*60*
– of porcelain or vitreous material	*70*
– of moulded material, rubber or wood	*85*
Parts in contact with oil having a flash-point of t °C	*t – 25*
Any point where the insulation of wires can come into contact with parts of a terminal block or compartment for fixed wiring of a STATIONARY APPLIANCE not provided with a SUPPLY CORD:	
– if the instructions require the use of supply wires with temperature rating (T)	*T*
– in other cases	*75*

[a] *Not required for motor-compressors that comply with IEC 60335-2-34.*

[b] *The temperatures within parentheses apply when thermocouples are used. The figures without parentheses apply when the resistance method is used.*

[c] *The classification is in accordance with IEC 60085.*

Examples of Class A (class 105) material are:

– impregnated cotton, silk, artificial silk and paper;

– enamels based on oleo or polyamide resins.

Examples of Class B (class 130) materials are:

– glass fibre, melamine-formaldehyde and phenol-formaldehyde resins.

Example of Class E (class 120) material are:

– mouldings with cellulose fillers, cotton fabric laminates and paper laminates, materials bonded with melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins;

– cross-linked polyester resins, cellulose triacetate films, polyethylene terephthalate films;

– varnished polyethylene terephthalate textile bonded with oil-modified alkyd resin varnish;

– enamels based on polyvinyl formalin, polyurethane or epoxy resins.

Table 3 Continued on Next Page

Table 3 Continued

Parts	Temperature °C
For totally enclosed motors, the temperature limits for class A (class 105), class E (class 120) and class B (class 130) materials may be increased by 5 °C (5 K). *A totally enclosed motor is a motor so constructed that the circulation of the air between the inside and the outside of the case is prevented, but which is not necessarily sufficiently enclosed to be called airtight.* *[d] T means the maximum operating temperature.* *The ambient of switches and THERMOSTATS is the temperature of the air at the hottest point at a distance of 5 mm from the surface of the switch and THERMOSTAT concerned.* *For the purpose of this test, switches and THERMOSTATS marked with the individual ratings may be considered as having no marking for the maximum operating temperature, if this is requested by the manufacturer of the appliance. However, if a THERMOSTAT or other TEMPERATURE LIMITER is mounted on a heat-conducting part, the declared temperature limit of the mounting surface (Ts) is also applicable. Therefore, the temperature of the mounting surface has to be measured.* *[e] This limit applies to cables, cords and wires complying with the relevant IEC standards; for others, it may be different.* *[f] There is no specific limit for thermoplastic material, which shall withstand the tests of 30.1, for which purpose the temperature shall be measured.* *[g] The limit specified concerns the deterioration of wood and it does not take into account deterioration of surface finishes.* *[h] There is no limit for the temperature rise of capacitors which are short-circuited in 19.11.2 c).* *[i] Temperature marking for capacitors mounted on printed circuit boards may be given in the technical sheet.* *[j] Locations for measuring the temperatures are specified in Table 12.1 of IEC 60598-1:2008.*	
If these or other materials are used, they shall not be subjected to temperatures in excess of the thermal capabilities as determined by aging tests made on the materials themselves.	

NOTE 101 The temperature limit for metal applies to parts having a metal coating at least 0,1 mm thick and to metal parts having a plastic coating less than 0,3 mm thick.

NOTE 102 The temperature of the terminal's switches is measured if the switch is tested in accordance with Annex H.

Table 3DV D2 *Modification of Table 3 of the Part 2 as follows:*

a) Replace footnote (a) of Table 3 with the following:

[a] Not required for motor-compressors that comply with Annex AA or 101.DVH of UL 60335-2-34 and CAN/CSA-C22.2 No. 60335-2-34. For hermetically sealed motor compressors that do not comply with Annex AA of UL 60335-2-34 and CAN/CSA C22.2 No. 60335-2-34 the temperature of the enclosure shall not exceed 150 °C.

b) Add the following to footnote (b) of Table 3:

For the windings of universal motors, relays, solenoids and similar components the resistance or TC method can be used and for windings of vibrator coils and a.c. motors, the figures without parentheses apply in both cases. Single ampere rating does not exceed 12 A at 208 ~ 240 V or 16 A at 120 V.

c) Add the following note:

"NOTE 103DV A maximum temperature for RTV silicon rubber is 130 °C."

d) Add the following to footnote (d) of Table 3:

For THERMOSTATS and TEMPERATURE LIMITERS evaluated to requirements without a required T marking, the temperature limit for the local ambient of the control shall not exceed the ambient temperature evaluated for the component.

NOTE: Standards such as UL 353, UL 873, or CSA C22.2 No. 24 which comply with 24.1.4DV.1 may not have a T marking, and the ambient temperature used during that evaluation shall be used.

e) In the eleventh item, change the maximum temperature for "material used as insulation, other than that specified for wires and windings: impregnated or varnished textile, paper or press-board" from "95" to "90" and change the maximum temperature for "polytetrafluoroethylene" from "290" to "205".

f) Add the following rows to Table 3:

Parts	Temperature °C
Surface temperatures of the product, discharge plenum, and duct at points of specified zero clearance to test casing	121
Wooden walls of the test casing	121
Appliance with a heat exchanger for the purpose of heating water, water outlet temperature.	85
Heat pump pool heater, water temperature	40

11.9 Test casing

The test casing consists of plywood walls having a thickness of about 20 mm, with dull black painted inside surfaces and all joints sealed. The distances between the casing and the surfaces of the appliance and the outlet duct, if any, are equal to the minimum CLEARANCES specified by the manufacturer.

For appliances not specified for installation with minimum CLEARANCES, as an alternative to the plywood test casing in direct contact with the appliance, glass fibre insulating material having a thickness of at least 25 mm and a density of at least 16 kg/m^3 may be wrapped closely around the appliance and the outlet duct, provided this is agreed with the manufacturer.

In that case, thermocouples are directly placed in contact with the enclosure.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

13.2 *Modification:*

For STATIONARY CLASS I APPLIANCES, the leakage current shall not exceed 2 mA per kilowatt RATED POWER INPUT with a maximum value of 10 mA for APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC, and a maximum value of 30 mA for APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC.

13.2DV.1 D1 *Modification of Clause 13.2 of the Part 2 by adding the following:*

For APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC, TOUCH CURRENT and leakage currents do not apply

For motor-operated and combined, permanently connected, stationary, class I appliances, which are APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC, replace LEAKAGE CURRENT with

TOUCH CURRENT as defined in IEC 60990 and measured using the IEC 60990, Figure 5 measuring network. The TOUCH CURRENT shall not exceed 3,5 mA unless one of the following conditions are met:

1. *Compliance determined by the following tests:*

a) at all frequencies, the open-circuit driving voltage on the protective earth is SELV, as measured using an instrument capable of isolating the frequency components, with input impedance of 1 MΩ or greater; or

b) TOUCH CURRENT shall not exceed 2 mA RMS per kilowatt rated power input with a maximum value of 5 mA RMS per Equation 13.2DV; or

c) at all frequencies other than 60 Hz, the open-circuit driving voltage on the protective earth is SELV, as measured using an instrument capable of isolating the frequency components, with input impedance of 1 MΩ or greater; and

At 60 Hz frequency, TOUCH CURRENT shall not exceed 2 mA RMS per kilowatt rated power input with a maximum value of 5 mA RMS TOUCH CURRENT per Equation 13.2DV.

For Items b) and c), see Figure 108DV in addition to Figure 2, and replace Figure 4 with Figure 109aDV and Figure 109bDV.

The TOUCH CURRENT (I_{tc}) limit is calculated as follows:

$$I_{tc} = (2 \times P) \qquad \textbf{(13.2DV)}$$

where

I_{tc} is the TOUCH CURRENT in mA

***P* is the rated power input as determined by Clause 7.1**

2 is a constant in mA/kW

Compliance is determined by testing.

Note 1DV: An oscilloscope in FFT mode can register voltages above or below SELV.

Note 2DV: Per IEC 60990, Annex G.2, the instrument should have frequency range from 15 Hz to 1 MHz (or more if higher frequencies are involved).

Note 3DV: The IEC 60990, Figure 5 measurement network is to be used for current measurements.

An oscilloscope may be used for voltage measurements.

2. A connecting terminal sized to accept a PROTECTIVE EARTHING CONDUCTOR one standard size larger than the minimum size required by the applicable national electric code (ANSI/NFPA 70, Table 250.122 or CSA C22.1, Table 16A) shall be provided. Appliances using this exception shall include the language required in Clause 7.112DV.3 in the instructions.

3. A second connecting terminal for an additional PROTECTIVE EARTHING CONDUCTOR shall be provided. Both terminals shall be sized to accept the minimum conductor sizes required by the applicable national electric code (ANSI/NFPA 70, Table 250.122 or CSA C22.1, Table 16A). Appliances using this exception shall include the language required in Clause 7.112DV.4 in the instructions.

4. A monitoring device that interrupts all supply conductors when it detects an open circuit on the PROTECTIVE EARTHING CONDUCTORS shall be provided. If the monitoring device is an electronic control, it shall be evaluated as a PROTECTIVE ELECTRONIC CONTROL.

NOTE 4DV: Protective impedance and radio interference filters are disconnected before carrying out the test. These impedances shall comply with Clauses 8.1.4 and 22.7 of the Part 1.

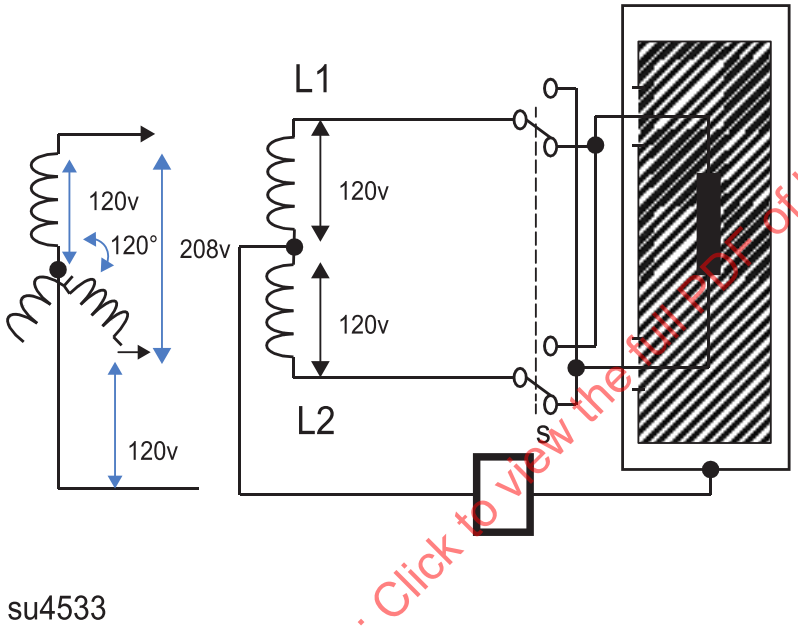
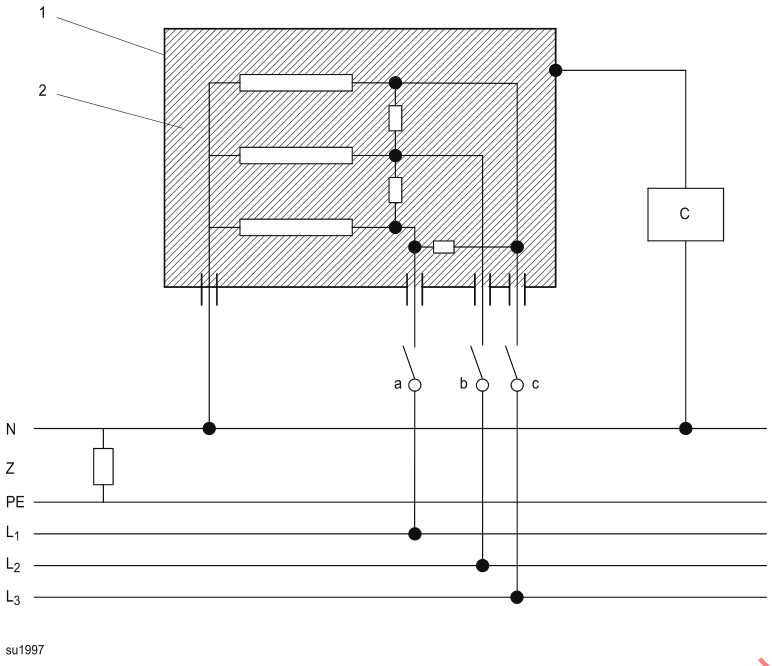


Figure 108DV

Circuit diagram for leakage current measurement at operating temperature for single-phase motor-operated, permanently connected, stationary, class I appliances which are APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC



NOTE 5DV Measuring circuit "C" is a 1 mΩ resistor, which is measured across for the open circuit voltage measurement; when measuring current, it is the circuit of IEC 60990, Figure 5.

Figure 109aDV

Circuit diagram for leakage current measurement at operating temperature for three-phase motor-operated, permanently connected, stationary, class I appliances which are APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC

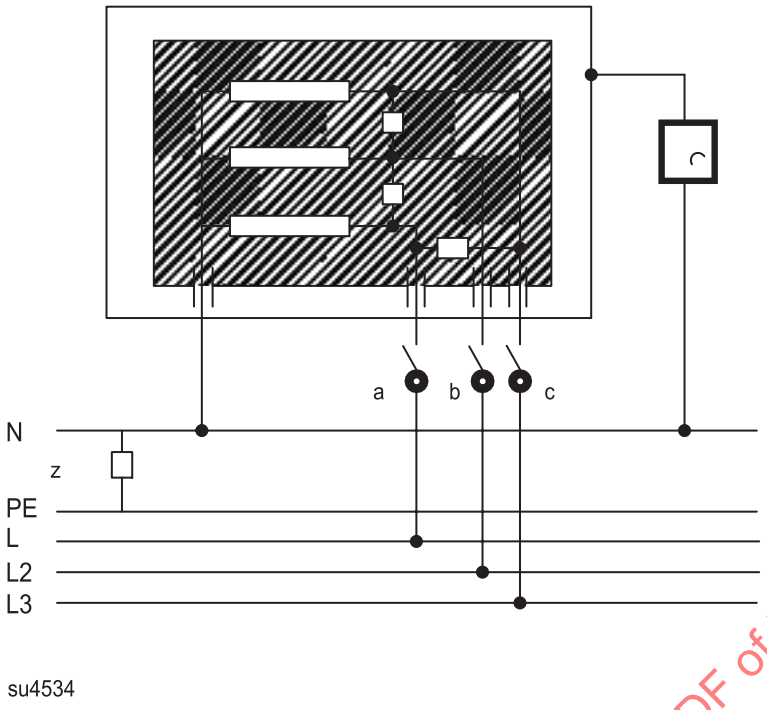


Figure 109bDV

Circuit diagram for leakage current measurement at operating temperature for three-phase motor-operated, permanently connected, stationary, class I appliances which are APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC

13.2DV.2 D1 ***Modification of Clause 13.2 in the Part 1 by adding the following:***

For cord-connected CLASS I appliances, Figure 2 shall be replaced by Figure 110DV or Figure 111DV, as applicable.

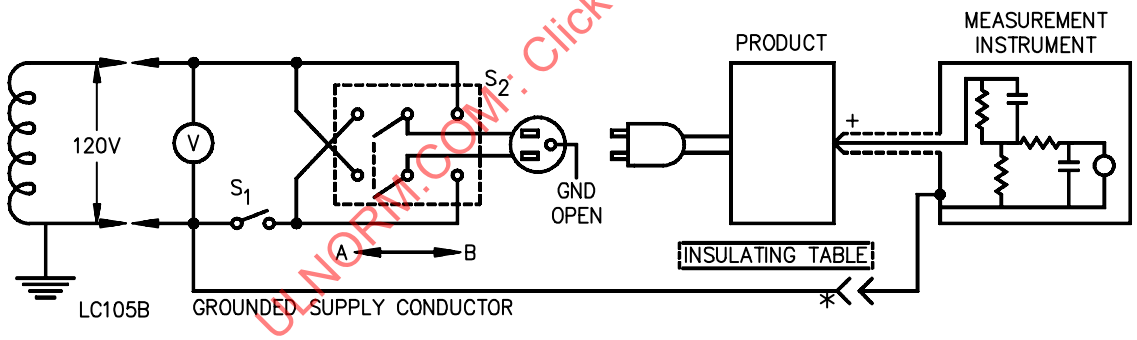
With reference to the measuring circuit in Figure 110DV and Figure 111DV, the leakage current test sequence shall be as described in Items a) to d). If the compressor stalls during the sequence in Item b) or c) due to changing the position of switch S2, the sequence shall be conducted in its entirety in one position of switch S2 and then repeated in the second position of switch S2, as follows:

a) With switch S1 open, the unit shall be connected to the measuring circuit. The leakage current shall be measured using both positions of switch S2 and with manually-operated unit switching devices successively placed in each mode (fan only, cooling, heating, etc.).

b) With unit controls set for maximum cooling and maximum fan speed, switch S1 shall be closed to energize the unit. Within 5 s, leakage current shall be measured using both positions of switch S2. Following this and using both positions of switch S2, manual switching devices shall be operated as quickly as possible through all cooling modes, but not in the "OFF" position, to determine the maximum leakage current condition.

c) With switching devices set at the position which causes the highest leakage current, the unit shall be operated continuously until the measured leakage current stabilizes or decreases. Both positions of switch S2 shall be used.

d) Following the sequence in Item c), switch S1 shall be opened to de-energize the unit. Measurement of leakage current shall continue, using both positions of switch S2, until values stabilize or begin to decrease.

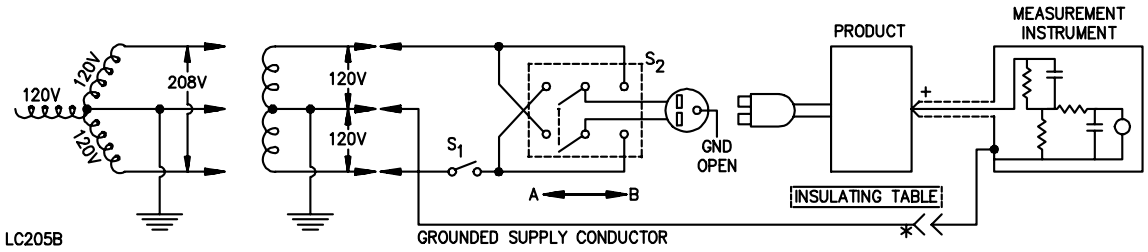


*** Separated and used as clip when measuring currents from one part of product to another.**

+ Probe with shielded lead.

Figure 110DV

Circuit diagram for leakage current measurement at operating temperature for single-phase motor-operated, cord-connected, stationary, class I appliances



*** Separated and used as clip when measuring currents from one part of product to another.**

+ Probe with shielded lead.

Figure 111DV

Circuit diagram for leakage current measurement at operating temperature for 208 V or 240 V products intended for connection to three-wire neutral grounded circuits which are motor-operated, cord-connected, stationary, class I appliances

13.3DV D2 *Modification of Clause 13.3 of the Part 1 by adding of the following:*

For Class I appliances, the insulation of the appliance shall be subjected to a voltage of substantially sinusoidal waveform having a frequency of approximately 50 Hz or 60 Hz for 1 min. The value of the test voltage shall be two times the rated voltage plus 1 000 V. The points of application shall be between live parts and accessible metal parts separated from live parts by basic insulation.

For APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC, the electric strength tests shall be conducted in accordance with Clause 101.DVH.13.3.

A DC potential equivalent to 1,414 times the test voltage in Clause 13 can be applied.

14 Transient overvoltages

This clause of Part 1 is applicable.

15 Moisture resistance

This clause of Part 1 is replaced by the following.

15.1 Electrical components of appliances shall be protected against the ingress of water which may be present in the appliance as a result of rain, overflow from the drain pan, or defrosting.

Compliance is checked by the tests of 15.2, followed immediately by the overflow test of 15.3; and this is followed by the defrost test of 11.6, and the tests of Clause 16.

Following these tests, an inspection is made within the enclosures. The water which may have entered the enclosure shall not have reduced CLEARANCES and CREEPAGE DISTANCES below the minimum values specified in Clause 29.

NOTE 101 Appliances designed to be installed completely inside a building and which have no outdoor parts are not subjected to the test of 15.2.

If ducts leading to the outside of a building are used, the test of 15.2 is carried out on the terminations of such ducts in an arrangement simulating the actual installation, according to the instructions.

For appliances intended to be mounted through a wall or a window, or for a split package unit, the test of 15.2 is carried out on that part or unit which, according to the instructions, is intended to be mounted outside the building.

The motor-compressor is not operated and DETACHABLE PARTS are removed during the tests of 15.2 and 15.3.

15.1DV.1 D1 *Modify Clause 15.1 of the Part 2 by deleting Note 101.*

15.1DV.2 D2 *Modification of Clause 15.1 of the Part 2 by addition of the following:*

If the appliance is equipped with an outdoor service receptacle, the test is to be conducted with a plug inserted in the receptacle.

15.2 *Appliances other than IPX0 are subjected to the tests of IEC 60529:1989 as follows:*

– IPX1 appliances as described in 14.2.1;

– IPX2 appliances as described in 14.2.2;

– IPX3 appliances as described in 14.2.3;

– IPX4 appliances as described in 14.2.4;

– IPX5 appliances as described in 14.2.5;

– IPX6 appliances as described in 14.2.6;

– IPX7 appliances as described in 14.2.7.

For this test, the appliance is immersed in water containing 1 % NaCl.

15.2DV.1 D2 *Modification of Clause 15.2 of the Part 2 by replacing "For this test, the appliance is immersed in water containing 1 % NaCl." with "For the IPX7 test, the appliance is immersed in water containing 1 % NaCl."*

15.2DV.2 D1 *Modification of Clause 15.2 of the Part 2 by adding the following:*

below "– IPX4 appliances as described in 14.2.4":

Note 1DV: At the manufacturer's option, a rain test can be conducted on the appliance in accordance with Annex 101.DVO.

15.3 *The appliance is installed in its position of normal use. The drain pan discharge pipe is blocked, and the pan carefully filled to the brim without splashing. The drain pan is then subjected to a continuous*

overflow, the rate of which is adjusted to approximately 17 cm^3/s per 1 m^3/s airflow, and the fan(s) switched on. The test is continued for a period of 30 min, or until water drains from the appliance.

15.101 Spillage test

Indoor floor or wall-mounted APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC are tested as follows.

The appliance is installed according to the installation instructions but not operated.

Covers which provide access for manual operation of electrical controls are set in the open position, unless such covers are of the self-closing type.

A solution of 0,25 l of water containing approximately 1 % NaCl is poured onto the unit in a manner which is most likely to cause entrance of water into or on electrical controls or UNINSULATED LIVE PARTS.

After spillage is completed, the appliances shall withstand the tests of Clause 16.

The spillage test is not applicable to units if the minimum linear dimension of a horizontal or near horizontal top surface of the cabinet is 75 mm or less.

A unit whose top, when installed, has a height of greater than 2 m need not be tested.

NOTE The intent is that a 75 mm diameter glass cannot be placed on the surface of the appliance and spill.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.2 *Modification:*

For STATIONARY CLASS I APPLIANCES, the leakage current shall not exceed 2 mA per kilowatt RATED POWER INPUT with a maximum value of 10 mA for APPLIANCES ACCESSIBLE TO THE GENERAL PUBLIC, and a maximum value of 30 mA for APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC.

16.2DV D1 *Modification of Clause 16.2 of the Part 2 by adding the following:*

Appliances may exceed the leakage current if Item 2, 3, or 4 of Clause 13.2DV.1 are met.

Leakage current is to be calculated as follows:

$$L_c = 2 \times P$$

where

L_c is the leakage current

***P* is the rated power input as determined by Clause 7.1**

2 is a constant in mA/kW

For APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC, leakage currents do not apply.

16.3DV D2 *Modification of Clause 16.3 of the Part 1 by adding the following:*

16.3DV.101 For CLASS I APPLIANCES, the insulation of the appliance shall be subjected to a voltage of substantially sinusoidal waveform having a frequency of approximately 50 Hz or 60 Hz for 1 min. The value of the test voltage shall be two times rated voltage plus 1 000 V. The points of application shall be between live parts and accessible metal parts separated from live parts by BASIC INSULATION.

For APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC, electrical strength tests shall be conducted in accordance with Annex 101.DVH.

16.3DV.102 A DC potential equivalent to 1,414 times the test voltage specified in Clause 16 may be applied.

17 Overload protection of transformers and associated circuits

This clause of Part 1 is applicable.

17DV D1 *Modification of Clause 17 of the Part 1 by addition of the following:*

The tests of Clause 17 are not required if

a) the transformer is protected in accordance with Table 450.3(B) of ANSI/NFPA 70 and Rule 26-252 or 26-254 of CSA C22.1

b) the transformer is a Class 2 transformer and complies with UL 5085-1/CSA C22.2 No. 66.1 and UL 5085-3/CSA C22.2 No. 66.3;

c) the transformer is integral to an adjustable speed drive where the transformer and drive assembly have been evaluated to UL 61800-5-1 and CSA C22.2 No. 274; or

d) power supplies have marked output of class 2 or LPS (limited power supply), and have been evaluated to UL 60950-1 and UL 62368-1, or UL 60730-1, or UL 1310.

18 Endurance

This clause of Part 1 is not applicable.

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.1 *Modification:*

Add after the second paragraph:

Failure of the transfer medium flow, or of any control devices, shall not result in a hazard.

Replace the 1st and 2nd paragraphs of the test specification by the following:

Appliances are subjected to the tests specified in 19.2 to 19.10, 19.101, 19.102 and 19.103, as applicable.

19.1DV.1 D1 ***Modification by adding the following note to Clause 19.1 of the Part 1:***

NOTE 101DV: Protective electronic circuit (PEC) operation is understood as the operation that stops, slows, or otherwise modifies operation of the components to ensure compliance during any test of the subclauses in Clause 19.

19.1DV.2 D1 ***Modification by replacing the last sentence of Clause 19.1 of the Part 2 with the following:***

Appliances are subjected to the tests specified in Clauses 19.2 to 19.10, 19.101, 19.102, 19.103, 19.104, 19.105, and 19.106, as applicable.

Appliances are additionally subjected to the tests specified in Clauses 19.104 and 19.105DV, as applicable.

19.1DV.3 D2 ***Modification of Clause 19.1 of the Part 2 by adding the following:***

After the airflow conditions specified are established, the airflow shall then be restricted at a rate of 1 K/min outlet air temperature rise until a self-resetting thermal cut-out device or non-self-resetting thermal cut-out device operates for the first time as a result of slowly restricting the free area of the inlet.

The restriction shall be halted after any protective device operates until steady state conditions are established.

If the first limit to operate is a self-resetting thermal cut-out after steady state conditions are reached, the restriction shall be resumed. The test shall continue until the last self-resetting thermal cut-out operates. If a self-resetting thermal cut-out device operates first, no non-self-resetting thermal cut-out devices shall operate.

If the first limit to operate is a non-self-resetting thermal cut-out, the test is complete after the first non-self-resetting device operates and the unit reaches steady state conditions.

The outlet air temperature shall not exceed 121 °C.

Appliances with supplementary heaters or provision for supplementary heaters shall be configured with inlet and outlet ducts and instrumented in accordance with the applicable subclauses of Clause 11.

For appliances with supplementary heaters or provision for supplementary heaters capable of operation with simultaneous supplementary heat and refrigerant heat, the refrigerant heat may be simulated by use of an alternate heating source equal to or greater than the heat pump's capacity when operated under the conditions of Clause 11. This capacity shall be maintained throughout the test of Clause 19. If, in any condition during the tests of Clause 19, the refrigerant heat would be interrupted by protective control, the alternate heat source shall be interrupted at that point in the test and the test continued.

19.2 *Replacement:*

All ducted appliances provided with SUPPLEMENTARY HEATERS are subjected to the following test under the conditions specified in Clause 11:

After the airflow conditions specified are established, the indoor airflow is restricted to such an extent that the temperature of the air in the outlet, measured by means of the thermocouple grid (see 11.3), is 3 K below the temperature obtained after a temperature limiting control, a motor PROTECTIVE DEVICE, a pressure switch or similar device operates for the first time as a result of slowly restricting the free area of the inlet.

This is achieved if the temperature rise is approximately 1 K per min.

It is necessary to restrict the free area of the inlet until the first of the PROTECTIVE DEVICES operates and then operation is resumed with sufficient restriction so that the temperature of the discharge air is 3 K below the temperature at the moment of cut-off.

Appliances are operated at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE.

To facilitate this test, the PROTECTIVE DEVICE which has operated shall be short-circuited once the temperature at which it operates has been determined, if necessary.

Non-ducted appliances provided with SUPPLEMENTARY HEATERS are operated as specified in Clause 11. Thermal controls that operate during the test of Clause 11 are short circuited.

When steady conditions are established, the airflow rate is reduced until it is just sufficient to prevent a thermal cut out from operating.

Under these conditions, the appliance is again operated until steady conditions are established or for 1 h, whichever is longer.

After this period, the airflow is further restricted to verify that the thermal cut out operates.

19.2DV D2 *Delete Clause 19.2 of the Part 2:*

Clause 19.2 is not applicable.

19.3 *Replacement:*

If all electric heating elements are not energized under the conditions specified in 19.2 for the air entering the EVAPORATOR, an additional test is carried out at a lower temperature of the inlet air, this temperature being the highest that will permit all electric heating elements to be energized.

It is the intention that the operating point be just below the point of maximum restriction of the air entering the indoor coil assembly thus permitting continuous operation of both the motor-compressor and the electric heating elements. If the temperature of the air entering the EVAPORATOR required to permit all electric heating elements to be energized is less than the values specified, this lower temperature may be simulated by reducing the airflow through the EVAPORATOR, by blocking a part of the EVAPORATOR, or by similar means in order to obtain the operating conditions which would occur at this lower temperature of the air entering the EVAPORATOR.

Appliances are operated at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE.

19.3DV D1 *Replace Clause 19.3 with the requirements in 19.104DV.1.*

19.4 *Addition:*

The appliance is operated under the conditions in Clause 11 and at rated voltage, with any form of operation or any defect that may be expected during normal use. Only one fault condition is reproduced at a time, the tests being made consecutively.

Examples of fault conditions are

– the timer, if any, stopping in any position;

– disconnection and reconnection of one or more phases of the supply;

– open-circuiting or short-circuiting of components, like relays, contactors, timers, THERMOSTATS, etc.

In general, tests are limited to those cases which are expected to give the most unfavourable results.

19.4DV D2 *Modification by adding the following note to Clause 19.4 of the Part 2:*

NOTE 1DV For appliances with supplementary heat, the test of Clause 19.104 addresses fault conditions. There can be other forms of operation or defects that could result in a hazardous condition that need to be addressed which are not related to supplementary heat.

19.5DV D2 *Modification of Clause 19.5 of the Part 1 by adding the following:*

The test is not applicable to heaters incorporated into constructions compliant with CSA C22.2 No. 110 or UL 174 or UL 1453.

19.7 *Modification:*

Replace the first paragraph by:

The motors, other than motor-compressors and stationary circulation pumps in compliance with IEC 60335-2-51, are mounted on a support of wood or similar material. The motor rotors are locked; fan blades and brackets are not removed.

The motors are supplied at their supplied voltage when the appliance is supplied at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE, in a circuit as shown in Figure 103.

Under these conditions, the motor is operated for 15 days (360 h) or until a PROTECTION DEVICE permanently opens the circuit, whichever is the shorter period.

During the test, the ambient temperature is maintained at 23 °C ± 5 °C.

If the temperature of the motor windings does not exceed 90 °C when steady conditions are established, the test is considered to be ended.

During the test, the temperature of the enclosure shall not exceed 150 °C and the temperature of the windings shall not exceed the values shown in Table 8.

Three days (72 h) after the beginning of the test, the motor shall withstand an electric strength test as specified in 16.3.

At the end of the test, the leakage current, when measured as specified in 16.2 but with a test voltage of twice the RATED VOLTAGE between all windings and the enclosure, shall not exceed 2 mA.

NOTE 101 Only for this test specified in 19.7 of 60335-2-40, the motor is locked and operated for 15 days (360 h) or until a protection device permanently opens the circuit. It is not the intention to repeat the 15-day locked rotor test up to two more time for motors having capacitors in the circuit of an auxiliary winding. Hence for all tests according to 19.7 of Part 1, the motor is operated under the conditions specified in 19.7 of 60335-1, including the time specifications.

Add after the last paragraph:

If the motor-compressor has not been type-tested against the requirements of IEC 60335-2-34, a sample shall be provided with the rotor locked and being filled with oil and refrigerant as intended.

The sample shall then be subjected to the tests specified in 19.101, 19.102, 19.103 and 19.105 of IEC 60335-2-34:2012, if applicable, and shall comply with the requirements in 19.104 of IEC 60335-2-34:2012.

19.7DV D1 ***Modification of Clause 19.7 of the Part 2 by replacing it with the following:***

Replace the first paragraph by:

The motors, other than motor-compressors, are mounted on a support of wood or similar material. The motor rotors are locked; fan blades and brackets are not removed.

The motors are supplied at their supplied voltage when the appliance is supplied at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE, in a circuit as shown in Figure 103.

Under these conditions, the motor is operated for 15 days (360 h) or until a PROTECTION DEVICE permanently opens the circuit, whichever is the shorter period.

During the test, the ambient temperature is maintained at 23 °C ± 5 °C.

If the temperature of the motor windings does not exceed 90 °C when steady conditions are established, the test is considered to be ended.

During the test, the temperature of the enclosure shall not exceed 150 °C and the temperature of the windings shall not exceed the values shown in Table 8.

Three days (72 h) after the beginning of the test, the motor shall withstand an electric strength test as specified in Clause 16.3.

At the end of the test, the leakage current, when measured as specified in Clause 16.2 but with a test voltage of twice the RATED VOLTAGE between all windings and the enclosure, shall not exceed 2 mA.

NOTE 101 Only for this test specified in Clause 19.7, the motor is locked and operated for 15 days (360 h) or until a protection device permanently opens the circuit. It is not the intention to repeat the 15-day locked rotor test up to two more times for motors having capacitors in the circuit of an auxiliary winding. Hence for all tests according to Clause 19.7 of the Part 1, the motor is operated under the conditions specified in Clause 19.7 of IEC 60335-1, including the time specifications.

Add after the last paragraph:

If the motor-compressor has not been type-tested against the requirements of UL 60335-2-34 or CAN/CSA C22.2 No. 60335-2-34, then it shall be subject to the following test.

A sample shall be provided with the rotor locked and being filled with oil and refrigerant as intended. The sample shall then be subjected to the tests specified in Clause 19.101, 19.102, 19.103, and 19.105 of UL 60335-2-34 or CAN/CSA- C22.2 No. 60335-2-34, if applicable, and shall comply with the requirements in Clause 19.104 of UL 60335-2-34 or CAN/CSA C22.2 No. 60335-2-34.

If the motors have been previously tested with their protection method in accordance with the one of the following standards, the tests of Clause 19.7 are not required:

– UL 1004-2 – Impedance Protected Motors

– UL 1004-3 – Thermally Protected Motors

– UL 1004-7 – Electronically Protected Motors

– CSA C22.2 No. 77 – Motors with Inherent Overheating Protection

If the safety of the motor depends upon the operation of an adjustable speed drive incorporating an internal solid state motor overload protection that has been evaluated to UL 61800-5-1 and CSA C22.2 No. 274, the adjustable speed drive shall comply with all of the following requirements:

– The adjustable speed drive shall be marked for "Equipment incorporating internal overload protection" or equivalent.

– The adjustable speed drive shall be utilized on a motor that is within the ratings of the adjustable speed drive; and

For components not previously evaluated in accordance with Clause 24, compliance is checked by the test of Clause 19.7. The temperature of the motor windings shall not exceed the limits specified in Clause 19.7.

If the safety of the motor relies on the operation of an overload relay, the relay shall be responsive to motor current and rated to set to trip at not more than the percentage of the motor nameplate full-load current rating specified in Table 19.7DV. If the percentage protection specified in Column A of Table 19.7DV does not correspond to the percentage value of an overload relay of a standard size, the device of the next higher size may be used. However, the overload device of the next higher size shall protect against currents exceeding the percentage values specified in Column B of Table 19.7DV.

Table 19.7DV
Motor nameplate full-load current rating

	Maximum percent of full-load current rating protection	
	A	B
Motor with marked service factor no less than 1.15	125	140
Motor with a marked temperature rise no more than 40 °C	125	140
Any other motor	115	130

For components not previously evaluated in accordance with Clause 24, compliance is checked by the test of Clause 19.7. The temperature of the motor windings shall not exceed the limits specified in Clause 19.7.

19.8 *Replacement:*

Three phase motors other than motor compressors are operated under the conditions of Clause 11 at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE with one phase disconnected, until steady conditions are obtained or the PROTECTIVE DEVICE operates.

19.9 This subclause of Part 1 is not applicable.

19.11.2DV D1 *Modification to add the following to Clause 19.11.2 of the Part 1:*

Testing is not required for adjustable speed drives that have been evaluated to UL 61800-5-1 or CSA C22.2 No. 274.

19.11.3DV D2 *Modification to add the following to Clause 19.11.3 of the Part 1:*

The ELECTRONIC CIRCUITS that operate during Clause 19 testing shall be evaluated to Item a), b), or c) to meet the exception.

Testing is not required for adjustable speed drives if the PROTECTIVE ELECTRONIC CIRCUIT used to comply with this standard was evaluated in accordance with the following:

a) as a safety function in UL 61800-5-2 (SIL2);

b) as a Class B or Class C control function in CSA C22.2 No. 0.8; or

c) as a Class B or Class C control function in Annex H of UL 60730-1 or CSA E60730-1.

Testing is also not required for adjustable speed drives with an ELECTRONIC CIRCUIT that operates during Clause 19.7 testing with solid-state motor overload protection as defined by UL 61800-5-1, Clause 3.36BDV, and Clause 3 of CSA C22.2 No. 274.

19.11.4 *Modification:*

Add before the first paragraph:

The first paragraph of Part 1 is not applicable for stand-by mode if unintentional operation does not cause any hazards.

Replace the second paragraph by the following:

Appliances incorporating a PROTECTIVE ELECTRONIC CIRCUIT are subjected to the tests of 19.11.4.1 to 19.11.4.7. The tests are carried out after the PROTECTIVE ELECTRONIC CIRCUIT has operated during the relevant tests of Clause 19, except 19.2, 19.6, 19.11.3, 19.102 and 19.103.

If the appliance incorporates more than one PROTECTIVE ELECTRONIC CIRCUIT, each PROTECTIVE ELECTRONIC CIRCUIT has to be tested individually with the appliance operated under NORMAL OPERATION at any temperature within the working range.

Components protected by a PROTECTIVE ELECTRONIC CIRCUIT that have been previously tested and shown to comply with the requirements of 19.11.4 of its standard need not to be retested in the final application, if

engineering judgement gives evidence that the test in the final application will not lead to a hazardous condition.

NOTE 101 Components can be for example motor compressors, fans and circulating pumps.

NOTE 102 Test results of 19.11.4.1, 19.11.4.2 and 19.11.4.3 can possibly be influenced by the wiring and the metal housing of the final application. Therefore, the best moment to perform these tests is once in the final application.

NOTE 103 Protective electronic circuit (PEC) operation is understood as the operation that stops the component(s) operation controlled by the PEC with the intention to prevent the hazardous situation.

Add, after the last paragraph of the test specification, the following:

For these tests, it may be necessary to provide specially prepared component samples, e.g. compressors with locked rotor.

19.11.4DV.1 D1 ***Modify Clause 19.11.4 of the Part 2 by deleting "for stand-by mode" in the first paragraph.***

19.11.4DV.2 D1 ***Modify Clause 19.11.4 of the Part 1 be deleting NOTE 2.***

19.11.4.8 *Modification:*

Add to the first sentence:

"at any temperature within the working range."

19.13 *Modification:*

Footnote a) of Table 9 is not applicable.

19.13DV.1 D2 ***Modification to add the following to Table 9 in the Part 1:***

s	Temperature °C
Surfaces of product, discharge plenum, and duct at points of specified zero clearance to test enclosure	121
Surfaces of test enclosure where clearance more than zero to combustible material is specified	121
Surfaces of motor compressor shell – all types (when subjected to high side discharge pressure)	150 (200)

19.13DV.2 D2 ***Modification of the sixth paragraph of Clause 19.13 in the Part 1 by adding the following:***

The FUNCTIONAL INSULATION of components shall be compliant with the applicable component standard in Annex DVA, and used within its certified ratings, is not tested.

19.14 *Modification:*

Add before the note:

Locking in the "on" position of the main contacts of a contact intended for switching on and off the heating element(s) in normal use is considered to be a fault condition, unless the appliance is provided with at least two sets of contacts connected in series. This condition is, for example, achieved by providing two contactors operating independently of each other or by providing one contactor having two independent armatures operating two independent sets of main contacts.

19.14DV D1 *Modification of Clause 19.14 of the Part 2 by adding the following:*

Contacts tested for 100K cycles are considered to meet the intent of Clause 19.14.

19.101 *The appliance is operated under the conditions in Clause 11 at RATED VOLTAGE or at the upper limit of the rated voltage range, at an ambient temperature of 23 °C ± 5 °C. When steady conditions are attained, the heat transfer medium flow of the OUTDOOR HEAT EXCHANGER is restricted or shut off, whichever is the most unfavourable without the appliance being non-operative.*

After this test, PROTECTIVE DEVICES that may have operated are reset, and the test is repeated, with the heat transfer medium flow, fluid or air, of the INDOOR HEAT EXCHANGER, restricted or shut off, whichever is the most unfavourable without the appliance being non-operative. In the case of appliances with defrosting systems, the heat transfer medium flow rate is additionally shut off at the beginning of the defrosting phase.

Appliances incorporating a motor common to both the INDOOR and OUTDOOR HEAT EXCHANGERS are subjected to the above test the motor being disconnected once steady conditions are attained.

19.102 *The INDOOR HEAT EXCHANGER of appliances using water as a heat transfer medium is subjected to the following test.*

The appliance is operated under the conditions specified for Clause 10 at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE at the maximum water temperature specified by the manufacturer. The indoor water temperature shall be raised 15 K with a rate of 2 K/min and this temperature maintained for 30 min, after which the water temperature is lowered to its original value at the same velocity.

19.102DV D1 *Modification of Clause 19.102 of the Part 2 by replacing the second paragraph with the following:*

The appliance is operated under the conditions specified for Clause 11 except at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE range at the maximum water temperature specified by the manufacturer. The indoor water temperature shall be raised 15 K with a rate of 2 K/min and this temperature maintained for 30 min, after which the water temperature is lowered to its original value at the same rate.

19.103 *Air to air appliances are operated under the conditions specified in Clause 11.*

The DRY-BULB TEMPERATURE is then reduced to a value 5 K below the minimum value specified by the manufacturer.

The test is repeated except that the DRY-BULB TEMPERATURE is increased to a value 10 K above the maximum temperature specified by the manufacturer.

The appliances are operated at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE.

19.103DV D2 *Modification by replacing the second paragraph of Clause 19.103 of the Part 2 with the following:*

The test is repeated except that the DRY-BULB TEMPERATURE shall be increased to a value 10 K above the maximum temperature specified by the manufacturer, but not to exceed 52 °C.

NOTE 1DV The ambient temperature may be increased slowly. If a protective control interrupts operation before reaching 10 K above the maximum temperature specified by the manufacturer, or 52 °C, the test may be terminated at that ambient.

19.104 All appliances provided with SUPPLEMENTARY HEATERS and with free air discharge are subjected to the following test in each mode of operation.

Appliances are operated under the conditions specified in Clause 11, with any controls which limit the temperature during the test of Clause 11 short-circuited, and with the appliance covered.

The covering is made with felt strips each having a width of 100 mm and lined with a single layer of textile material.

The felt has a specified mass of 4 kg/m^2 ± 0,4 kg/m^2 and a thickness of 25 mm.

The textile material consists of a prewashed double-hemmed cotton sheet having a mass between 140 g/m^2 and 175 g/m^2 in the dry condition.

Thermocouples are attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick.

The disks are spaced 50 mm apart and placed between the textile material and the felt on the vertical centre line of each strip.

The disks are supported in such a way as to prevent them from sinking into the felt.

The strips are applied with the textile material in contact with the appliance so that they cover the whole vertical dimension of the front, pass over the top and extend down the rear surface.

If the appliance is constructed to stand away from the wall or if it is for fixing to a wall so that the gap between the heater and the wall exceeds 30 mm and the horizontal components of the distance between any two fixing points or spacers or between such points and the end of the appliance exceed 100 mm, the rear surface of the appliance shall be completely covered.

Otherwise, the rear surface is covered over a distance approximately equal to one-fifth of the vertical dimension of the heater.

The strips are applied to each half of the appliance in turn and then to the complete appliance.

During the test, the temperature shall not exceed 150 °C but an overshoot of 25 °C is permitted during the first hour.

Thermal PROTECTIVE DEVICES are allowed to operate.

19.104DV D2 ***Modification of Clause 19.104 of the Part 2 by replacing it with Clauses 19.104DV.1 to 19.104DV.8:***

19.104DV.1 General

Appliances with supplementary air heaters or provisions for supplementary air heaters are subjected to the test of Clauses 19.104DV.2 through 19.104DV.8 under the conditions specified in Clause 11 unless otherwise indicated.

All appliances with supplementary air heaters shall be configured with inlet and outlet ducts as applicable and instrumented in accordance with the applicable subclauses of Clause 11.

Appliances are tested in the operating state and configuration, which give the most unfavourable results.

Appliances are operated at an ambient temperature of 23 °C ± 5 °C and rated voltage or at the upper limit of the rated voltage range of the supplementary air heaters.

Tests shall be conducted with all the supplementary air heater heating elements activated as allowed by the unit controls with the thermostats over-ridden, if the unit controls do not allow all supplementary air heater heating elements to be activated by over-riding the thermostats then the test shall be conducted with the thermostats over-ridden and the air temperature reduced to a value, which causes all the elements to switch on.

For appliances with supplementary air heaters the heat provided by the heat pump may be simulated by use of an alternate heating source equal to the capacity of the heat pump when operated under the conditions of Clause 11. If at any condition during the tests of Clause 19.104DV the heat pump operation is interrupted by a protective control, the alternate heat source shall be interrupted in the same way.

19.104DV.2 Restricted inlet – First limit cut-out

To test limit cut-out conditions, the airflow conditions specified are established, the indoor airflow is reduced by restricting the inlet air opening to a rate resulting in not more than 1 K/min outlet air temperature rise until a self-resetting thermal cut-out device operates for the first time as a result of slowly restricting the free area of the inlet.

The outlet air temperature, measured by means of the thermocouple grid shall not exceed 90 °C.

19.104DV.3 Restricted inlet – Minimum airflow

To test heating operation conditions, after the airflow conditions specified are established, the indoor airflow is reduced by restricting the inlet air opening to such an extent that the temperature of the air in the outlet is 3 K below the temperature obtained after a self-resetting thermal cut-out device operate for the first time as a result of slowly restricting the free area of the inlet.

The appliance shall be operated until steady state conditions are established or for 1 h, whichever is longer. During the test, the temperatures are monitored continuously and shall not exceed the values shown in Table 3.

To facilitate this test, the self-resetting thermal cut-out which has operated in Clause 19.104DV.2 may be short-circuited, if necessary.

NOTE Tests of Clause 19.104DV.4 can be conducted immediately after the tests of 19.104DV.2.

19.104DV.4 Restricted inlet – Restrict inlet to fully blocked

To test restricted inlet conditions, after the airflow conditions specified are established, the indoor airflow is reduced by restricting the inlet air opening at a rate resulting in not more than 1 K/min outlet air temperature rise until a self-resetting thermal cut-out device operates.

The restriction shall be halted after any protective device operates until steady state conditions are established. After steady state conditions are reached, the restriction is resumed. The test shall continue until the inlet is fully restricted.

The temperatures are monitored continuously. Temperatures shall not exceed the values shown in (Table 3 + 30 K) during the first hour and Table 3 thereafter.

19.104DV.5 Fan failure

To test fan failure conditions, after steady state conditions are attained, heat transfer medium flow of the indoor heat exchanger is restricted or shut off, whichever is the most unfavorable without the appliance being non-operative.

Temperatures shall not exceed the values shown in Clause 19.13.

19.104DV.6 Blocked outlet

To test blocked outlet conditions, when steady conditions are attained, the appliance outlet air opening is totally closed off and operation continued until maximum temperatures are determined.

This test with the outlet air opening closed shall not be conducted on any unit with free air discharge openings located more than 1,2 m above the floor level when the unit is installed as intended.

Temperatures shall not exceed the values in Clause 19.13.

19.104DV.7 Curtain drape

All appliances provided with supplementary air heaters and with free air discharge openings are subjected to the following test in each mode of operation.

This test shall not be conducted on any unit with free air discharge openings located more than 1,8 m above the floor level when the unit is installed as intended.

Appliances are operated under the conditions specified in Clause 11, with any controls which limit the temperature during the test of Clause 11 short-circuited, and with the appliance covered.

The covering is made with felt strips each having a width of 100 mm and lined with a single layer of textile material.

The felt has a specified mass of 4 kg/m^2 ± 0,4 kg/m^2 and a thickness of 25 mm.

The textile material consists of a prewashed double-hemmed cotton sheet having a mass between 140 g/m^2 and 175 g/m^2 in the dry condition.

Thermocouples are attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick.

The disks are spaced 50 mm apart and placed between the textile material and the felt on the vertical center line of each strip.

The disks are supported in such a way as to prevent them from sinking into the felt.

The strips are applied with the textile material in contact with the appliance so that they cover the whole vertical dimension of the front, pass over the top and extend down the rear surface.

If the appliance is constructed to stand away from the wall or if it is for fixing to a wall so that the gap between the heater and the wall exceeds 30 mm and the horizontal components of the distance between any two fixing points or spacers or between such points and the end of the appliance exceed 100 mm, the rear surface of the appliance shall be completely covered.

Otherwise, the rear surface is covered over a distance approximately equal to one-fifth of the vertical dimension of the heater.

The strips are applied to each half of the appliance in turn and then to the complete appliance.

During the test, the temperature shall not exceed 150 °C but an overshoot of 25 K is permitted during the first hour.

Thermal protective devices are allowed to operate.

19.104DV.8 Backup protection test

If a self-resetting thermal cut-out operates during the tests of Clause 19.104DV, then the self-resetting thermal cut-out shall be by-passed and the tests of Clauses 119.104DV.4 through 19.104DV.7 shall be repeated.

For the test of Clause 19.104DV.4, the rate of restriction shall be such that the opening is totally blocked at the end of 30 min.

Temperatures shall not exceed the values in Clause 19.13.

19.105DV D1 *Add the following subclauses to Clause 19 of the Part 2:*

19.105DV.1 For portable and NON-FIXED FACTORY SEALED SINGLE PACKAGE APPLIANCES in which the compressor is enclosed by a non-metallic material that isolates it from the forced air stream providing air to the heat exchanger, the following test shall apply.

The test shall be conducted under each of the following conditions:

– with 75 % of the charge removed; and

– with the system pressure less than 0,12 MPa, but not less than 0,10 MPa with the appliance de-energized.

The appliance shall be operated under the conditions of Clause 11 at the lower limit of the rated voltage range and an ambient temperature of 23 °C ± 5 °C. The appliance shall be operated until all components and the enclosure temperatures stabilize or are declining, but for not less than 24 h, or until the operation of the compressor is terminated by a non-self-resetting protective device. Any self-resetting protective devices that actuates during this test shall be allowed to cycle as intended.

Temperatures of non-metallic parts shall not exceed the relative thermal index of the material in accordance with IEC 60695-1-10.

Compliance is checked by test.

For the test of Clause 19.2DV.4, the rate of restriction shall be such that the opening is totally blocked at the end of 30 min.

When tested in accordance with this clause, the temperatures of the appliance and metal duct, where suitable for zero clearance, or the inside surface of the wooden enclosure shall not exceed 100 °C, except that the temperature shall not exceed 130 °C during the 30 min period following the initial imposition of the test condition. The temperature following the functioning of one or more of the non-self-resetting thermal cut-outs shall be no more than 175 °C; however, at the end of the 30 min period following the functioning of the first control or cutoff, the temperature shall not exceed 100 °C.

19.105DV.2 Backup Protection: For appliances with supplementary heaters, all self-resetting thermal cut-outs or all non-self-resetting thermal cut-outs that operated in clauses 19.2DV.4, 19.101 or 19.101DV.2 shall be by-passed and the tests of Clauses 19.2DV.4, 19.101 or 19.101DV.2 shall be repeated.

The rate of restriction shall be such that the opening is totally blocked at the end of 30 min.

When tested in accordance with this clause, the temperatures of the appliance and metal duct, where suitable for zero clearance, or the inside surface of the wooden enclosure shall not exceed 100 °C, except that the temperature shall not exceed 130 °C during the 30 min period following the initial imposition of the test condition. The temperature following the functioning of one or more of the non-self-resetting thermal cut-outs shall be no more than 175 °C; however, at the end of the 30 min period following the functioning of the first control or cutoff, the temperature shall not exceed 100 °C.

The temperature limits and outlet air temperature limits do not apply.

Clause 19.13 of the Part 2 and of the Part 1 do not apply to this test.

19.106DV D1 *Add the following subclause to Clause 19 of the Part 2:*

Appliances with a heat exchanger for the purpose of heating water shall be operated under the conditions specified in Clause 11 at rated voltage with the temperature-regulating control bypassed.

Appliances with a heat exchanger for the purpose of heating water shall not have a water temperature exceeding 99 °C during the test.

Heat pump pool heaters shall not have a water temperature exceeding 60 °C during the test.

No other limiting or other protective device shall function except as specified in Clause 22.132DV.9.

– For units with storage tanks after a tankful of water has been heated to the temperature at which the temperature regulating thermostats open, one-fourth of the water shall be drawn off and replaced promptly with cold water. Immediately after the first closure of the temperature-regulating thermostat thereafter, the temperature regulating thermostats shall be bypassed and operation shall be continued until the temperature-limiting control opens. Immediately thereafter, hot water shall be drawn off, and its temperature shall be measured at the hot water outlet.

– For units without storage tanks, the water flow rate through the unit shall be reduced with the temperature-regulating thermostat by-passed until the temperature limiting control operates, at which point the outlet water temperature shall be measured.

20 Stability and mechanical hazards

This clause of Part 1 is applicable.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

21.1 *Addition:*

Safety requirements specified in ISO 5149-2 shall apply.

Safety requirements specified in Annex EE shall apply. The pressure test in Annex EE applies to parts other than pressure vessels.

21.1DV.101 D1 *Modification of Clause 21.1 of the Part 2 by replacing it with the following:*

The first sentence of Clause 21.1 in the Part 1 is not applicable.

21.1DV.102 D2 *Modification by adding the following to Clause 21.1 of the Part 1:*

For appliances with refrigerant to water heat exchangers for the purpose of heating water, the water side of the heat exchanger shall have sufficient strength to withstand a pressure of not less than 2,1 MPa when two samples are tested for 1 min.

21.1DV.103 D2 ***Modification by adding the following to Clause 21.1 of the Part 1:***

A non-metallic ACCESSIBLE PART used as an enclosure for a LIVE PART shall be subjected to the mechanical strength test of Clause 21.1 with an impact energy of 6,8 J.

21.2 *Addition:*

Appliances using FLAMMABLE REFRIGERANTS shall withstand the effects of vibration during transport.

The appliance is tested in its final packaging for transport and shall withstand a random vibration test according to ASTM D4728-06. Tests shall be run for a duration of 180 min.

Compliance is checked by the following:

• The use of detection equipment having an equivalent sensitivity of 3 g/year of refrigerant shall reveal no leaks.

• The test may be carried out on the appliance charged with a non-FLAMMABLE REFRIGERANT or a non-hazardous gas.

• Damage of parts other than the refrigerating circuit is allowed.

21.2DV D1 ***Modification of Clause 21.2 of the Part 2 by replacing it with the following:***

NON-FIXED FACTORY SEALED SINGLE PACKAGED UNIT appliances using FLAMMABLE REFRIGERANTS shall withstand the effects of vibration during transport.

The appliance is tested in its final packaging for transport, fixed to the vibration table, and shall withstand a random vibration test for 180 min according to ASTM D4728.

Compliance is checked by the following:

– the use of detection equipment having an equivalent sensitivity of 3 g/year of refrigerant shall reveal no leaks.

– damage of parts other than the refrigerating circuit is allowed.

The manufacturer shall show evidence suitable to the testing agency that any unit intended to be transported over a highway during its normal use has been subjected to actual road test conditions. The road test shall consist of a minimum trip of 160 km (100 miles) over the road at a speed of 22.35 m/s (50 mph) or greater, or equal at the completion of the test. See ANSI Z83.11-2016/CSA 1.8, Clause 4.1.18 d).

NOTE The test can be carried out on the appliance charged with a non-flammable refrigerant or a non-hazardous gas when pressurized to the saturated vapor pressure corresponding to a temperature of 23 °C.

NOTE A representative samples, min 3 samples, tested to verify a product family (line).

21.101DV D1 ***Add subclauses 21.101DV.1 to 21.101DV.8 to Clause 21 of the Part 2:***

21.101DV.1 A window-type air conditioning unit shall withstand a static load of 180 kg applied to the outer 130 mm of the outdoor portion of the unit when mounted in a simulated window in accordance with the instructions provided by the manufacturer.

A load of 180 kg acting vertically downward shall be applied along the edge parallel with and farthest from the plane of the window. If the simulated window fails, the test shall be repeated with a stronger window.

21.101DV.2 Appliances shall withstand reasonably foreseeable mechanical abuse.

21.101DV.3 For appliances other than dehumidifiers, a substantially horizontal plane on the top of the appliance shall be capable of sustaining a static load of 91 kg, applied in a vertical direction, in the most unfavourable location, over a 152 mm diameter circular area.

21.101DV.4 For dehumidifiers, the appliance shall be positioned as intended for use and shall withstand a static load of 45 kg applied to each of two flat metal plates simultaneously. The plates shall be 102 × 254 × 6,6 mm and should be positioned to simulate an individual sitting on the appliance

21.101DV.5 For appliances with a guard, a force of 111 N shall be applied to the guard by a 38 mm diameter rod. The force shall be applied in a direction normal to the guard surface.

21.101DV.6 During or following the tests in Clauses 21.101DV.3 through 21.101DV.5, the applied load shall not result in

a) a deflection that causes the structure to contact a moving part; or

b) a permanent deformation of the structure so as not to comply with Clause 20.2.

The structure shall comply with the requirements of Clauses 8, 15 and 29 of this standard following the loading tests in the as received condition.

21.101DV.7 Appliances intended to be suspended from the wall or ceiling shall withstand the test described in Clause 21.101DV.8 without falling from its intended mounting location.

21.101DV.8 The appliance shall be installed in accordance with the manufacturer's instructions. A load equal to three times the weight of the unit but not exceeding 180 kg mass, acting vertically downwards, shall be applied uniformly to the unit for minimum of 1 min.

22 Construction

This clause of Part 1 is applicable except as follows.

22.2DV.1 D1 ***Modification of Clause 22.2DV of the Part 1 by adding the following:***

Switching devices that disconnect open coil heating elements shall disconnect all phases. Thermal cut-outs shall not be considered a means of disconnect.

22.2DV.2 D1 *Modification of Clause 22.2 of the Part 1 by adding the following:*

The controller for a motor-compressor employed on a unit in which water is used as the heat exchange medium shall open all ungrounded conductors to the motor-compressor unless

a) the unit uses double walled heat exchangers that employ a vented interface; or

b) the unit is equipped with a refrigerant pressure relief valve or a rupture member that will safely relieve pressure.

22.6 *Addition:*

The electrical insulation shall not be affected by snow which might enter the appliance enclosure.

NOTE 101 This requirement can be met by the provision of suitable drain holes.

22.6DV D1 *Modify Clause 22.6 of the Part 2 as follows:*

Note 101 is not applicable.

22.8DV D1 *Modification of Clause 22.8 of the Part 1 by adding the following:*

For appliances having walk-in service compartments accessible by doors or hinged panels that require the use of a TOOL for entry, the method of access shall not require a TOOL for a person to exfiltrate or leave the compartment in the event the door or panel is unexpectedly shut.

Note 1DV: A key is considered a tool.

22.11DV.1 D1 *Modification of Clause 22.11 of the Part 1 by adding the following to the first paragraph:*

A door or cover of an enclosure giving access to a replaceable fuse shall be hinged, sliding type, pivoted, or equivalent, provided with an automatic latch, and secured in a manner that requires a tool for opening, for fuses other than

– fuses connected in Class 2 circuits;

– extractor-type fuses that have their own enclosures;

– control circuit fuses, provided that the control circuit loads (other than fixed loads, such as pilot lamps) are housed in the same enclosure as the fuses; or

– supplementary type fuses rated 2 A or less, used in small, auxiliary resistance heater circuits having a maximum rating of 100 W.

This is not required if more than one door or cover has to be opened to provide access; only one of these doors or covers needs to comply with this requirement.

Enclosures that, when opened or removed, de-energize the circuit for the fuse(s) are exempt from this requirement.

22.11DV.2 D1 ***Modification of Clause 22.11 of the Part 1 by adding the following:***

Doors and covers that give access to uninsulated live hazardous voltage parts shall be secured firmly in place and shall require the use of a tool or key to open them, or they shall be provided with an interlocking mechanism. However, components having covers that comply with their respective standards do not require additional enclosures. An interlock that is required to reduce the risk of electric shock shall open all supply conductors.

An interlocking mechanism complies with this requirement if it

a) secures the cover in the closed position when engaged;

b) must be engaged before parts in a hazardous voltage circuit can be energized; and

c) is located so that unintentional operation is unlikely during normal servicing.

22.14 *Addition:*

This requirement does not apply to the metallic fins of HEAT EXCHANGERS.

22.24 *Replacement:*

Bare heating elements shall be supported so that, in case of rupture or sagging, the heating conductor cannot come into contact with accessible metal parts nor give rise to a hazard. Bare heating elements shall not be used with wood or wood composite enclosures.

Compliance is checked by inspection and, if necessary, by cutting the element in the most unfavourable place.

NOTE 101 No force is applied to the conductor after it has been cut.

NOTE 102 This test is made after the tests of Clause 29.

22.24DV D1 ***Modify Clause 22.24 of the Part 2 by replacing the second paragraph and NOTES 101 and 102 with the following:***

Compliance is checked by inspection.

22.46 *Modification:*

Add after the 1st paragraph:

If the PROTECTIVE ELECTRONIC CIRCUIT software is a part of the NORMAL OPERATION control, inspection of software shall be limited to relevant source code of safety controls or related software controls. Alternative methods may be used if they demonstrate equivalent levels of safety.

22.46DV D1 ***Modification of Clause 22.46 of the Part 2 by adding the following after the first paragraph:***

When the manufacturer declares that this software is intended to be updated remotely, then Clause 24.1.4DV.101 shall be applied.

Annex R evaluation is not required for adjustable speed drives that have been evaluated to UL 61800-5-1, UL 61800-5-2, and CSA C22.2 No. 274 if the PROTECTIVE ELECTRONIC CIRCUIT used to comply with this standard was evaluated in accordance with the following:

a) as a safety function UL 61800-5-2 (SIL2);

b) as a Class B or Class C control function in CSA C22.2 No. 0.8; or

c) as a Class B or Class C control function in Annex H of UL 60730-1 or CSA E60730-1.

Annex R evaluation is also not required for adjustable speed drives with an ELECTRONIC CIRCUIT which operates during Clause 19.7 with solid state motor overload protection as defined by UL 61800-5-1, Clause 3.36BDV and Clause 3 of CSA C22.2 No. 274.

NOTE 1DV Only the ELECTRONIC CIRCUITS that operate during Clause 19 testing are required to be evaluated to Items a), b), or c) to meet the exception.

When the manufacturer declares that the appliance has Class B firmware or software intended to be updated remotely, then Clause 24.1.4DV.101 shall be applied.

22.101 Appliances intended to be fixed shall be so designed that they can be securely fixed and maintained in position.

Compliance is checked by inspection and in case of doubt, after installation of the appliance in accordance with the installation instructions.

22.102 **Appliances provided with supplementary heaters**

22.102.1 Appliances provided with SUPPLEMENTARY HEATERS for air shall be provided with at least two THERMAL CUT-OUTS. The THERMAL CUT-OUT intended to operate first shall be either a SELF-RESETTING THERMAL CUT-OUT or a NON-SELF-RESETTING THERMAL CUT-OUT, the other THERMAL CUT-OUT shall be a NON-SELF-RESETTING THERMAL CUT-OUT.

Compliance is checked by inspection and during the tests of Clause 19.

NOTE If, during the tests of Clause 19, a SELF-RESETTING CONTROL operates, it would be necessary to short out this control to determine if the NON-SELF-RESETTING THERMAL CUT-OUT then operates.

22.102.1DV D1 ***Modify Clause 22.102.1 of the Part 2 by replacing it Replace 22.102.1 with the following:***

Appliances provided with SUPPLEMENTARY AIR HEATERS shall be provided with at least two THERMAL CUT-OUTS. The THERMAL CUT-OUT intended to operate first shall be either a SELF-RESETTING THERMAL CUT-OUT or a NON-SELF-RESETTING THERMAL CUT-OUT; the other THERMAL CUT-OUT shall be a NON-SELF-RESETTING THERMAL CUT-OUT.

Compliance is checked by inspection and during the tests of Clause 19.

22.102.2 Appliances provided with SUPPLEMENTARY HEATERS for water shall incorporate a NON-SELF-RESETTING THERMAL CUT-OUT, providing ALL-POLE DISCONNECTION that operates separately from WATER THERMOSTATS. However, for appliances intended to be connected to fixed wiring, the neutral conductor need not be disconnected.

Compliance is checked by inspection and during the tests Clause 19.

NOTE Anti-frost heaters are not considered to be SUPPLEMENTARY HEATERS for water, if it is not possible to heat up the water to a temperature higher than 80 °C at the highest operating temperature within 6 h, with the temperature switch short circuited and with water flow stopped.

22.102.2DV D1 *Modify Clause 22.102.2 of the Part 2 by replacing it with the following:*

Appliances provided with SUPPLEMENTARY WATER HEATERS shall incorporate a NON-SELF-RESETTING THERMAL CUT-OUT, providing ALL-POLE DISCONNECTION that operates separately from water THERMOSTATS. However, for appliances intended to be connected to fixed wiring, the neutral conductor need not be disconnected.

Compliance is checked by inspection and during the tests Clause 19.

NOTE Anti-frost heaters are not considered to be SUPPLEMENTARY WATER HEATERS if it is not possible to heat up the water to a temperature higher than 80 °C at the highest operating temperature within 6 h, with the temperature switch short circuited and with water flow stopped.

22.102.3 THERMAL CUT-OUTS of the capillary type shall be so designed that the contacts open in the event of leakage from the capillary tube.

Compliance is checked by inspection and test.

22.103 The sensing and switching elements of electromechanical non-self-resetting cut-outs shall be functionally independent of other control devices. If the switching element of a non-self-resetting cut-out is operating a relay or contactor, the relay or contactor may also be operated by other control devices. Protective electronic circuits are covered by Clause 19.

Compliance is checked by inspection.

22.103DV D1 *Modify Clause 22.103 of the Part 2 by replacing it with the following:*

The sensing and switching elements of electromechanical non-self-resetting cut-outs shall be independent of self-resetting cut-outs and other control devices. If the switching element of a non-self-resetting cut-out is operating a relay or contactor, the relay or contactor shall not be operated by other control devices. Protective electronic circuits are covered by Clause 19.

Compliance is checked by inspection.

22.104 Containers of SANITARY HOT WATER HEAT PUMPS shall withstand the water pressure occurring in normal use.

Compliance is checked by subjecting the containers and HEAT EXCHANGERS, if any, to a water pressure which is raised to the value specified hereafter at a rate of 0,13 MPa per second and is maintained at that value for 5 min.

The water pressure is

• twice the permissible excessive operating pressure for closed containers;

• 0,15 MPa for open containers.

After the test, no water shall have leaked out and the containers shall not have ruptured.

NOTE If the container of SANITARY HOT WATER HEAT PUMPS incorporates a HEAT EXCHANGER, the container and the HEAT EXCHANGER are subjected to the pressure test in accordance with the relevant standard.

22.104DV DR *Modification of Clauses 22.104 through 22.108 of the Part 2 by replacing them with the following:*

Hot water storage tanks connected to REFRIGERATING SYSTEMS and rated as a SANITARY WATER system shall meet the requirements of CSA C22.2 No. 110 or CSA B51, as applicable, and UL 174 or UL 1453.

22.105 In the case of closed containers of SANITARY HOT WATER HEAT PUMPS, the formation of an air or vapour cushion of more than 2 % of the capacity, but not more than 10 % as a maximum, shall be provided.

Compliance is checked by inspection and, where necessary, by measurements.

22.105DV DR *Modification: Clause 22.105 in the Part 2 has been replaced by Clause 22.104DV.*

22.106 PRESSURE-RELIEF DEVICES, whether incorporated in the container of SANITARY HOT WATER HEAT PUMPS or supplied separately, shall prevent the pressure in the container from exceeding the permissible excessive operating pressure by more than 0,1 MPa.

Compliance is checked by subjecting the container to a slowly increasing water pressure and by observing the pressure at which the relief device operates.

22.106DV DR *Modification: Clause 22.106 in the Part 2 has been replaced by Clause 22.104DV.*

22.107 The outlet system of open containers of SANITARY HOT WATER HEAT PUMPS shall be free from obstructions that could limit the water flow to such an extent that the pressure in the container would exceed the permissible excessive operating pressure.

Vented containers of SANITARY HOT WATER HEAT PUMPS shall be so constructed that the container is always open to the atmosphere through an aperture of at least 5 mm in diameter or 20 mm^2 in area, with a width of at least 3 mm.

Compliance is checked by inspection and measurement.

NOTE The first requirement is considered to be met if the area of the water outlet from the heated part of the container of SANITARY HOT WATER HEAT PUMPS is equal or greater than the area of the water inlet to the heated part.

22.107DV DR *Modification: Clause 22.107 in the Part 2 has been replaced by Clause 22.104DV.*

22.108 Storage tanks of SANITARY HOT WATER HEAT PUMPS shall be resistant to vacuum pressure impulses which may occur in normal use.

Compliance is checked by subjecting containers which are not vented in accordance with 22.104 to a vacuum of 33 kPa for 15 min.

After the test, the container shall show no deformation which might result in a hazard.

Anti-vacuum valves, if any, are not rendered inoperative.

NOTE This test can be carried out on separate containers.

22.108DV DR *Modification: Clause 22.108 in the Part 2 has been replaced by Clause 22.104DV.*

22.109 Wiring connected to a NON-SELF-RESETTING THERMAL CUT-OUT designed to be replaced after its operation shall be so secured that replacement of the THERMAL CUT-OUT itself or to a heating element assembly on which the THERMAL CUT-OUT is mounted will not damage other connections or internal wiring.

Compliance is checked by inspection and, if necessary, by manual test.

22.110 NON-SELF-RESETTING THERMAL CUT-OUTS designed to be replaced after their operation shall open the circuit in the intended manner without short-circuiting LIVE PARTS of different potential and without causing LIVE PARTS to come into contact with the enclosure.

Compliance is checked by the following test.

The appliance is operated five times, each time with a new NON-SELF-RESETTING THERMAL CUTOUT, any other thermally operated control devices being short-circuited.

Each time, the THERMAL CUT-OUT shall operate appropriately.

During the test, the enclosure of the appliance is connected to earth through a 3 A fuse; this fuse shall not blow.

After this test, the supplementary heating elements shall withstand an electric strength test as specified in 16.3.

22.110DV D2 *Modification of Clause 22.110 of the Part 2 by adding the following:*

A compliance test is not required if the component has been tested and complies with national standards.

22.112 The construction of the refrigerating system shall comply with the requirements of ISO 5149-2.

Appliances using flammable refrigerants shall comply with the requirements and tests of Annex GG.

22.112DV DR *Modification of Clause 22.112 of the Part 2 by deleting the second sentence, and by adding subclauses 22.112DV.1 to 22.112DV.18:*

22.112DV.1 The tubing connections of dissimilar metals, such as aluminum and copper, shall be protected against moisture to minimize galvanic action.

22.112DV.2 Tubing used in the construction of refrigerant-containing parts, such as an evaporator or condenser coil, shall comply with the strength requirements specified in Annex EE, or Table 22.112DV.20.

22.112DV.3 If the equipment includes pressure vessels having an inside diameter over 152 mm (6 in), and having an internal or external design pressure greater than 15 psig (103.4 kPA gauge), they shall comply with the applicable national pressure vessel, and shall be designed and tested in accordance with the ASME Unfired Pressure Vessel Code for a design pressure in compliance with the requirements of the strength test specified in Annex EE.

22.112DV.4 Water-side components, regardless of inside diameter or length, containing water under pressure, including those containing air the compression of which only serves as a cushion, with a design pressure greater than 2 MPa (300 psi) or a design temperature greater than 99 °C (210 °F), shall comply with CSA B51 and shall be designed, tested, and listed to the ASME Boiler and Pressure Vessel Code, Section VIII.

The water may contain additives, provided that the flash point of the aqueous solution at atmospheric pressure is 85 °C (185 °F) or higher. The flash point shall be determined by the methods specified in ASTM D93 or in ASTM D56, whichever is appropriate.

If the appliance includes pressure vessels having an inside diameter over 152 mm, and having a design pressure greater than 103 kPa gauge, all pressure vessels shall comply with the applicable national pressure code and be in compliance with the requirements of the strength test specified in Annex EE.

22.112DV.5 Appliances shall have protective means such as a fusible plug, a rupture member, soldered or brazed tubing joints, special terminals, or pressure relief valves, or shall be so constructed that some part of the system will safely relieve the overpressure in case of fire or other abnormal conditions.

22.112DV.6 A means for relieving pressure is not required on a forced air-cooled condenser in which the only refrigerant-containing component is tubing, and which is not equipped with shutoff valves.

22.112DV.7 A pressure vessel having an inside diameter greater than 76 mm but not exceeding 152 mm (6 in) and having a gross internal volume not exceeding 0,085 m^3 (3ft^3) shall be protected by a pressure-relief device(s) if it can contain liquid refrigerant.

22.112DV.8 A pressure vessel having an inside diameter greater than 76 mm but not exceeding 152 mm (6 in) and having a gross internal volume greater than 0,085 m^3 (3 ft^3) shall be protected by a pressure-relief device(s) if it can contain liquid refrigerant. Fusible plugs shall not be used.

22.112DV.9 A pressure vessel having an inside diameter greater than 152 mm (6 in) mentioned in Clause 22.112DV.8 shall have pressure relief in accordance with ANSI/ASHRAE 15 or CSA B52.

22.112DV.10 Calculation of the discharge capacity of a pressure relief device or fusible plug shall be in accordance with ANSI/ASHRAE 15 or CSA B52.

22.112DV.11 The requirements for the pressure relief device(s) indicated in Clauses 22.112DV.7 through 22.112DV.9 are

a) a rupture member or pressure relief valve that will relieve the pressure at not more than 40 % of the highest pressure defined in Annex EE; or

b) a fusible plug, provided that the critical pressure of the refrigerant used does not exceed the relieving pressure specified above, and that the saturation pressure of the refrigerant used, at the temperature marked on the plug, does not exceed the relieving pressure specified above. When FLAMMABLE REFRIGERANT is used, pressure relief devices or fusible plugs located in the occupied space shall have provision to be connected to piping that is vented to the outdoors. The provision's discharge capacity shall meet the requirements of ANSI/ASHRAE 15 and CSA B52.

22.112DV.12 A stop valve or shutoff valve shall not be located between any pressure relief device or fusible plug, etc., and the part or parts of the system protected thereby.

22.112DV.13 All pressure relief means shall be connected adjacent to or directly to the pressure vessel or parts of the system protected. Pressure-relief devices shall be connected above the liquid refrigerant level and installed to make them accessible for inspection and repair and to protect them from conditions that could cause them to malfunction.

22.112DV.14 A positive displacement compressor operating at pressures exceeding 103 kPa and having a displacement exceeding 0,02 m^3/s) shall be equipped with a pressure-relief device having the capacity and the pressure setting necessary to prevent rupture of the compressor. The pressure-relief device shall be located between the compressor and stop valve on the discharge side. Discharge from the pressure-relief device may be vented to the atmosphere or into the low pressure side of the system. When FLAMMABLE REFRIGERANT is used, pressure relief devices or fusible plugs located in the occupied space shall have provision to be connected to piping that is vented to the outdoors. The provision's discharge capacity shall meet the requirements of ANSI/ASHRAE 15 and CSA B52.

22.112DV.15 If pressure-relief devices discharge into the low pressure side of the system, the low side pressure-relief devices shall have capacity to protect either the pressure vessels that are relieved into the low pressure side of the system, or all pressure vessels on the low side of the system, whichever relieving capacity is the largest.

22.112DV.16 The nominal rated rupture pressure of a rupture member or the start-to-discharge pressure of a pressure relief valve shall not exceed

a) the marked maximum working pressure of a pressure vessel being protected; or

b) one-third of the ultimate strength of a pressure vessel that is not marked with the maximum working pressure.

22.112DV.17 *Compliance with Clauses 22.112DV.1 to 22.112DV.18 is checked by inspection and, if necessary, by manual test.*

22.112DV.18 Electrical connections to refrigerant sensors or REFRIGERANT DETECTION SYSTEMS that are intended to be made in the field by installers and service personnel, or an output signal from a REFRIGERANT DETECTION SYSTEM to a device for notification, shall comply

with the requirements of this standard for functional insulation between other circuits. When the wiring is terminated in a single electrical plug connection, the plug shall be polarized in such a manner that it shall prevent an improper connection from being intentionally made.

Compliance is checked by inspection.

22.112DV.19 DR *Add the following subclauses to Clause 22 of the Part 2:*

22.112DV.19.1 Appliances containing a LEAK DETECTION SYSTEM shall provide an output signal when the LEAK DETECTION SYSTEM has initiated a SYSTEM RESPONSE required by either Annex LL or 101.DVP.

Compliance is checked by inspection of literature per Annex DD.

NOTE An output signal can be one or more methods including, but not limited to, wireless signals, dry contacts, low-voltage signals, digital/binary output, etc.

22.112DV.19.2 Output and input signals for REFRIGERANT DETECTION SYSTEMS on ITE COOLING APPLIANCES shall comply with Annex 101.DVN requirements.

Compliance is checked by inspection

22.112DV.20 D1 *Addition of Clause 22.112DV.20 to Clause 22 of the Part 2:*

Compliance with ISO 5149-2 shall not be necessary if tubing wall thickness complies with Item a).

Refrigerant-containing components shall comply with UL 207 or CSA C22.2 No. 140.3, or they shall comply with the following:

a) they shall be constructed of corrosion-resistant material, or they shall be plated, dipped, coated, or otherwise treated to resist external corrosion;

b) except as stated in Item c), tubing used to connect refrigerant-containing components shall comply with the minimum wall thickness requirements of Table 22.112DV.20; and

c) tubing used in the construction of refrigerant-containing components, such as an evaporator or condenser coil, that is adequately protected by the inherent construction, as well as protected tubing not meeting the wall thickness requirements of Table 22.112DV.20, shall comply with the strength requirements specified in Annex EE.

Table 22.112DV.20
Tubing wall thickness

Outside diameter		Minimum wall thickness,[a] mm (in)					
		Copper					
		Protected		Unprotected		Steel	
4.76	(3/16)	0.62	(0.0245)	0.67	(0.0265)	0.64	(0.025)
6.35	(1/4)	0.62	(0.0245)	0.67	(0.0265)	0.64	(0.025)
7.94	(5/16)	0.62	(0.0245)	0.72	(0.0285)	0.64	(0.025)
9.53	(3/8)	0.62	(0.0245)	0.72	(0.0285)	0.64	(0.025)
12.70	(1/2)	0.62	(0.0245)	0.72	(0.0285)	0.64	(0.025)
15.88	(5/8)	0.80	(0.0315)	0.80	(0.0315)	0.81	(0.032)
19.05	(3/4)	0.80	(0.0315)	0.98	(0.0385)	0.81	(0.032)
22.23	(7/8)	1.04	(0.0410)	1.04	(0.0410)	1.17	(0.046)
25.40	(1)	1.17	(0.0460)	1.17	(0.0460)	1.17	(0.046)
28.58	(1-1/8)	1.17	(0.0460)	1.17	(0.0460)	1.17	(0.046)
31.75	(1-1/4)	1.28	(0.0505)	1.28	(0.0505)	1.17	(0.046)
34.93	(1-3/8)	1.28	(0.0505)	1.28	(0.0505)	1.17	(0.046)
38.10	(1-1/2)	1.41	(0.0555)	1.41	(0.0555)	1.58	(0.062)
41.3	(1-5/8)	1.410	(0.0555)	1.410	(0.0555)	1.58	(0.062)
54.0	(2-1/8)	1.626	(0.0640)	1.626	(0.0640)	–	–
66.7	(2-5/8)	1.880	(0.0740)	1.880	(0.0740)	–	–

[a] Nominal wall thickness of tubing shall be greater than the thickness indicated to maintain the minimum wall thickness.

22.113 When a FLAMMABLE REFRIGERANT is used, refrigerant tubing shall be protected or enclosed to avoid mechanical damage. The tubing shall be protected to the extent that it will not be handled or used for carrying during moving of the product. Tubing located within the confines of the cabinet is considered to be protected from mechanical damage.

Compliance is checked by inspection.

22.113DV D1 ***Modification of Clause 22.113 of the Part 2 by replacing it with the following:***

Appliances using flammable refrigerants shall be FACTORY SEALED SINGLE PACKAGE UNITS and shall be fully charged at the factory. This does not apply to appliances using A2L refrigerants or to indirect system complying with Clause GG.6.

22.114 When a FLAMMABLE REFRIGERANT is used, low temperature solder alloys, such as lead/tin alloys, are not acceptable for pipe connections or any other refrigerant pressure containing purposes.

22.114DV D1 ***Modification of Clause 22.114 of the Part 2 by replacing it with the following:***

When a FLAMMABLE REFRIGERANT is used, alloys used indoors to join refrigerant containing connections shall have a melting point (liquidus temperature) greater than 427 °C.

22.115 The REFRIGERANT CHARGE (m_c) of all REFRIGERATING SYSTEMS within the appliance employing A2 and A3 REFRIGERANTS shall not exceed m_3 as defined in Annex GG.

The REFRIGERANT CHARGE (m_c) in each REFRIGERATING SYSTEM employing A2L REFRIGERANT shall not exceed m_3 as defined in Annex GG.

The construction of the REFRIGERATING SYSTEM using FLAMMABLE REFRIGERANTS shall comply with the requirements in Annex GG.

22.115DV D1 ***Modification of Clause 22.115 of the Part 2 by adding the following:***

A REFRIGERATING SYSTEM using FLAMMABLE REFRIGERANTS shall comply with the requirements in Annex GG or Annex 101.DVN. The REFRIGERANT CHARGE (m_c) in each REFRIGERATING SYSTEM employing A2 and A3 REFRIGERANTS shall not exceed m_1.

22.116 Appliances using FLAMMABLE REFRIGERANTS shall be constructed so that any leaked refrigerant will not flow or stagnate so as to cause a fire or explosion hazard in areas within the appliance and connected ducts where electrical components, which could be a source of ignition and which could function under normal conditions or in the event of a leak, are fitted.

Separate components, such as THERMOSTATS, which are charged with less than 0,5 g of a flammable gas are not considered to cause a fire or explosion hazard in the event of leakage of the gas within the component itself.

Refrigerant pipes containing A2L REFRIGERANT which connect REFRIGERATING SYSTEM components shall not be considered a source of leaked refrigerant for the purpose of evaluating potential for fire or explosion hazard relative to POTENTIAL IGNITION SOURCES within the appliance if the piping within the area of the appliance to be evaluated complies with all of the following;

• no connecting joints;

• no bends with centreline bend radius less than 2,5 times the external pipe diameter;

• protected from potential damage during NORMAL OPERATION, service or maintenance.

All electric components that could be a source of ignition and which could function under normal conditions or in the event of a leak, shall comply with at least one of the following:

• shall be located in an enclosure which complies with Clause 20 of IEC 60079-15:2010 for restricted breathing enclosures suitable for use with group IIA gases or the refrigerant used;

• shall not be located in an area where a potentially flammable gas mixture will accumulate as demonstrated by the test of Annex FF. Electrical components not located in an area where a potentially flammable gas mixture will accumulate as demonstrated by the test of Annex FF are not considered an POTENTIAL IGNITION SOURCE;

• for A2L REFRIGERANTS, located in an enclosure which is in compliance with Annex NN.

Components and apparatus complying with Clause 16 to 22 of IEC 60079-15:2010, for group IIA gases or the refrigerant used or an applicable standard that makes electrical components suitable for use in Zone 2, 1 or 0 as defined IEC 60079-14 are not considered as a source of ignition.

NOTE 1 The test current for a switching component is the RATED CURRENT of the component or the actual load to be switched, whichever is greater.

NOTE 2 POTENTIAL IGNITION SOURCES can be electrical components which produce sparks or arcs or hot surfaces under normal conditions. Examples are brush-type motors, light switches, relays, electric heaters, or UV lights.

For A2L REFRIGERANTS, electrical components in compliance with Annex JJ are not considered a POTENTIAL IGNITION SOURCE.

For A2L REFRIGERANTS, switching devices in compliance with all of the following are not considered a POTENTIAL IGNITION SOURCE:

• the device is capable of 100 000 cycles per Clause 24;

• the switched electrical load (L_e) in kVA is less than or equal to:

– $L_e = 5 \times (6{,}7/S_u)^4$ when breaking all phases;

– $L_e = 2{,}5 \times (6{,}7/S_u)^4$ when breaking two legs of a three phase load, or when breaking one or two legs of a single phase load

where

L_e is the switched inductive electrical load in kilovoltamperes (kVA),

S_u is the burning velocity of a refrigerant in centimeters per second (cm/s).

Compliance is checked by measurement.

The burning velocity (S_u) for the purpose of determining the maximum quenching diameter (d_q) in Annex JJ and the maximum allowable electrical load L_e according to the above shall take into consideration the effect of humidity on burn velocity (S_u).

The burning velocity (S_u) shall be the highest value of

• as specified in ISO 817; or

• as measured in humid air at 27 °C ± 0,5 °C dew point at 101,3 kPa containing 21,0 ± 0,1 % O_2 excluding water vapour determined at the nominal composition as specified in ISO 817.

NOTE 3 The 27 °C dew point equates to an absolute humidity of 0,022 7 kg water vapour per 1 kg dry air.

This test can be done at the temperature higher than 27 °C. The required dew point is only for humidity.

The burning velocity (S_u) at 27 °C dew point may be determined by extrapolation of the measurement at 23 °C and 50 % relative humidity and the burning velocity (S_u) as provided by ISO 817. The extrapolation shall be based on the measured value increased by the measurement uncertainty to the burning velocity (S_u) at 23 °C and 50 % relative humidity. If the burning velocity (S_u) is not measurable at dry condition, the burning velocity shall be measured at 27 °C dew point.

For appliances with A2L REFRIGERANTS, electrostatic air cleaners and similar devices which may produce electrical arcing during NORMAL OPERATION that could ignite the refrigerant used, and which are installed in the unit airstream or connecting ducts, are not considered as a POTENTIAL IGNITION SOURCE if the airflow is monitored and the energy source of the electric arcing is switched off when the airflow is below the minimum airflow according to Annex GG.

22.116DV D1 ***Modification of Clause 22.116 of the Part 2 by replacing it with the following:***

22.116DV.1 Arcs and sparks from electric components

22.116DV.1.1 Appliances using FLAMMABLE REFRIGERANTS shall be constructed so that any leaked refrigerant will not flow or stagnate so as to cause a fire or explosion hazard in areas within the appliance or connected ducts where electrical components, which could be a source of ignition and which could function during NORMAL OPERATION or as a result of a leak, are located.

NOTE Thermal cut-outs and similar devices are not considered to function during NORMAL OPERATION.

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

Electrical components, which are potential ignition sources that could function under NORMAL OPERATION or as a result of a leak, are not considered a source of ignition if they comply with at least one of the following requirements:

– they are not located in an area where a potentially flammable gas mixture will accumulate as demonstrated by the test of Annex FF;

– the have an equipment protection level according to Clause 22.116DV.2;

– they are sealed components in compliance with the tests of Clause 22.116DV.3, and they shall be protected from impact by the appliance enclosure;

– they are located in an enclosure that complies with Clauses 7 to 10 of IEC 60079-15 for restricted breathing enclosures suitable for use with group IIA gases or the refrigerant used;

– they shall be located in an enclosure that complies with IEC 60529, Clause 13.4 and 14.2.4, or 14.2.5, or 14.2.6, or 14.2, or they are located in an enclosure which complies with Annex NN – applicable to appliances employing A2L REFRIGERANTS only;

– they are in compliance with Annex JJ – applicable to appliances with A2L REFRIGERANTS only;

– they are in compliance with Clause 22.116DV.4 – applicable to appliances employing A2L REFRIGERANTS only;

Electrostatic air cleaners or similar devices shall comply with Clause 22.116DV.5 – applicable to appliances with A2L REFRIGERANTS only.

– they are in compliance with UL 121201.

– REFRIGERANT SENSOR tested and found to comply with Clause LL.13DV.

– A manual disconnect switch used during servicing.

22.116DV.1.2 For appliances using FLAMMABLE REFRIGERANTS that utilize a pressurized enclosure, for the electrical equipment the electrical components located in the enclosure are not considered as a potential ignition sources if

– the enclosure complies with ANSI/NFPA 496;

– the enclosure complies with UL 60079-2; or

– for appliances using A2L REFRIGERANT, the enclosure complies with all the following:

• it continuously maintains a positive internal gauge pressure of at least 25 Pa using air from a clean source that is either outside air or air from location known to have clean air;

• it has a pressure monitoring device or sensor;

• the monitoring device provides an electrical output signal (e.g., an alarm or a signal that turns off the equipment) in the event that the pressure in the enclosure falls below the required minimum; and

• it is marked per Clause 7.1DV.18.

22.116DV.2 Components are not considered to be ignition sources if they comply with the requirements for equipment protection level Ga, Gb, or Gc as defined in IEC 60079-14 for the refrigerant used in the appliance, or the relevant gas group (IIA, IIB, or IIC) to which the refrigerant belongs. However, the following requirements do not apply:

– marking requirements of the applicable standard in the IEC 60079 series (all parts);

– the impact tests of IEC 60079-0;

– the IP test of IEC 60079-0;

– the drop test of IEC 60079-0; and

the creepage and CLEARANCE requirements in IEC 60079-7.

NOTE 1 Most refrigerants belong to group IIA gases,; however, R-E170 belongs to group IIB gases.

NOTE 2 The following are examples of relevant protection principles that can be applied:

• non incendive components “nC” in IEC 60079-15:2017;

• flameproof “dc” in IEC 60079-1:2014 (formerly enclosed break device “nC” in IEC 60079-15:2010);

• increased safety “ec” in IEC 60079-7:2015/AMD1:2017 (formerly non sparking low power equipment “nA” in IEC 60079-15:2010);

• intrinsic safety “ic” in IEC 60079-11:2011 (formerly energy limited apparatus “nL” in IEC 60079-15:2010);

• sealed device “nC” in IEC 60079-15:2017;

• hermetically sealed device “nC” in IEC 60079-15:2017; and

• restricted breathing enclosure “nR” in IEC 60079-15:2017.

Compliance is checked by inspection or testing as required by the relevant IEC 60079 series standard.

22.116DV.3 Three samples of the component shall be conditioned in a climate chamber for 168 h at the maximum operating temperature during the test of Clause 11 plus 12 K, but not less than 75 °C. This conditioning is followed by 24 h at the minimum operating temperature during the test of Clause 11 reduced by at least 5 K.

The test temperature in the climate chamber shall be maintained within 2 K for the duration of the test.

The components shall be stabilized at a temperature of 25 °C. The entire components shall then be rapidly immersed in water at a temperature of (50 ± 2) °C to a depth of at least 25 mm below the surface for at least 60 s.

No bubbles shall emerge from the inside of the samples during this test.

22.116DV.4 For A2L REFRIGERANTS, devices capable of 100 000 cycles per Clause 24 switching AC loads in compliance with one of the following are not considered a potential ignition source:

– For resistive loads where the impedance has a power factor higher than 0,99: breaking current per contact is not more than 48A during NORMAL OPERATION.

– For inductive loads where the power factor is not more than 0,99, the apparent power (S) of the switched inductive electrical load per phase in kVA is less than or equal to

- **$L_e = 5 \times (6{,}7/S_u)^4$ when breaking all phases of a 3-phase load; or**
- **$L_e = 2{,}5 \times (6{,}7/S_u)^4$ for all others.**

where

L_e is the maximum allowed apparent power of the switched inductive electrical load in kilovolt amperes (kVA),

S_u is the burning velocity of a refrigerant in centimeters per second (cm/s).

Compliance is checked by measurement at maximum switching load operating conditions per Clause 10.

22.116DV.5 For appliances with A2L REFRIGERANTS, electrostatic air cleaners and similar devices which may produce electrical arcing during NORMAL OPERATION that could ignite the refrigerant used, and which are installed in the unit airstream or connecting ducts, are not considered as a potential ignition source if the airflow is monitored and the energy source of the electric arcing is switched off when the airflow is below the minimum airflow according to Clause GG.9.

Compliance is checked by inspection and, if necessary, by an appropriate test.

22.116DV.6 The burning velocity (S_u) of 10 cm/s for the purpose of determining the maximum quenching diameter (d_q) in Annex JJ and the maximum switched inductive electrical load (L_e) (see Clause 22.116DV.4) with no consideration the effect of humidity on burn velocity (S_u), or the maximum switched load (L_e) with no consideration to the effect of humidity or burning velocity (see clause 22.116DV.4).

The burning velocity (S_u) shall be the highest value

– as specified in ISO 817; or

– as measured in humid air at 27 °C ± 0,5 °C dew point at 101,3 kPa containing 21,0 % ± 0,1 % O_2 excluding water vapor, determined at the nominal composition as specified in ISO 817.

NOTE The 27 °C dew point equates to an absolute humidity of 0,022 7 kg water vapor per 1 kg dry air.

This test can be done at a temperature higher than 27 °C. The required dew point is only for humidity.

The burning velocity (S_u) at 27 °C dew point may be determined by extrapolation of the measurement at 23 °C and 50 % relative humidity and the burning velocity (S_u) as provided by ISO 817. The extrapolation shall be based on the measured value increased by the measurement uncertainty to the burning velocity (S_u) at 23 °C and 50 % relative humidity. If the burning velocity (S_u) is not measurable at dry condition, the burning velocity shall be measured at the 27 °C dew point.

22.117 Hot surfaces

22.117.1 Temperatures on surfaces that may be exposed to leakage of FLAMMABLE REFRIGERANTS shall not exceed the maximum allowable surface temperature given in Annex BB.

For FLAMMABLE REFRIGERANTS except A2L REFRIGERANTS not listed in Annex BB, the maximum allowable surface temperature is determined by AIT reduced by 100 K.

For A2L REFRIGERANTS not listed in Annex BB, the maximum allowable surface temperature is determined by the highest of AIT reduced by 100 K or, if tested per annex KK, the HOT SURFACE IGNITION TEMPERATURE reduced by 100 K, but not higher than 700 °C.

Compliance is checked by measuring the appropriate surface temperatures during the tests of Clauses 11 and 19, except those which during the tests of Clause 19 are terminated in a non-self-resetting way. Compliance for A2L REFRIGERANTS is checked by measuring the appropriate surface temperatures during the tests of Clause 11.

Surfaces in compliance with this clause shall not be considered a POTENTIAL IGNITION SOURCE.

22.117.1DV.1 D1 *Modification of Clause 22.117.1 of the Part 2 by replacing the third paragraph with the following:*

For A2L refrigerants not listed in Annex BB, the maximum allowable surface temperature is determined by the highest of AIT reduced by 100 K or, if tested per Annex KK or ASTM D8211, the hot surface ignition temperature reduced by 100 K.

22.117.1DV.2 D2 *Modification of Clause 22.117.1 of the Part 2 by adding the following paragraph:*

Refrigerant sensors tested and found to comply with Clause LL.13DV are considered to comply with this clause.

22.117.2 Temperatures on surfaces that may be exposed to leakage of A2L REFRIGERANTS may exceed the maximum allowable surface temperature in case of loss of airflow when all the following applies:

• the temperatures are not exceeding the maximum allowable surface temperature with the minimum airflow;

• the airflow is supervised and the heat source of the hot surface is switched off, when the airflow is below the minimum airflow.

NOTE Proof of airflow can be provided by any reliable means, including detection of fan speed.

Compliance is checked by inspection and by measuring the appropriate surface temperatures during the tests of Clause 19.2, 19.3, 19.101 to 19.104.

22.117.2DV D2 *Modification of Clause 22.117.2 of the Part 2 by replacing it with the following:*

Temperatures on surfaces that can be exposed to leakage of A2L refrigerants may exceed the maximum allowable surface temperature when all the following applies:

a) The indoor fan is provided with a fan failure switch capable of detecting that the fan is not operating as intended.

b) The heat source cannot be energized if the fan failure switch detects that the fan is not operating as intended.

c) The minimum average airflow velocity is no less than 1,0 m/s (200 ft/min).

$$QH_{\min} = 30 \times m_c / LFL$$

where

***QH*$_{min}$ is the airflow in m^3/h**

***m*$_c$ is the actual refrigerant charge amount in the system in kg**

***LFL* is the lower flammability limit in kg/m^3**

If a refrigerant detection system is provided which de-energizes the heat source when a leak is detected, a fan failure switch is not required.

NOTE 1DV A heat source can be electric supplementary heat, fossil fuel heat, or other source that can exceed a surface temperature of 700 °C.

NOTE 2DV A fan failure switch could be any number of solutions which confirm the fan is operating. For example,

a) hall effect switch on the fan shaft or blade pass;

b) pressure switch across the fan;

c) sail switch on the outlet of the fan;

d) on direct drive, a Hall effect switch on the motor shaft;

e) on direct drive ECM and similar, a digital output indicating the motor is not turning, current draw, etc.; and

f) a control system of a unit having an electric heater so designed that the heater cannot operate unless the direct drive circulating fan motor circuit is energized.

For appliances with A2L refrigerants, electrostatic air cleaners, and similar devices which can produce electrical arcing during NORMAL OPERATION that could ignite the refrigerant used, and which are installed in the unit airstream or connecting ducts, are also not

considered as a potential ignition source if they comply with the requirements in this clause, where "heat source" is replaced by source of "electrical arcing".

Compliance is checked by inspection and if in doubt by test to confirm the airflow. The airflow for determining compliance with QH_{min} shall be the manufacturer's specified minimum airflow in any operating mode that energizes the source of heat.

22.117.3 Open source of ignition, including open flames, pilot flames, direct spark ignition or hot surface ignition or other similar sources of ignition in the combustion air-stream, if the combustion air is drawn from an unventilated space in which leaked refrigerant may enter through the combustion air intake, are allowed, when these appliances are provided with a flame arrest or equivalent to ensure that in the event of an ignition, the flame will not propagate.

Compliance is checked by inspection.

22.118 When a FLAMMABLE REFRIGERANT is used, all appliances shall be charged with refrigerant at the manufacturing location or charged on site as recommended by the manufacturer.

part of an appliance that is charged on site, which requires brazing or welding in the installation, shall not be shipped with a FLAMMABLE REFRIGERANT CHARGE. Joints made in the installation between parts of the REFRIGERATING SYSTEM, with at least one part charged, shall be made in accordance with the following.

• A brazed, welded, or mechanical connection shall be made before opening the valves to permit refrigerant to flow between the REFRIGERATING SYSTEM parts. A vacuum valve shall be provided to evacuate the interconnecting pipe and/or any uncharged REFRIGERATING SYSTEM part.

• Mechanical connectors used indoors shall comply with ISO 14903. When mechanical connectors are reused indoors, sealing parts shall be renewed. When flared joints are reused indoors, the flare part shall be re-fabricated.

• Refrigerant tubing shall be protected or enclosed to avoid damage.

Flexible refrigerant connectors (such as connecting lines between the indoor and outdoor unit) that may be displaced during NORMAL OPERATION shall be protected against mechanical damage.

Compliance is checked according to the installation instructions and a trial installation if necessary.

22.118DV D1 *Modify Clause 22.118 of the Part 2 by replacing it with the following:*

For appliances using FLAMMABLE REFRIGERANTS, all joints made in the installation between parts of the REFRIGERATING SYSTEM, with at least one part charged, shall be made in accordance with the following:

– A brazed, welded, or mechanical connection shall be made before opening the valves to permit refrigerant to flow between the REFRIGERATING SYSTEM parts. A vacuum valve shall be provided to evacuate the interconnecting pipe or any uncharged REFRIGERATING SYSTEM part.

– Mechanical connectors used indoors shall comply with ISO 14903. When mechanical connectors are reused indoors, sealing parts shall be renewed. When flared joints are reused indoors, the flare part shall be refabricated.

– Refrigerant tubing shall be protected or enclosed to avoid damage.

– Flexible refrigerant connectors (such as connecting lines between the indoor and outdoor unit) that may be displaced during NORMAL OPERATION shall be protected against mechanical damage.

Compliance is checked according to the installation instructions and a trial installation, if necessary.

For installations with field applied joints that are exposed in the occupied space, these joints shall be at least one of the following:

– mechanical joints in compliance with ISO 14903 or UL 207 (U.S. only);

– welded or brazed joints; or

– joints in enclosures that vent to the unit or to the outside.

Compliance is checked by inspection and tests.

22.119 CONDENSING UNITS and EVAPORATING UNITS shall be equipped with a PRESSURE-LIMITING DEVICE or equivalent to assure that the equipment does not exceed the MAXIMUM ALLOWABLE PRESSURE.

NOTE Applies to PARTIAL UNIT types, CONDENSING UNITS and EVAPORATING UNITS only.

For PARTIAL UNITS, the interconnection circuits for signal communication between each unit shall be of the same type.

SELV level connection is recommended.

22.119DV D1 ***Modify Clause 22.119 of the Part 2 by adding subclauses 22.119DV.1 to 22.119DV.4:***

22.119DV.1 ***A PRESSURE-LIMITING DEVICE shall be installed on all systems that contain at least 10 kg of refrigerant and incorporate a motor-compressor. The PRESSURE-LIMITING DEVICE shall comply with one of the following:***

– a Type 2 Action in accordance with UL 60730-2-6 and CSA E60730-2-6,

– operation test in accordance with UL 353 and calibration in accordance with CSA C22.2 No. 24, or

– calibration verification in accordance with UL 873 and calibration in accordance with CSA C22.2 No. 24.

22.119DV.2 A PRESSURE-LIMITING DEVICE is not required if the CONDENSING UNIT or EVAPORATING UNIT that contains one or more hermetic refrigerant motor-compressors, each of which has a steel shell that is provided with an internal bypass valve that does not allow the equipment to exceed the maximum allowable pressure.

22.119DV.3 The adjustable cutout pressure setting of a PRESSURE-LIMITING DEVICE shall not exceed the maximum allowable pressure of the unit, or 90 % of the pressure relief setting if the unit is equipped with a pressure-relief device.

22.119DV.4 There shall be no stop valves between the pressure-limiting device and the compressor.

NOTE A Schrader valve is not a stop valve.

22.120 PARTIAL UNITS shall be provided with a means of connection to the supply mains and shall not be powered by an electrical circuit from another appliance.

22.120DV D1 ***Modify Clause 22.120 of the Part 2 by adding the following:***

Compliance is checked by inspection.

22.121 For the installation condition of appliances using an A2L REFRIGERANT and where a REFRIGERANT DETECTION SYSTEM is applied to fulfil the requirements of Annex GG, the refrigerant sensor of the system shall be located where leaking refrigerant is likely to stagnate. The sensor shall be located:

• within the unit for appliances connected via an air duct system to one or more rooms,

• within the unit where release height h_0 as determined in Clause GG.2 is not more than 1,5 m,

• where the release height h_0 as determined in Clause GG.2 is more than 1,5 m, the sensor may be located within

– the unit, or

– 100 mm or less directly below the unit, or

– remote located within 300 mm above the floor. If a remote located sensor is specified by the manufacturer, the instructions shall state that the sensor shall be located within

1) 10 m horizontal distance in line sight of the unit and on a wall within the room in which the unit is installed, or

2) 7 m, if not in line sight of the unit, and on a wall within the room in which the unit is installed. The distance from the unit to the sensor shall be measured as the shortest horizontal unobstructed path between the unit and the nearest sensor.

For installations with field applied mechanical joints which are exposed in the occupied space, the instructions shall state that a sensor shall be located

• remote located within 2 m horizontal distance in line of sight of the unit and on a wall within the room in which the unit is installed; and

– 100 mm above the floor where h_0 is not more than 300 mm from the floor; or

– 300 mm above the floor where h_0 is greater than 300 mm from the floor.

The following mechanical joints shall not require that sensor:

• mechanical joints in compliance with ISO 14903;

• joints in enclosures which vent to the unit or to the outside.

NOTE 1 A single sensor can be used if it satisfies all of the requirements for the unit and the field applied joints.

NOTE 2 The appliance can need several refrigerant sensors in different locations to comply with this International Standard.

Compliance is checked by inspection and by testing in accordance with Annex MM. Remote located sensor location is not tested. Sensors located 100 mm or less directly below the unit are not considered remote sensors.

22.121DV D1 ***Modification of Clause 22.121 of the Part 2 by replacing it with the following:***

22.121DV REFRIGERANT SENSOR location

22.121DV.1 For the installation condition of appliances using an A2L REFRIGERANT and where a LEAK DETECTION SYSTEM is applied to fulfil the requirements of Annex GG or for the purpose of limiting RELEASABLE CHARGE, the REFRIGERANT SENSOR shall be

– within the unit for appliances connected via an air duct system to one or more rooms, and

• for ADD ON HEAT PUMPS, mounting means and all wiring shall be provided from the factory for the sensor of the REFRIGERANT DETECTION SYSTEM as part of the indoor coil assembly;

• REFRIGERANT SENSORS that are not factory installed shall have factory supplied mounting hardware and shall have clear and concise instructions for installation and wiring; and

• REFRIGERANT SENSORS which may be relocated due to appliance installation position shall have clear and concise instructions for positioning and wire routing;

– within the ventilated enclosure if in compliance with Clause GG.4;

– within the unit where release height h_0 as determined in Clause GG.2 is not more than 1,5 m; and

– where the release height h_0 as determined in Clause GG.2 is more than 1,5 m, the REFRIGERANT SENSOR may be

• located within the unit; or

• located within 100 mm or less directly below the unit.

Compliance is checked by inspection and by testing in accordance with Annex MM or Annex 101.DVP. Testing according to Annex MM and Annex 101.DVP is not required when the LEAK DETECTION SYSTEM is only used for reducing the RELEASABLE CHARGE as determined by Annex 101.DVQ. Remote located REFRIGERANT SENSOR location is not tested. REFRIGERANT SENSORS located 100 mm or less directly below the unit are not considered remote REFRIGERANT SENSORS.

NOTE 1 Annex 101.DVQ specifies when Annex MM or Annex 101.DVP is applicable.

22.122 REFRIGERANT DETECTION SYSTEMS that are required by this standard for A2L REFRIGERANTS shall comply with Annex LL.

22.122DV D1 ***Modify Clause 22.122 of the Part 2 by replacing it with the following:***

For REFRIGERANT DETECTION SYSTEMS that are required by this standard for FLAMMABLE REFRIGERANTS the output signal of the REFRIGERANT DETECTION SYSTEM shall activate the actions required to comply with Annex GG or Annex 101.DVN in the event of a leak. If a

REFRIGERANT DETECTION SYSTEM can provide notification to the user that replacement of the REFRIGERANT SENSOR is required, then resetting this notification shall only be possible when the cover of the casing is removed or opened to enable the replacement of the REFRIGERANT SENSOR. REFRIGERANT DETECTION SYSTEMS shall comply with Annex LL.

Compliance is checked by inspection and tests according to Annex LL.

22.123 For appliances connected via an air duct system to one or more rooms using an A2L REFRIGERANT

– which include a separate section with refrigerant containing components except pipes (e.g. compressors, CONDENSERS), and

– which are isolated from the airflow and located in a room smaller than A_{min} per Clause GG.2,

then Clause GG.4 (ventilated enclosure) can be applied, where the required ventilation can be provided by the ventilation system. That section shall have an opening to the outdoor or indoor air-stream to be able to ventilate the refrigerant to an area in compliance with Annex GG.

22.123DV D1 ***Modify Clause 22.123 in the Part 2 by replacing it with the following:***

For appliances using a FLAMMABLE REFRIGERANT according to Clause GG.9, which include a separate section with refrigerant-containing components, except pipes (e.g., compressors, condensers), located in a room or a compartment smaller than A_{min} per Clause GG.2, that section shall be

– ventilated from the indoor air stream;

– mechanically ventilated from the compartment to the indoor air stream or to the outdoors in compliance with Clause GG.4;

– naturally ventilated to outdoors in compliance with Clause GG.8.2.3, or

– be compliant with the requirements of Annex 101.DVN.

Compliance is checked by inspection.

22.124 If a REFRIGERANT DETECTION SYSTEM is used, care has to be taken that in the event of a leak, accumulating refrigerant will be detected properly in every operating mode (e.g. indoor fan off).

Compliance for sensors is checked by inspection and by testing in accordance with Annex MM. Remote located sensor location is not tested. Sensors located 100 mm or less directly below the unit are not considered remote sensors.

22.124DV D1 ***Delete Clause 22.124 of the Part 2:***

Clause 22.124 is not applicable.

22.125 REFRIGERATING SYSTEMS that fulfil all of the following conditions shall be considered ENHANCED TIGHTNESS REFRIGERATING SYSTEMS:

a) the compressor, pressure relief device or pressure vessel type refrigerant containing components of the REFRIGERATING SYSTEM shall be located in locations other than the occupied space,

NOTE Pressure vessel means any refrigerant-containing part of a REFRIGERATING SYSTEM other than

– compressors,

– pumps,

– component parts of sealed absorption systems,

– EVAPORATORS, each separate section of which does not exceed 15 l of refrigerant containing volume,

– coils,

– piping and its valves, joints and fittings,

– control devices, and

– pressure-containing components (including headers),

having an internal diameter or a largest cross-sectional dimension not greater than 152 mm.

b) REFRIGERANT DISTRIBUTION ASSEMBLIES shall meet all applicable requirements of this standard,

c) REFRIGERATING SYSTEMS shall use only permanent joints indoors except for site-made joints directly connecting the indoor unit to the refrigerant piping, or factory made mechanical joints in compliance with ISO 14903,

d) refrigerant containing parts in indoor units shall be protected from damage in the event of catastrophic failure of moving parts, e.g. fans, belts,

e) systems where the equipment pipes in the occupied space in question are installed in such a way that it is protected against accidental damage,

f) the REFRIGERATING SYSTEM of each indoor unit shall be tightness tested at the factory with detection equipment with a capability of 3 grams per year of refrigerant or better under a pressure of at least 0,25 times the MAXIMUM ALLOWABLE PRESSURE. No leak shall be detected,

Compliance for bullet a) to bullet f) is checked by inspection.

g) vibrations exceeding 0,30 G RMS, when measured with a low pass filter at 200 Hz, are not allowed in the refrigerant containing parts in the occupied space under NORMAL OPERATION.

Compliance is checked by testing:

The equipment shall be mounted per installation instructions. The outdoor unit shall be directly connected to the indoor unit by the shortest line set per the installation instructions. Testing shall be conducted in fan only mode, the heating mode and cooling mode if applicable.

Vibration level shall be measured over the full range of the compressor and indoor fan speeds as allowed by the controls in consideration of the operation modes. Care shall be taken that the measurement sensors do not influence the line vibration level, and that the rate of change of speed is sufficiently slow that the maximum vibration is captured.

h) INDOOR HEAT EXCHANGERS shall be protected from damage in the event of freezing

Compliance is checked as follows:

– Coils protected by controls. Compliance is checked by inspection, if in doubt, the test for non-freezing coils shall be executed.

– Non-freezing coils. Compliance is checked by conducting the minimum cooling performance test as described in ISO 5151, ISO 13253, ISO 15042, or ISO 13256.

– Freezing coils. Compliance is checked on 3 samples by testing as follows. Cycling testing of the HEAT EXCHANGER under frosting conditions confirms that the HEAT EXCHANGER has adequate strength to withstand freezing without failure. The appliance shall cycle as intended by the controls for 10 days. At the end of the test, the HEAT EXCHANGER shall withstand the strength requirements of Annex EE.

i) the maximum speed of the fan, in NORMAL OPERATION, shall be less than 90 % of the maximum allowable fan speed as specified by the manufacturer of the fan wheel. If the manufacturer does not specify a maximum allowable fan speed then the fan wheel shall be tested as follows:

The maximum allowable fan speed shall be established by running continuously at 120 % of maximum speed for 10 days. There shall be no structural failure of the fan.

If non-metallic fan wheels have a minimum thermal index rating of 65 ºC per UL 746B, preconditioning is not required.

If no thermal index rating for the material is available, specimens shall be aged at 90 °C for 168 h. The samples shall not have more than a 50-percent reduction of the unconditioned property values for items a) to d) below when tested in accordance with CAN/CSA-C22.2 No. 0.17 and UL 746A:

a) tensile strength,

b) flexural strength,

c) Izod impact,

d) tensile impact.

Compliance is checked by inspection.

22.125DV D1 *Modify Clause 22.125 of the Part 2 by replacing it with the following:*

22.125DV.1 REFRIGERATING SYSTEMS that fulfill all of the following conditions may be considered ENHANCED TIGHTNESS REFRIGERATING SYSTEMS:

a) compressors, PRESSURE RELIEF devices and PRESSURE VESSELS of the REFRIGERATING SYSTEM shall not be located in the occupied space,

b) refrigerant distribution assemblies shall meet all applicable requirements of this standard,

c) REFRIGERATING SYSTEMS shall use only permanent joints indoors except for site-made joints directly connecting the indoor unit to the refrigerant piping, or factory made mechanical joints in compliance with ISO 14903 or UL 207,

d) refrigerant containing parts in indoor units shall be protected from damage in the event of catastrophic failure of moving parts, e.g., fans, belts,

e) the REFRIGERATING SYSTEM of each indoor unit shall be tightness tested at the factory with detection equipment with a capability of 3 grams per year of refrigerant or better under a pressure of at least 0,25 times the maximum allowable pressure. No leak shall be detected,

f) it is not a PARTIAL UNIT,

Compliance with Items a) to f) is checked by inspection or testing.

g) vibrations exceeding 0,30 G RMS, when measured with a low pass filter at 200 Hz, are not allowed in the refrigerant containing parts in the occupied space under NORMAL OPERATION,

Compliance is checked by testing:

The equipment shall be mounted per installation instructions. The outdoor unit shall be directly connected to the indoor unit by the shortest line set per the installation instructions. Testing shall be conducted in fan only mode, the heating mode and cooling mode if applicable.

Vibration level shall be measured over the full range of the compressor and indoor fan speeds as allowed by the controls in consideration of the operation modes. Care shall be taken that the measurement sensors do not influence the line vibration level, and that the rate of change of speed is sufficiently slow that the maximum vibration is captured.

h) indoor heat exchangers shall be protected from damage in the event of freezing, and

Compliance is checked as follows:

> ***– Coils protected by controls. Compliance is checked by inspection, if in doubt, the test for non-freezing coils shall be executed.***
>
> ***– Non-freezing coils: Compliance is checked by conducting the minimum cooling performance test as described in ISO 5151, ISO 13253, ISO 15042, and ISO 13256 or AHRI 210/240, AHRI 340/360, AHRI 13256.***
>
> ***– Freezing coils. Compliance is checked on 3 samples by testing as follows. Cycling testing of the heat exchanger under frosting conditions confirms that the heat exchanger has adequate strength to withstand freezing without failure. The appliance shall cycle as intended by the controls for 10 days. At the end of the test, the heat exchanger shall withstand the strength requirements of Annex EE.***

i) the maximum speed of the indoor fan, in NORMAL OPERATION, shall be less than 90 % of the maximum allowable fan speed as specified by the manufacturer of the fan wheel. If the manufacturer does not specify a maximum allowable fan speed, then the fan wheel shall be tested as follows:

> **– The maximum allowable fan speed shall be established by running continuously at 120 % of maximum speed for 10 days. There shall be no structural failure of the fan.**
>
> **– If non-metallic fans have a thermal index rating of 65 °C or greater in accordance with UL 746B, preconditioning is not required.**

– If non-metallic fans have a thermal index rating less than 65 °C in accordance with UL 746B, or no thermal index rating for the material is available, specimens shall be preconditioned by aging at 90 °C for 168 h. The samples shall not have more than a 50 % reduction of the unconditioned property values for Items 1 to 4 when tested in accordance with CAN/CSA-C22.2 No. 0.17 and UL 746A:

1) tensile strength;

2) flexural strength;

3) izod impact; and

4) tensile impact.

Compliance is checked by inspection.

22.126 For the purpose of this standard, GERMICIDAL LAMPS are limited to low pressure mercury lamps with a quartz envelope having a continuous spectral irradiance at 254 nm.

NOTE The quartz envelope blocks the 185 nm resonant wavelength for mercury that can generate ozone.

Compliance is checked by inspection.

22.126DV D1 ***Modify Clause 22.126 of the Part 2 by replacing it with the following:***

For the purpose of this standard, GERMICIDAL LAMPS shall be designed to exclude the 185 nm resonant wavelength that can generate ozone, and are limited to one of the following:

a) low-pressure mercury lamps having a continuous spectral irradiance at 254 nm;

b) UV-C LED arrays; or

c) mixed gas lamps or excimer lamps.

22.127 The appliance enclosure, UV-C LAMPS and UV-C BARRIERS shall be located in such a manner that the UV-C SPECTRAL IRRADIANCE is not emitted outside the unit into an occupied space at a level exceeding the irradiance limit specified in 32.101.1.

Compliance is checked by inspection and test per Subclause 32.101.

The appliance indoor airflow inlet and outlet shall be considered as possible radiation paths. The unit filters are not considered UV-C BARRIERS.

22.128 For appliances that employ UV-C GERMICIDAL LAMP SYSTEMS and which have doors and/or panels that provide direct access to an area within the appliance where the measured UV-C SPECTRAL IRRADIANCE is greater than 1,7 μW/cm^2, the doors and/or panels shall be equipped with an interlock device that terminates the power to the lamps when opened.

Compliance is checked by inspection, manual test, and test per Subclause 32.101.

If a switch is used to de-energize the UV-C LAMPS so as to meet the requirement, it shall not be possible to operate the switch with test probe B of IEC 61032.

22.129 For USER MAINTENANCE access areas, the UV-C SPECTRAL IRRADIANCE shall not exceed the limit specified in 32.101.2 with the access panels opened or removed as needed to perform the required USER MAINTENANCE. Panels that are opened or removed to perform USER MAINTENANCE shall be required to be closed or put back in place for proper operation of the appliance.

Compliance is checked by inspection and test per Subclause 32.101.

22.130 If the replacement of the UV-C LAMP is allowed by the user, the appliance shall be constructed so that

– the replacement of the UV-C LAMP is easily possible;

– if screws or components are omitted or incorrectly positioned or fastened, the appliance is rendered inoperable or manifestly incomplete.

Compliance is checked by inspection.

22.131 Appliances that employ refrigerants in a TRANSCRITICAL REFRIGERATING SYSTEM shall be equipped with a PRESSURE-LIMITING DEVICE that operates no greater than the MAXIMUM ALLOWABLE PRESSURE plus the tolerance of the PRESSURE-LIMITING DEVICE.

Compliance is checked by inspection.

22.131DV D1 *Modification by replacing Clause 22.131 of the Part 2 with the following:*

Appliances that employ refrigerants in a TRANSCRITICAL REFRIGERATING SYSTEM shall be equipped with a PRESSURE-LIMITING DEVICE. The PRESSURE-LIMITING DEVICE set point plus the tolerance of the pressure-limiting device shall be no greater than the MAXIMUM ALLOWABLE PRESSURE as determined in Annex EE.

22.131DV.1 A PRESSURE-RELIEF VALVE used on equipment intended to utilize a TRANSCRITICAL REFRIGERATING SYSTEM in a secondary loop or a cascade system and provided with a pressure vessel shall be sealed at a value not less than 3448 kPa (500 psig). If the equipment on which the pressure vessel is located does not use a hot gas defrost system, then the pressure-relief valve on the low side may be sealed at not less than 2069 kPa (300 psig).

22.131DV.2 A PRESSURE RELIEF VALVE used on equipment intended to utilize a TRANSCRITICAL REFRIGERATING SYSTEM shall be sealed at a value not less than 8273 kPa (1200 psig) on the high side of the system, and a value not less than 3448 kPa (500 psig) on the intermediate pressure side of the system.

22.131DV.3 Equipment intended to utilize a TRANSCRITICAL REFRIGERATING SYSTEM and that may contain a pressure vessel within the TRANSCRITICAL REFRIGERATING SYSTEM shall be furnished with the following items which are installed as part of the equipment:

a) a PRESSURE RELIEF DEVICE set to open as indicated in Clause 22.131DV.1, and

b) a PRESSURE RELIEF DEVICE set to operate at no higher than 90 % of the marked setting of the PRESSURE RELIEF DEVICE. Such a PRESSURE RELIEF DEVICE shall

– be factory set and sealed to prevent changing the relief setting; and

– have a discharge capacity not less than 20 % of the marked discharge capacity of a required pressure relief valve.

22.131DV.4 Equipment that may contain a PRESSURE VESSEL within a TRANSCRITICAL REFRIGERATING SYSTEM is not required to be provided with the pressure-relief valve or the pressure-regulating relief valve as part of the equipment if the instructions provide the information indicated in Item c) of Clause 7.112DV.5 and the equipment is marked according to Clause 7.112DV.6.

22.131DV.5 Equipment intended to utilize a TRANSCRITICAL REFRIGERATING SYSTEM is not required to be provided with a pressure-regulating relief valve if it does not contain a pressure vessel in the TRANSCRITICAL REFRIGERATING SYSTEM.

22.132DV D1 *Add subclauses 22.132DV.1 to 22.132DV.9 to Clause 22 of the Part 2:*

22.132DV.1 The appliance shall be designed so that the installation of auxiliary devices by service personal shall

a) be by the means of receptacles, plug-in connectors, wiring terminals, or insulated wire connectors;

b) not require drilling, cutting, soldering, or rearrangement of existing components;

c) prevent stress from being transmitted to the appliance wiring or terminals; and

d) reduce the likelihood that the auxiliary device will be incorrectly installed.

22.132DV.2 Thermal or acoustic insulating material shall be securely fastened in position or secured by an adhesive that complies the applicable requirements of the peel test per with UL 2395. Leading edges shall be protected against damage, including from the effects of moving air.

Compliance shall be checked by inspection.

22.132DV.3 The control system for an add on heat pump shall be provided with a fan interlock designed to prevent operation of the heat pump unless the circulating fan is energized and preventing simultaneous operation of the heat pump and the installed fossil fuel furnace.

Simultaneous operation of the heat pump and furnace during a defrost cycle, or during short transition periods from heat pump to furnace operation, or from furnace to heat pump operation is acceptable, provided it can be determined that the motor-compressor overload device will not operate during these periods

22.132DV.4 Supplementary heater circuits shall not have a concurrent load exceeding 48 A and shall have overcurrent protection rated at no greater than 60 A.

22.132DV.5 Appliances with heat exchangers for the purpose of heating sanitary water shall be designed to prevent contamination of the sanitary water by refrigerant or oil. Such designs may include the use of double wall heat exchangers with a vented interface evaluated in accordance with Clause 22.107.

22.132DV.6 No openings shall be located in the enclosure underneath hazardous voltage wiring or uninsulated live parts that could permit molten metal to drop onto flammable material located underneath the enclosure. With regard to wiring, the above requirement does not apply if VW-1 or FT-1 wiring is used.

22.132DV.7 A component shall not be connected across the contact terminals of a safety control.

22.132DV.8 Sufficient and reasonable accessibility shall be afforded to all parts that require normal servicing or adjustment when the equipment is installed as intended.

Adequate space or barriers shall be provided to prevent accidental contact with uninsulated LIVE PARTS or moving parts when performing routine service functions or operating controls intended to be adjusted during installation or in normal use when these functions are intended to be performed while the appliance is energized.

Note: Adjusting controls, replacing filters, greasing bearings, adjustment of belts and changing ultraviolet (UV) lamps are examples of routine service or adjustments.

22.132DV.9 Appliances with refrigerant to water heat exchangers for the purpose of heating water shall be provided with a temperature-regulating control and water-temperature-limiting control. The temperature-limiting control shall be temperature- or pressure-actuated and shall not function during the tests of Clause 11. The temperature-limiting control circuit shall be independent of any temperature-regulating control.

22.133DV D2 *Add subclause 22.133DV to Clause 22 of the Part 2:*

SAFETY SHUT-OFF VALVES for FLAMMABLE REFRIGERANTS for the purposes of limiting the releasable charge.

SAFETY SHUT-OFF VALVES shall default to fully closed position when the appliance is de-energised for any reason other than failure of the supply mains.

NOTE 1 If the appliance is powered through a supply cord fitted with a plug, then disconnecting this plug is not considered a failure of the supply mains.

NOTE 2 Backup power can be utilized to close motor driven valves (e.g., capacitors or batteries).

SAFETY SHUT-OFF VALVES that are activated by a leak detection system shall either

- **– have manual operation for resetting that requires the aid of a tool, or**
- **– for other than ITE COOLING APPLIANCES, automatically reset after the leak detection system has not detected refrigerant for at least 2 h.**

When used in conjunction with ITE COOLING APPLIANCES, SAFETY SHUT-OFF VALVES shall comply with the requirements of Annex 101.DVN.

Compliance is checked by inspection.

The total seat leak rate for the refrigerant used of all the SAFETY SHUT-OFF VALVES that reduce the leak into the same space shall be no more than m_{sv}.

$$m_{sv} = 0.75 \times LFL$$

where

- **m_{sv} is total seat leak rate in gram per second (g/s) of the nameplate marked refrigerant;**

LFL is the lower flammability limit in kilogram per cubic meter (kg/m^3);

0.75 is a constant.

Compliance is checked by the following test.

The SAFETY SHUT-OFF VALVE shall be subjected to a cycle test, where it is opened and closed a number of times depending on its intended function, as follows:

– a SAFETY SHUT-OFF VALVE activating in parallel with compressor cycling: 100 000 cycles; and

– a SAFETY SHUT-OFF VALVE activating only in response to a leak detection system and when is de-energized: 1 000 cycles.

Before and after this cycle test the seat leakage shall pass the below-mentioned test, where the leakage rate at each of the tested pressures shall be no more than m_{sv}.

Seat leakage shall be measured, at the valve outlet port at each of the following pressures, after having been applied to the valve inlet for 1 min:

– 0,5 × MAXIMUM ALLOWABLE PRESSURE; and

– 1,0 × MAXIMUM ALLOWABLE PRESSURE.

The test shall be performed per UL 429 Section 30 with the volume converted from above test pressures. The 0.75 × *LFL* maximum refers to refrigerant leakage; results from UL 429 shall be converted to refrigerant-based value.

The SAFETY SHUT-OFF VALVE shall be marked with the following information for the identification of the valve in case of replacement:

– means for identification of the safety shut-off valve for facilitating correct replacement; and

– an arrow indicating the direction of flow, when applicable.

Compliance is checked by inspection

The closing of the SAFETY SHUT-OFF VALVE in liquid refrigerant lines shall not result in pressures exceeding the maximum allowable pressure.

NOTE 3 The purpose is to prevent excessive pressures due to hydraulic shock or trapped liquid refrigerant that could expand when the temperature changes.

Compliance is tested by measuring the pressure before and after the valve with a fast response pressure sensor with a time resolution not greater than 0,1 s while opening and closing the valve at the highest liquid refrigerant velocity during NORMAL OPERATION.

NOTE 4 SAFETY SHUT-OFF VALVES are used the same as isolating valves for the purpose of ISO 5149-2.

22.134DV D1 ***Add subclause 22.134DV to Clause 22 of the Part 2:***

Appliances shall be constructed so that particle foam material expanded polypropylene is separated from metallic parts containing cobalt, manganese or copper if operating at a temperature higher than 80 °C.

NOTE Direct contact of expanded polypropylene foam material (Material marking according to ISO 1043-1: PP-E) with cobalt, manganese, or copper causes degradation of the expanded polypropylene foam material at temperatures above 80 °C.

However, this requirement is not applicable for particle foam material parts when a deterioration of 3 mm at the contact point will not cause the appliance to fail to comply with this standard. If the separation is provided by an air gap, it shall be at least 3 mm.

PARTICLE FOAM MATERIAL shall not be used outdoors without protective cover of metal or rigid plastic material.

Compliance is checked by inspection and measurement.

22.135DV D2 ***Add subclause 22.135DV to Clause 22 of the Part 2:***

If an appliance is marked for use with alternative refrigerants, the appliance shall comply with all of the requirements of this standard for each refrigerant. The refrigerants shall be the same class in accordance with ISO 817.

22.136DV D1 ***Add subclause 22.136DV to Clause 22 of the Part 2:***

Water and steam containing heat exchangers shall withstand the water pressure occurring in normal use.

Compliance is checked by subjecting the containers and heat exchangers, if any, to a water pressure which is raised to the value specified hereafter at a rate of not more than 130 kPa per second and is maintained at that value for 5 min, as follows:

> ***a) heat exchangers operating at more than 93 °C and a steam coil shall withstand a hydrostatic pressure equal to three times the marked operating pressure; or***
>
> ***b) heat exchangers operating at equal to or less than 93 °C shall withstand a hydrostatic pressure equal to 1,04 MPa gauge or two times the marked operating pressure, whichever is higher.***

After the test, no water shall have leaked out and the containers shall not have ruptured.

22.137DV D1 ***Add subclause 22.137DV to Clause 22 of the Part 2:***

If a switch or controller has a marked off position, the off position shall introduce an air gap equivalent to basic insulation to interrupt current flow.

Compliance for air gap switches are verified by visual inspection.

22.138DV D1 ***Add subclauses 22.138DV.1 to 22.138DV.4 to Clause 22 of the Part 2:***

22.138DV.1 Unless intended to be connected to a power supply separate from that supplying other loads, each receptacle intended for general use shall be rated at 15 or 20 A, 125 V or 250 V. Each general or special use receptacle shall be of the grounding type and shall comply with the applicable requirements of CSA C22.2 No. 42 and UL 498.

22.138DV.2 Overcurrent protection shall be provided as part of the appliance for each receptacle included in the equipment unless

a) the receptacle is intended to be connected to a power supply separate from that supplying the appliance;

b) the equipment can be connected to a branch circuit rated at not more than 15 A or 20 A in accordance with CSA C22.1 or ANSI/NFPA 70; or

c) the receptacle is intended for use only with specific accessories.

22.138DV.3 Receptacles connected to the line side of a unit disconnect shall have a separate disconnect.

22.138DV.4 When installed on appliances for outdoor or indoor use the receptacle shall comply with the following:

a) installation shall comply with the requirements in CSA C22.1 and ANSI/NFPA 70;

b) a 125 V or 250 V, single-phase, 15 A or 20 A receptacle intended for general use shall have a ground-fault circuit-interrupter (GFCI). The GFCI shall comply with CSA C22.2 No. 144.1 and UL 943; and

c) unless subjected to the moisture resistance test of Clause 15, 125 V or 250 V, single-phase, 15 A or 20 A receptacles installed in wet locations shall have an enclosure that is weatherproof, whether or not the attachment plug is inserted, and all 125 V or 250 V, single-phase, 15 A or 20 A non-locking receptacles shall be weather-resistant types.

22.139DV D1 ***Add subclause 22.139DV to Clause 22 of the Part 2:***

Polymeric enclosures, insulating materials, internal wiring, and other component parts that are exposed to the UV light shall be resistant to degradation when exposed to ultraviolet light, if degradation of the part would result in non-compliance with other requirements of this Standard. To determine whether a part is acceptably resistant to ultraviolet light, the part shall be subjected to

a) the ultraviolet light exposure test specified in UL 746C, except that the testing shall be conducted based on the actual UV radiation to which the nonmetallic material is exposed rather than the twin enclosed carbon-arc or xenon-arc conditioning. The test shall be conducted for not less than 1 000 h. Following the UV exposure, enclosure materials shall comply with the impact test of Clause 21.1 and other materials shall comply with the flammability test; or

b) the UV-C radiation effect on non-metallic materials test in Annex T of IEC 60335-1:2020.

22.140DV D1 *Add subclause 22.140DV to Clause 22 of the Part 2:*

With reference to Clause 22.139DV and UL 746C, the material properties to evaluate the parts shall be as follows:

a) A polymeric enclosure shall be subjected to flammability classification, tensile or flexural strength, and impact testing.

b) A polymeric internal component part shall be subjected to flammability classification. If the part provides functional support it shall also be subjected to tensile and flexural strength testing.

22.141DV D1 *Add subclause 22.141DV to Clause 22 of the Part 2:*

Motor-compressors that are not tested and comply with UL 60335-2-34 shall be investigated for the compatibility of the Insulating materials with the refrigerant and oil used within the housing of the motor-compressor.

For the types of refrigerant and types of oil for which the motor-compressor is intended to be used, compliance of winding wire insulation shall be checked by the tests detailed in Annex BB of UL 60335-2-34, or for motor-compressors that do not use oil by test 16 in IEC 60851-4 for resistance to refrigerants.

For test 16 in IEC 60851-4, the percentage of extractable matter shall not exceed 0,5 %. The breakdown voltage shall be at least 75 % of the minimum specified value.

For the types of refrigerant and types of oil for which the motor-compressor is intended to be used, compliance of tie cords and insulation materials other than winding wire insulation shall be checked by the tests detailed in Annex CC of UL 60335-2-34.

Annex 101.DVK of UL 60335-2-34 may also be used to show compliance with these requirements.

23 Internal wiring

This clause of Part 1 is applicable except as follows.

23.3DV D2 *Modification of Clause 23.3 of the Part 1 by adding the following:*

Conductors of Group B flexible cords per Table 23.103DV comply with the movable parts flex test.

23.101 Internal wiring that is exposed to direct or reflected UV-C RADIATION shall be UV-C resistant.

Compliance is checked by the following test.

Samples of the internal wiring are conditioned in accordance with Annex OO.

On completion of the conditioning, the cable is wrapped in metal foil and is wound around a conductive mandrel 15 mm in diameter for three turns. A voltage of 2 000 V is applied for 15 min between the conductor and the mandrel. There shall be no breakdown.

23.101DV.1 D2 ***Modify Clause 23.101 of the Part 2 by adding the following:***

Wires shall be protected if they can be damaged from contact with refrigerant piping.

NOTE Refrigerant piping can destroy the cable insulation by relative movement between the pipe and the wire due to vibrations, even when the vibrations are not severe.

Compliance is checked by inspection.

23.101DV.2 D2 ***Modify Clause 23.101 of the Part 2 by adding the following:***

Conductors of hazardous voltage motor circuits having two or more thermal or overcurrent protected motors, or such (one or more) motors in combination with an electric resistance heater for connection to one power supply, shall be tested in accordance with the short circuit test of Clause 27. A fuse or circuit breaker sized to the conductor supplying the load is deemed to meet the requirements of the short circuit test.

The short circuit test is not required if at least one of following conditions is met:

a) The conductors have an ampacity that is greater than 1/3 of the capacity of the supply conductors.

b) The conductors are 18 AWG or larger, and not more than 1.2 m in length and the supply circuit is not protected at greater than 60 A.

c) The conductor is connected between two fixed impedances that reduce the risk of high fault current.

d) The conductor is a jumper lead between controls and is not longer than 76 mm unless the jumper is located inside the control panel.

Compliance is determined by conducting the limited short circuit test specified in Clauses 27.7DV.1.6 and 27.7DV.1.7 of the Part 1.

23.102DV D1 ***Modification of Clause 23 of the Part 2 by adding of the following:***

The internal wiring of the appliance to components of the appliance shall consist of conductors having insulation rated for the potential involved and the temperatures to which it may be subjected and having required mechanical strength and current-carrying capacity for the service. The wiring shall be routed away from moving parts and sharp projections and held in place with clamps, string, ties, or equivalent, unless of sufficient rigidity to retain a shaped form.

Wiring run through flexible conduit shall be secured or supported within 756 mm of each box, cabinet, conduit body, or other conduit termination and shall be secured or supported at intervals not to exceed 1 360 mm.

23.103DV DR *Modification of Clause 23 of the Part 2 by adding the following:*

23.103DV.1 Conductors used in hazardous voltage circuits and PROTECTIVE ELECTRONIC CIRCUITS shall be selected from Table 23.103DV in accordance with the circuit requirements for conductor size, voltage, and temperature rating.

23.103DV.2 Wiring materials referenced in Group B of Table 23.103DV shall be suitably enclosed so as to prevent damage to the wiring, ignition of combustible material, or emission of flame or molten metal through openings in the cabinet.

Such wiring is considered to be suitably enclosed when the cabinet or compartment enclosing the wiring has

a) no openings in the bottom, unless a U-shaped channel or trough is located beneath the wiring, and the wires do not project through the plane of the top of the channel or trough. A bottom closure is considered to be provided

1) if the bottom opening is always intended to be connected to a supply or return indoor air duct; and the unit includes space heating means (electric heater, hot water, or steam heating coil);

2) if the unit is intended only for nonresidential applications and is so marked, except those openings intended only for conduit or piping; or

3) if the bottom opening is provided with a finned coil construction at least two rows in depth and with at least 12 fins per 25.4 mm (1 in);

b) no louvre or openings that permit the test probe of Clause 8.1.3 to touch the Group B wiring material; and

c) no combustible material other than electrical insulation within the enclosure. An air filter may be employed within the enclosure.

23.103DV.3 Thermoplastic-insulated hazardous voltage wiring materials that are referenced in Group A of Table 23.103DV, and have an insulation thickness of 0.8 mm (2/64 in) for sizes 16 and 18 AWG, and 1.2 mm (3/64 in) for sizes 14, 12, 10, and 8 AWG, are considered to be equivalent to the wiring materials referenced in Group B when the conductors are covered with thermoplastic insulating tubing that has a wall thickness of 0.8 mm (2/64 in) and is of a type rated for the purpose from the standpoint of electrical, mechanical, and flammability properties. For sizes 6, 4, and 2 AWG, thermoplastic wiring materials that are referenced in Group A of Table 23.103DV and enclosed in thermoplastic tubing as described in this requirement are considered to be equivalent to the wiring materials specified in Group B when the total wall thickness (of the conductor insulation plus tubing) is not less than the value specified for Group B.

23.103DV.4 Wiring materials referenced in Group B of Table 23.103DV shall be used in continuous lengths and shall not have any splices between electrical components.

Table 23.103DV
Typical wiring materials

Group	Type of wire, cord, or cable [a,b]	Wire size		Insulation thickness	
		mm^2	AWG	mm	in
A	Thermoplastic or thermoset appliance wiring material, with insulation thicknesses shown at the right corresponding to wire sizes indicated; or Type TW; or Typed AC, ACT, FFH-2, TF, TFF, TFN, TFFN, SF-2, SFF-2, RH, RHH, RHW, THW, XHH, XHHW, MTW, THHN, THW-MTW, THWN, PF, PGF, PFF, PGFF; or Type[c] GTF, TW75, TEW, TR-32, R90, RW90, T90, SEW-1, SEW-2	5.3 to 0.41	10 to 22	0.8	2/64
		8.4	8	1.2	3/64
		13.3	6	1.6	4/64
		21.2	4	1.6	4/64
		26.7	3	1.6	4/64
		33.6	2	1.6	4/64
		42.4	1	2.0	5/64
		54.0	1/0	2.0	5/64
		67.0	2/0	2/0	5/64
		85.0	3/0	2/0	5/64
		107.2	4/0	2.0	5/64
B	Appliance wiring material having thermoplastic or thermoset insulation, with insulation thicknesses shown at right corresponding to the wire sizes indicated; or Type S, SJO, SJOO, SJT, SJTO, SJTOO, SO, SOO, SPT-3, ST, STO, STOO; or Type[d] SE,SJE, or Type[c] NMD90, NMWU	0.82	18	1.6	4/64
		1.3	16	1.6	4/64
		2.1	14	2.0	5/64
		3.3	12	2.0	5/64
		5.3	10	2.0	5/64
		8.4	8	2.4	6/64
		13.3	6	3.2	8/64
		21.2	4	3.6	9/64
		33.6	2	4.0	10/64
C	Appliance wiring material with cross-linked synthetic polymer insulation; or Type S, SJ; or Typed SP-3	Same as for Group B			

[a] The designated cord or cable, or types of wire other than appliance wiring material, may be used without regard to the values specified in the Table.

[b] Type CL wire may be used within a separate metal enclosure as leads of components.

[c] Wire types included only in CSA C22.1.

[d] Wire types included only in ANSI/NFPA 70.

[e] Non-metallic flexible conduit in conditioned air compartments within the appliance are not allowed per ANSI/NFPA 70 Article 300.22.

24 Components

This clause of Part 1 is applicable except as follows.

24.1 *Addition:*

Motor compressors are not required to be separately tested according to IEC 60335-2-34, nor are they required to meet all requirements of IEC 60335-2-34 if they meet all requirements of this standard.

24.1DV DC *Modification by replacing Clause 24.1 in the Part 2 with the following:*

24.1DV.1 Components shall comply with any relevant component requirements within this standard. In addition, components shall comply with the safety requirements as far as they reasonably apply, as follows:

a) in the relevant component standard of Annex DVA;

b) in the relevant national safety component standard if such standard is not specified in Annex DVA;

c) in the safety requirements within this standard as allowed by footnote 1 of Annex DVA; or

d) in the safety requirements within this standard if no national safety component standard exists.

24.1DV.1.1 If a component is not used in accordance with its intended marking(s), rating(s), use conditions, or limitations, it shall be evaluated to the required rating(s), use conditions, and limitations in accordance with one of the Items a) to d) of Clause 24.1DV.1.

24.1DV.1.2 The following components shall comply with these additional requirements, respectively:

a) Capacitors likely to be permanently subjected to the supply voltage and used for radio interference suppression or for voltage dividing shall comply with Clause 24.1.1.

b) Switches shall comply with Clause 24.1.3.

c) Automatic controls shall comply with Clause 24.1.4DV.2.

24.1DV.2 Compliance with the standard for the relevant component does not necessarily ensure compliance with the requirements of this standard.

24.1DV.3 Unless the component complies with Clause 24.1DV.1 a) or b), parts of non-metallic material in components, including parts of non-metallic material supporting current-carrying connections inside components shall comply with one of the following:

a) Clauses 30.1 and 30.2; or

b) the relevant requirements in UL 746C for parts used as nonmetallic enclosures or for parts used to support live current-carrying connections.

24.1DV.4 Motor-compressors shall

– comply with IEC 60335-2-34 (including its Annex AA);

– comply with IEC 60335-2-34 (without Annex AA) and comply with Clauses 11 and 19 of this standard, and in addition, shall comply with Clause 22.9 in UL 60335-2-34 or CAN /CSA-C22.2 No. 60335-2-34; or

– comply with UL 60335-2-34 or CAN/CSA-C22.2 No. 60335-2-34, Annex 101.DVH.

NOTE The motor compressor includes its motor compressor protection and control system used for compliance with the UL 60335-2-34 or CAN/CSA-C22.2 No. 60335-2-34.

24.1DV.5 DC *Delete Clauses 24.1DV.2 to 24.1DV.4 of the Part 1:*

The requirements in Clauses 24.1DV.2 to 24.1DV.4 of the Part 1 do not apply.

24.1.4 *Modification:*

• *SELF-RESETTING THERMAL CUT-OUTS*	*3 000*
• *NON-SELF-RESETTING THERMAL CUT-OUTS*	*300*
Addition:	
• *THERMOSTATS which control the motor-compressor*	*100 000*
• *motor-compressor starting relays*	*100 000*
• *automatic thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type*	*min 2 000*
	(but not less than the number of operations during the locked rotor test)
• *manual reset thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type*	*50*
• *other automatic thermal motor protectors*	*2 000*
• *other manual reset thermal motor protectors*	*30*
• *REFRIGERANT DETECTION SYSTEMS SELF RESETTING*	*300*
• *REFRIGERANT DETECTION SYSTEMS NON SELF RESETTING*	*30*
• *electromechanical proof of airflow control*	*100 000*
• *self-resetting electrical PRESSURE-LIMITING DEVICE*	*3 000*
• *non-self-resetting electrical PRESSURE-LIMITING DEVICE*	*300*

24.1.4DV.1 DC *Delete Clause 24.1.4DV of the Part 1.*

24.1.4DV.2 D1 *Modify Clause 24.1.4 of the Part 2 by replacing it with the following:*

• SELF-RESETTING THERMAL CUT-OUTS	***100 000***
• other non-self-resetting thermal cut-outs	***6 000***
Addition:	
• thermostats which control the motor-compressor	***100 000***
• motor-compressor starting relays	***100 000***
• automatic thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type	***min 2 000***
	(but not less than the number of operations during the locked rotor test)
• manual reset thermal motor-protectors for motor-compressors of the hermetic and semi-hermetic type	***50***
• contactors, relays, and sequencers/time delay relays controlling electric heat elements	***100 000***
• safety shut-off valves, normally open	***300***
• safety shut-off valves, normally closed	***100 000***

For the U.S., cycle requirements for pressure limiters and pressure cut-outs are as specified in UL 60730-2-6, Table AA.1DV. Cycle requirements for temperature limiters and thermal cut-outs are as specified in UL 60730-2-9, Table CC.2.

24.1.4DV.3 D2 ***Modification of Clause 24.1.4 of the Part 2 by adding the following:***

An interlock that is required to reduce a risk of electric shock or injury to persons shall withstand 1 000 cycles with a load not less than that controlled in the appliance, and 5 000 cycles without a load, or shall comply with CSA-C22.2 No. 55 and UL 353.

24.1.4DV.101 D2 ***Add the following subclauses to Clause 24 of the Part 2:***

24.1.4DV.101 Remote safety firmware/safety software updates

NOTE: These requirements are for methods of evaluation when using controls evaluated to UL 60730-1 and CSA E60730-1 containing Class B control functions and firmware.

24.1.4DV.101.1 The following clauses apply when the manufacturer declares the appliance has the functionality to remotely update safety firmware or software.

Note: An update occurs when firmware or software replaces or modifies the previous version of the Class B firmware or software. Additionally, an update occurs when the same version of Class B firmware or software is replaced during the remote update process.
For example, consider a software update that includes both Class A and Class B software. If the Class A software is a modified version of the original and the Class B software has not been modified, though will be re-installed on a microcontroller, then this is considered a software update and subjected to the relevant requirements of Clause 24.1.4DV.101.

24.1.4DV.101.2 The Class B firmware or software intended to be updated, shall comply with UL 60730-1 and CSA E60730-1, Clause H.11.12.

24.1.4DV.101.3 The remotely actuated control function, including the software update function, shall comply with UL 60730-1, 5th edition and CSA E60730-1, Clause H.11.12.4.

With respect to transmission faults, Note 1 of Clause H.11.12.4.1.3.1 in UL 60730-1, 5th edition and CSA E60730-1 is considered normative.

Note: Remotely actuated control functions may be connected to separate, independent devices, which may themselves contain control functions or provide other information. A remotely actuated control function is a function providing any operation by control devices through external means. This includes, but is not limited to

a) the use of communication lines/protocols;

b) additional hardware, software, or both;

c) IR/RF transmission; or

d) all combinations of Items a) to c) via Internet usage (modems, portable telephones, etc.).

24.1.4DV.101.4 User authorization is required prior to any remote update of Class B firmware or software. This will be evaluated in accordance with UL 60730-1 and CSA E60730-1, Clause H.11.12.4.4.3.

Note: User authorization can be a one-time event. This one-time event may be when the consumer registers their appliance with the manufacturer, or downloads the application needed to remotely operate the appliance on their smart device (cell phone, tablet, etc.).

24.1.7DV D2 ***Modification of Clause 24.1.7 of the Part 1 by adding the following:***

If the REMOTE OPERATION of an APPLIANCE NOT ACCESSIBLE TO THE GENERAL PUBLIC is via a telecommunication network, the relevant standard for the telecommunications network interface circuitry may be UL 61010-1.

24.1.10DV D2 ***Add the following subclause to Clause 24.1 of the Part 1:***

Lamps and lamp systems that have not been previously tested and found to comply with the exempt group classification of IEC 62471:2006 general lighting systems (GLS).

Actinic ultraviolet hazards (ES) and near-UV hazards (EUVA) are tested as a part of the appliance and shall comply with the requirements of Clause 32 under the conditions occurring in the appliance.

Unless otherwise specified, the following components are considered to comply with the exempt group classification of IEC 62471:2006 regarding actinic ultraviolet hazards (ES) and near-UV hazards (EUVA):

– visible light indicators;

– infrared sources used for signaling or communication;

– seven-segment indicators;

– liquid-crystal displays;

– organic LED displays (OLED);

– plasma displays; and

– luminaires that comply with the requirements of UL 1598.

24.1.11DV D2 ***Add the following subclause to Clause 24.1 of the Part 1:***

Appliances incorporating electrostatic air cleaners shall comply with UL 867 and CSA C22.2 No.187.

24.1.12DV D2 ***Add the following subclause to Clause 24.1 of the Part 1:***

Appliances incorporating ultraviolet radiation generating wavelengths less than 250 nm shall comply with the ozone test requirements of UL 867 and CSA C22.2 No.187.

NOTE Independent of the safety requirements in this standard, depending on the installation, additional regulatory requirements may need to be met per ANSI/ASHRAE 62.1.

24.101 Thermal control devices incorporating replaceable parts shall be marked in such a way that the replaceable parts can be identified.

The replacement part shall be marked accordingly.

Compliance is checked by inspection of the marking.

24.102 The PRESSURE-LIMITING DEVICES used in TRANSCRITICAL REFRIGERATING SYSTEMS shall comply with IEC 60730-2-6 and

– shall be of type 2A or 2B;

– shall have a trip free mechanism of type 2J;

– the deviation and drift shall not exceed + 0 %.

24.103DV DR *Add Clauses 24.103DV.1 and 24.103DV.2 to the Part 1:*

24.103DV.1 A motor overcurrent protective device or a thermal protective device employed on appliances having more than one motor, or having a motor and supplementary heater, wired for connection to one supply circuit, shall withstand short-circuit conditions in accordance with the limited short-circuit test described in Clause 27.7DV.1.5. The short-circuit tests on the protective device may be waived if

a) the thermally protected motor or separately enclosed motor overload protective device is within an outer cabinet of a product or section of a product;

b) the motor or device is intended to be protected by the overcurrent protective device as specified on the unit nameplate, or provided as part of the product, and which is acceptable for the branch circuit protection;

c) the assembly is constructed so that flame and molten metal will be confined within the cabinet; and

d) combustible material, except electrical insulation or an air filter, is not located below the motor.

24.103DV.2 Three samples of each component shall be subjected to each test condition, and a new protective device shall be used for each test. The devices shall withstand short-circuit conditions described in Table 27DV.3 when protected by an overcurrent protective device that is suitable for branch-circuit protection and of the type and rating as specified in Clause 27.7DV.1.8. There shall be no damage to conductors or their terminations, no ignition of cheesecloth or cotton surrounding the enclosure housing the components under test, and no arc over between hazardous voltage and extra-low-voltage circuits.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 *Addition:*

The appliances may be provided with a SUPPLY CORD fitted with a plug

• if they are for indoor use only,

• if they have a marked rating of 25 A or less, and

• if they comply with the applicable code requirements for cord-connected appliances appropriate to the specific country in which they are to be used.

Modification:

Appliances shall not be provided with an appliance inlet.

25.1DV DR *Modification of Clause 25.1 of the Part 2 by deleting "appliances shall not be provided with an appliance inlet" and adding the following:*

The supply cord shall terminate in a grounding type attachment plug having a current rating of not less than 125 % of the marked input in amperes.

Appliances other than cord-connected shall be equipped with wiring terminals or leads not less than 152 mm long for connection of field wiring conductors. A lead shall

a) not be connected to a wire binding screw or pressure terminal connector located in the same compartment as the splice, unless the screw or connector is rendered unusable;

b) not be more than two standard wire sizes smaller than the conductor to which it will be connected; and

c) be insulated at the unconnected end, and is intended use is clearly indicated on an applied wiring diagram.

Manufactured wiring systems (whips) shall comply with UL 183 and CSA C22.2 No. 203.1.

25.4DV DR *Modification of Clause 25.4 of the Part 1 by replacing it with the following:*

Appliances intended to be permanently connected to fixed wiring shall

a) be in accordance with the national electrical codes, and be provided with conduit openings or knockouts and conduit connections with diameter to accommodate the conduit according to Table 25.4DV.1 and Table 25.4DV.2 of Annex 101.DVB based on the number and size of fixed wires required for intended installation;

b) comply with Item a) for each supply connection if more than one means of connection is intended; and

c) be provided with a flat surrounding surface that is equivalent to 0.88 mm thick steel for securing the conduit connections.

Knockouts intended for field wiring connections shall remain in place when a force of 44 N is applied at a right angle to the knockout by a 6.4 mm diameter mandrel having a flat end.

Compliance is determined by test.

The mandrel shall be applied at the point considered most likely to cause movement of the knockout.

25.7 *Addition:*

SUPPLY CORDS of parts of appliances for outdoor use shall not be lighter than polychloroprene sheathed flexible cord (code designation 60245 IEC 57).

25.7DV DR *Modification of Clause 25.7 of the Part 2 by replacing it with the following:*

The supply cord of shall be between 1,2 and 3 m long for units rated 125V or less, and between 1,2 and 1,8 m for units rated more than 125 V.

A dehumidifier intended for use for water damage restoration of commercial/household properties shall employ an outdoor-use power-supply cord that is not less than 1,83 m or more than 7,6 m. The cord shall be flexible and of Type SOW, SOOW, STW, STOW, STOOW, SEW, SEOW, SEOOW, SJOW, SJOOW, SJTW, SJTOW, SJTOOW, SJEW, SJEOW, or SJEOOW.

Cord-connected appliances installed in an information technology equipment (ITE) room shall have a power supply cord of no more than 4,5 m in length.

A supply cord other than a HARD USAGE or EXTRA HARD USAGE CORD shall have equivalent electrical and mechanical properties.

25.101DV DR *Add subclauses 25.101DV.1 to 25.101DV.3 to Clause 25 of the Part 2:*

25.101DV.1 A cord-connected single phase room air conditioner rated not more than 40 A and 250 V, single phase shall be provided with factory installed LCDI or AFCI protection. The LCDI or AFCI shall be installed as an integral part of the attachment plug or be located in the supply cord within 300 mm (12 in) of the attachment plug.

Room air conditioners include packaged terminal air conditioners. They are factory-made encased assemblies designed as a unit primarily to provide free delivery of conditioned air to an enclosed space, room, or zone. This equipment is intended for installation in a window, through a wall, or as a console located in or adjacent to the room, zone, or space to be conditioned. These units employ hermetic refrigerant motor-compressors with factory-charged refrigeration systems and include means for circulating air. They may also have provision for heating and ventilation.

Cord-connected room air conditioners provided with a SUPPLY CORD fitted with a plug may exceed 20 A if all of the following applicable requirements are met:

– A cord-connected room air conditioner with a AFCI shall employ a Type S, SE, SEO, SEOO, SEW, SEOW, SEOOW, SO, SOO, SOW, SOOW, ST, STO, STOO, STW, STOW, STOOW, SJ, SJE, SJEO, SJEOO, SJEW, SJEOW, SJEOOW, SJO, SJOO, SJOW, SJOOW, SJT, SJTO, SJTOO, SJTW, SJTOW, SJTOOW, SP-3, SPE-3, or SPT-3 power supply cord having a voltage rating not less than that of the room air conditioner.

– A cord-connected room air conditioner with a LCDI shall be provided with an integral shielded power supply cord.

– The ampacity of the cord, as given in the National Electrical Code, ANSI/NFPA 70, shall be not less than that required by the ampere input measured in Clause 10.

- The attachment plug configuration rating shall not be less than 125 % of the marked rating of the room air conditioner and not less than the total current measured in Clause 10.

– A cord-connected air conditioner shall employ a grounding-type attachment plug that complies with the ANSI/NEMA WD 6.

– A cord-connected single-phase room air conditioner shall be provided with factory installed LCDI or AFCI protection. The LCDI or AFCI shall be installed as an integral part of the attachment plug or be located in the supply cord within 300 mm of the attachment plug.

– Computer room air conditioners are not required to have LCDI or AFCI protection.

– When a packaged terminal air conditioner (PTAC) or PTHP is provided with a sub-base that encloses the supply cord and attachment plug, AFCI or LCDI protection is not required.

25.101DV.2 Barriers shall separate field installed conductors from conductors and hazardous voltage live parts connected to any other circuits unless all conductors and hazardous voltage live parts are insulated for the maximum voltage of any of the circuits. Field-installed conductors may be segregated from other field-installed conductors and from uninsulated live parts connected to other circuits by arranging the location of the openings in the enclosure for the various conductors, with respect to the terminals or other uninsulated live parts, so that conductors or parts of different circuits will not intermingle.

25.101DV.3 Leads (including a grounding conductor as specified by the National Electrical Code, ANSI/NFPA 70) provided for the power supply connection of heating and cooling equipment may be brought out through factory-attached flexible conduit not less than 0,91 m (3 ft) long. The leads shall extend at least 152 mm (6 in) beyond the end of the flexible conduit. An outlet box need not be provided at the free end of the conduit. Non-metallic or water-tight conduit is being used.

Note: A grounding conductor is not required if

a) the conduit is not longer than 6 feet (1.8 m);

b) no circuit conductor protected by an overcurrent protective device rated at more than 20 A is included; and

c) the conduit is no larger than 3/4 in trade size, unless the fittings are identified as providing grounding.

26 Terminals for external conductors

This clause of Part 1 is applicable.

27 Provision for earthing

This clause of Part 1 is applicable except as follows:

27.5 *Addition:*

NOTE If the ground continuity between system components meets the minimum values specified in 27.5, it is considered to meet the requirements without dedicated grounding conductors.

27.5DV.1 D1 ***Modification of Clause 27.5DV.1.1 in the Part 1 by replacing it with the following (USA only):***

A minimum current derived from a source having a no-load voltage not exceeding 12 V (ac or dc) and equal to 2,0 times the rating of the earthed branch circuit, or 60 A, whichever is less, shall be passed between the earthing terminal or earthing contact and each of the ACCESSIBLE METAL PARTS in turn.

27.5DV.2 DR ***Modification of Clause 27.5 of the Part 1 by adding the following:***

Heat pump pool heaters shall have a provision for equipotential bonding by at least one wiring connection located on the external surface of the supply terminal box. The connection point must be suitable to terminate a 6 AWG solid copper conductor.

27.6DV.1 DR ***Modification of Clause 27.6DV.1 of the Part 1 by adding the following:***

This requirement does not apply for printed conductors on adjustable speed drives that have been evaluated to UL 61800-5-1 and CSA C22.2 No. 274, or UL 60730-1 and CSA E60730-1.

28 Screws and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is not checked on parts relating to motor-compressors if the motor-compressor complies with IEC 60335-2-34. For motor-compressors not complying with IEC 60335-2-34, the additions and modifications specified in IEC 60335-2-34 are applicable.

29.2 *Addition:*

For insulation located in any airflow, the micro-environment is pollution degree 3 unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution due to normal use of the appliance.

29.101DV D1 ***Add the following subclause to Clause 29 of the Part 1:***

29.101DV.1 For APPLIANCES NOT ACCESSIBLE TO THE GENERAL PUBLIC, Clause 101.DVH.29 applies.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2DV D1 ***Modification to add the following after the third paragraph of Clause 30.2 of the Part 1:***

For a FIXED APPLIANCE, the requirement does not apply to

a) small parts such as refrigerant line bushings or insulating bushings, resilient or vibration mounts, wire ties, clamps, labels, or drain line fittings having a total exposed surface area not exceeding 162 cm^2;

b) drive belts;

c) paint applied for corrosion protection;

d) gaskets forming air or water seals between metal parts;

e) an adhesive, when tested in combination with the specific insulating material; and

f) air filters and media wheels or plates meeting the test requirements in UL 900 or CAN/ULC-S111.

30.2.1DV D2 ***Modification to replace the third paragraph of Clause 30.2.1 of the Part 1 with the following:***

The glow-wire test is also not carried out on parts of material classified at least HB according to UL 94 or CAN/CSA-C22.2 No. 0.17, provided that the test sample used for the classification was no thicker than the relevant part of the appliance.

NOTE 1DV Insulation material that has been evaluated and tested per Clause 30.103DV.1 does not need to meet the requirements specified in ISO 9772 for material classified HBF if it meets the requirements specified in Clause 30.103DV.1.

30.2.2 Not applicable.

30.101DV DC ***Add subclauses 30.101DV.1 and 30.101DV.2 to Clause 30 of the Part 1:***

30.101DV.1 Polymeric enclosures that contain exposed uninsulated live parts shall have a 5VA flammability rating when tested in accordance with IEC 60695-11-20. The enclosure shall confine materials that can burn and drip when ignited.

30.101DV.2 The ball pressure test for particle foam material is carried out using the apparatus specified in Clause 5 of IEC 60695-10-2 using the loading device shown in Figure 1 a) with additional dimensions and shape as shown in Figure 105.

NOTE 1 The size of the test specimen shall be at least 60 mm × 60 mm.

The weight shall be applied to the outer surface of the part, and not to a cut-away exposing an interior substrate for the purposes of sample preparation.

The test specimen shall be stored for at least 24 h before the test in an atmosphere having a temperature between 15 °C and 35 °C and a relative humidity between 45 % and 75 %.

Place the test specimen in the approximate center of the test specimen support, ensuring that its upper surface is horizontal. Gently lower the pressure ball of the loading device on to the approximate center of the test specimen. Ensure that no conditions exist that will cause the pressure ball to move other than in a downward direction during the test.

The installation of the test specimen and application of the weight shall be performed within 30 s. The test chamber shall return to the specified temperature (± 2 °C) within 5 min and without any overshoot exceeding 5 °C.

The test specimen with the loading device shall remain for a period of minutes in the test chamber.

The thickness of the sample at the point of contact with the loading device shall be measured before and immediately after the conditioning in the chamber according to Figure 106.

The test shall be performed at a temperature (40 ± 2) °C above the maximum temperature rise measured at an accessible surface during the tests in Clause 11, but not less than 75 °C.

NOTE 2 There can be a big difference between the internal and external surface of thermal isolation.

However, for parts providing supplementary insulation or reinforced insulation, the test shall be performed at a temperature that is (25 ± 2) °C above the maximum temperature rise measured during the test in Clause 19, if this is higher. The temperature rises of Clause 19 are not considered, provided that the tests of Clause 19 are terminated by a non-self-resetting protective device. The resetting of the non-self-resetting protective device shall require removal of a cover or the use of a tool.

After the test, the thickness of the material shall be no less than 50 % of the original material thickness, but not less than 4 mm.

30.102DV D1 *Add subclause 30.102DV.1 to Clause 30 of the Part 1:*

30.102DV.1 Cord-connected appliances shall comply with the additional requirements of Annex 101.DVI.

30.103DV DC *Add subclause 30.103DV.1 to Clause 30 of the Part 1:*

30.103DV.1 Materials in a compartment handling conditioned air for circulation through a duct system shall have a flame spread rating of not more than 25, and a smoke developed rating of not more than 50, when tested as specified in CAN/ULC-S102 and UL 723. Alternately, the material shall be evaluated and determined to have a maximum optical density of 0.5 or less and an average optical density of 0.15 or less and a peak heat release rate of 100 kW or less when tested in accordance with UL 2043. If a unit is intended for installation in a building plenum, then the entire unit shall be considered to be in a compartment handling conditioned air for circulation through a duct system. This requirement does not apply to the following:

a) drive belts, wire insulation, paint applied for corrosion protection, or tubing of material equivalent to one of the types of wire insulation permitted by this standard;

b) gaskets forming air or water seals between metal parts;

c) miscellaneous small parts such as refrigerant line bushings or insulating bushings, resilient or vibration mounts, wire ties, clamps, labels, or drain line fittings having a total exposed surface area not exceeding 162 cm^2;

d) an adhesive that, when tested in combination with the specific insulating material, complies with the requirement;

e) molded or formed components (not liners) of polymeric materials in such quantities that their total exposed surface area within the compartment does not exceed 0.93 m^2. Materials shall have a flame spread rating of not more than 25, or shall comply with the requirements of the vertical burning test for classifying materials 5 VA or 5VB in accordance with UL 94 and Test 5 V (500 W) of CAN/CSA-C22.2 No. 0.17 with a flammability rating of 5 VA;

f) materials in a compartment handling air for circulation through a duct supplying only one room;

g) vibration isolation connectors having a maximum length of 25.4 cm in the direction of airflow and rated as a flame retardant fabrics in accordance with ANSI/NFPA 701; or

h) air filters and media wheels or plates meeting the test requirements in UL 900 or CAN/ULC-S111.

31 Resistance to rusting

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is checked by the salt mist test of IEC 60068-2-52, severity 2 being applicable.

Before the test, coatings are scratched by means of a hardened steel pin, the end of which has the form of a cone with an angle of 40°. Its tip is rounded with a radius of 0,25 mm ± 0,02 mm. The pin is loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches are made by drawing the pin along the surface of the coating at a speed of approximately 20 mm/s. Five scratches are made at least 5 mm apart and at least 5 mm from the edges.

After the test, the appliance shall not have deteriorated to such an extent that compliance with this standard, in particular with Clauses 8 and 27, is impaired. The coating shall not be broken and shall not have loosened from the metal surface.

31DV.1 D1 ***Modification of the first paragraph of the "Addition" to Clause 31 of the Part 2 by replacing "severity 2" with "Test Method 2".***

31DV.2 D1 ***Modification of Clause 31 of the Part 2 by adding the following:***

The test does not apply to enclosures that are intended for outdoor use and are protected against corrosion by a coating designated G90 in accordance with ASTM A90/A90M or by other metallic or non-metallic coatings that provide equivalent protection.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable except as follows.

Addition:

32.101 UV-C irradiance test

32.101.1 For the occupied space outside the unit, a test shall be performed to determine the UV-C SPECTRAL IRRADIANCE. The emissions from the equipment shall not exceed a UV-C SPECTRAL IRRADIANCE limit of 0,2 μW/cm^2.

NOTE The UV-C SPECTRAL IRRADIANCE limit of 0,2 μW/cm^2 is equivalent to 0,1 μW/cm^2 effective irradiance at 254 nm (i.e., 0,2 μW/cm^2 multiplied by the hazard function, S_{UV} = 0,5 at 254 nm as defined in IEC 62471 equals 0,1 μW/cm^2). Effective irradiance of 0,1 μW/cm^2 is classified as exempt in IEC 62471.

32.101.2 For areas inside the unit that are accessible for anticipated USER MAINTENANCE and are not equipped with the interlock required by Subclause 22.128, there shall be no UV-C SPECTRAL IRRADIANCE greater than 1,7 μW/cm^2. The UV-C SPECTRAL IRRADIANCE is measured at any point of accessibility required for USER MAINTENANCE. When determining user accessibility, consideration should be given to the actual degree of exposure that the user would experience in performing his duties.

NOTE The UV-C SPECTRAL IRRADIANCE limit of 1,7 μW/cm^2 is equivalent to 0,85 μW/cm^2 effective irradiance at 254 nm (i.e., 1,7 μW/cm^2 multiplied by the hazard function, S_{UV} = 0,5 at 254 nm as defined in IEC 62471 equals 0,85 μW/cm^2). The exposure limit at 0,85 μW/cm^2 effective irradiance at this level is 60 min/day.

Compliance is determined by measuring the UV-C IRRADIANCE per IEC 62471:2006, Clause 5 and Annex B.

32.101.2DV D2 ***Modify Clause 32.101.2 of the Part 2 by replacing "consideration should be given to the actual degree of exposure" with "consideration should be given to the maximum exposure time of 60 min/day at 1,7 μW/cm^2 spectral irradiance".***

32.101.3 UV-C IRRADIANCE shall be measured at the location in Table 101.

Table 101
UVC irradiance measurement location

	UV-C spectral irradiance limits		For compliance, UV-C irradiance is measured
	μW/cm^2	W/m^2	
Occupied space outside unit	≤ 0,2[a]	≤ 0,002	At 0,3 m from all outside surfaces of appliance[c]
Supply and return air openings	≤ 0,2[a]	≤ 0,002	At 0,3 m from the perpendicular plane of the opening
USER MAINTENANCE openings[b]	≤ 1,7	≤ 0,017	At 0,3 m from the perpendicular plane of the access opening
UV-C LAMP replacement			Not required – all power shall be disconnected

[a] Less than or equal to 0,1 μW/cm^2 effective irradiance is exempt per IEC 62471. This is 0,2 μW/cm^2 spectral irradiance at 254 nm.

[b] Based on maximum exposure time of 60 min.

[c] If the appliance has an inspection window, the measuring distance is reduced to 0,0 m.

32.101.4 *When conducting UV-C IRRADIANCE tests:*

– the UV-C IRRADIANCE measurements shall be conducted with a scanning spectroradiometer, or a narrow band range radiometer;

– all panels and components shall be positioned or adjusted in the most severe position;

– removable air filters shall be removed;

– measurements shall be made at the worst case location and angle of incidence;

– the minimum specified duct and configuration, including any duct liners, specified by the manufacturer shall be in place and the measurements taken at the opening at the end of the duct.

32.102DV D1 *Add subclause 32.102DV.1 to Clause 32 of the Part 2:*

32.102DV UV-C irradiance test for LED arrays, mixed gas lamps, and excimer lamps

32.102DV.1 Appliances shall not present an optical radiation hazard due to their operation in normal use.

This requirement does not apply to lamps and lamp systems that comply with Clause 24.1.10DV.

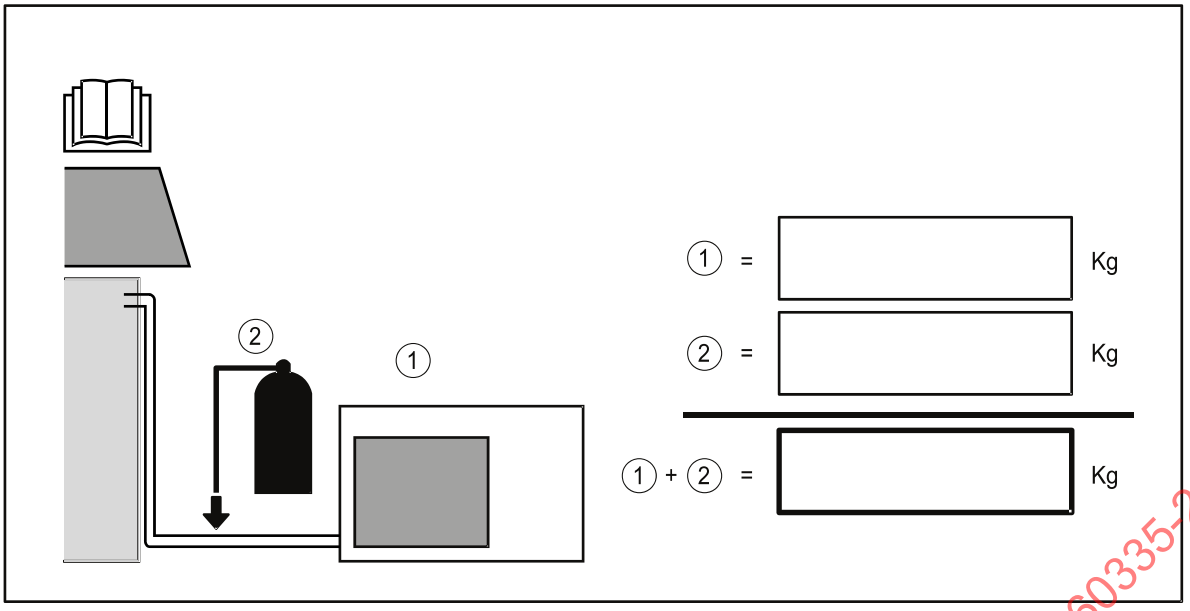
Compliance is checked as follows with the appliance supplied at rated voltage.

Radiation assessment is performed at or recalculated to 200 mm distance or at the fixed use distance indicated in the instructions for use, following the measurement procedure described in IEC 62471:2006.

If a lamp or lamp system is intended to illuminate objects, it shall be assessed at the GLS assessment distance which produces a luminance of 500 lx as described in IEC 62471:2006.

The appliance shall comply with the exempt group classification requirements of IEC 62471:2006 regarding actinic ultraviolet hazards (ES) and near-UV hazards (EUVA).

NOTE To avoid errors associated with low signal to noise ratio from spectroradiometers, handheld radiometers with specialized detectors sensitive to either the actinic UV or UV-A region can be used for these measurements.



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IEC

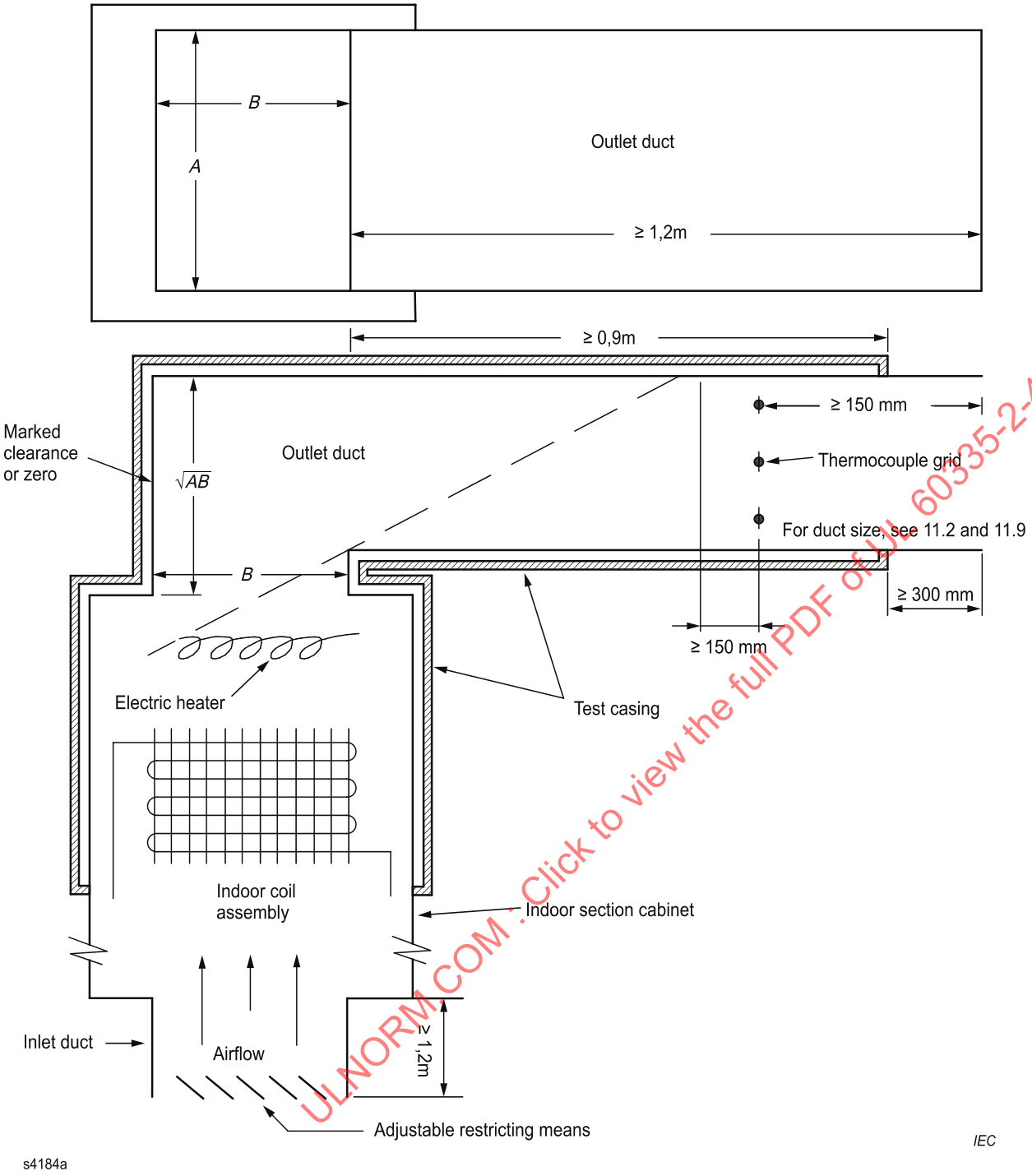
Key

Example 1 REFRIGERANT CHARGE of the precharged part of the appliance

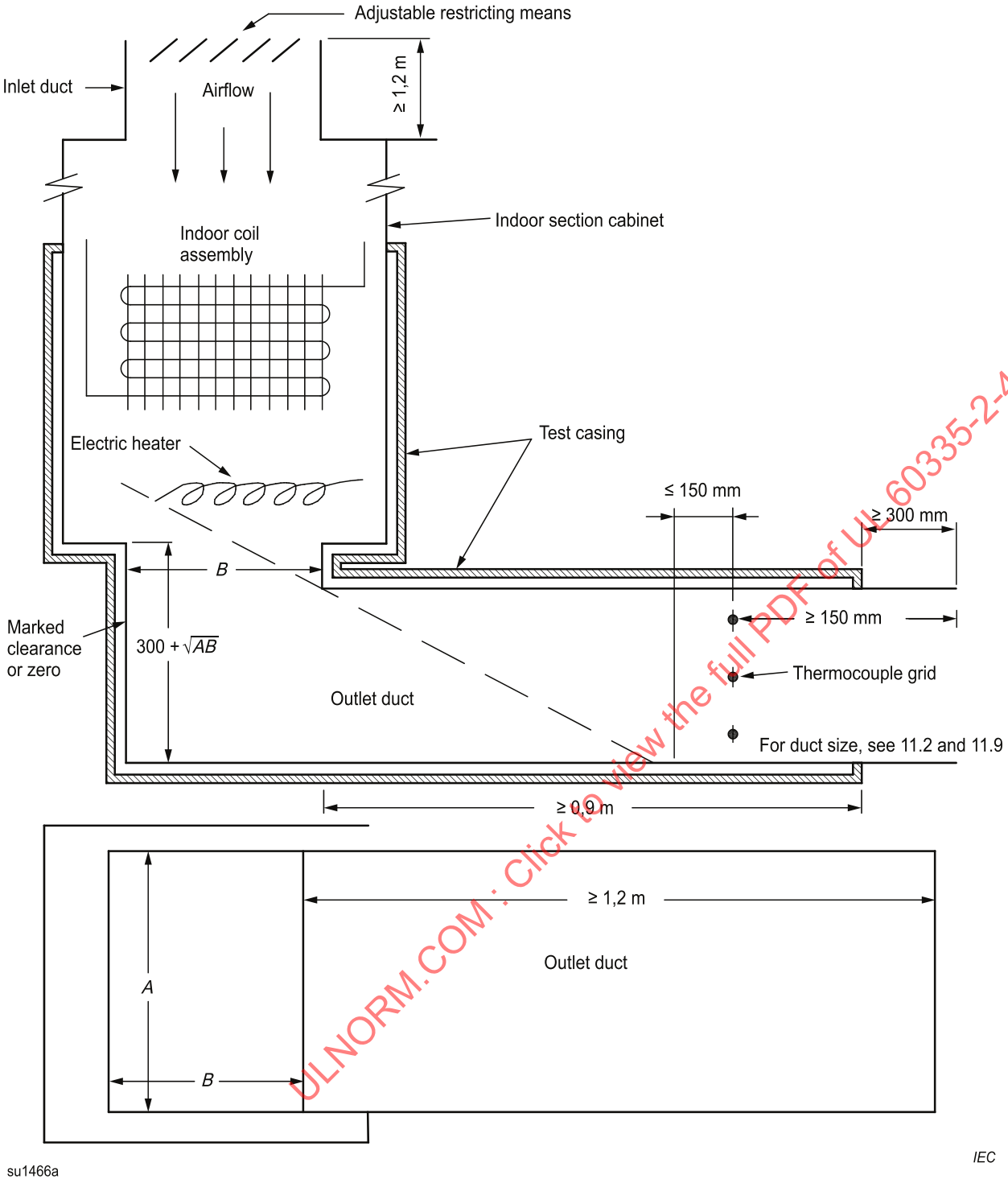
Example 2 REFRIGERANT CHARGE added during installation

Figure 101

Example of label for field charged units



a) Upflow application



b) Downflow application

Figure 102

Arrangement for heating test of appliances with supplementary heater

Figure 102ADV D1 ***Modify Figure 102 of the Part 2 for upflow application, as follows:***

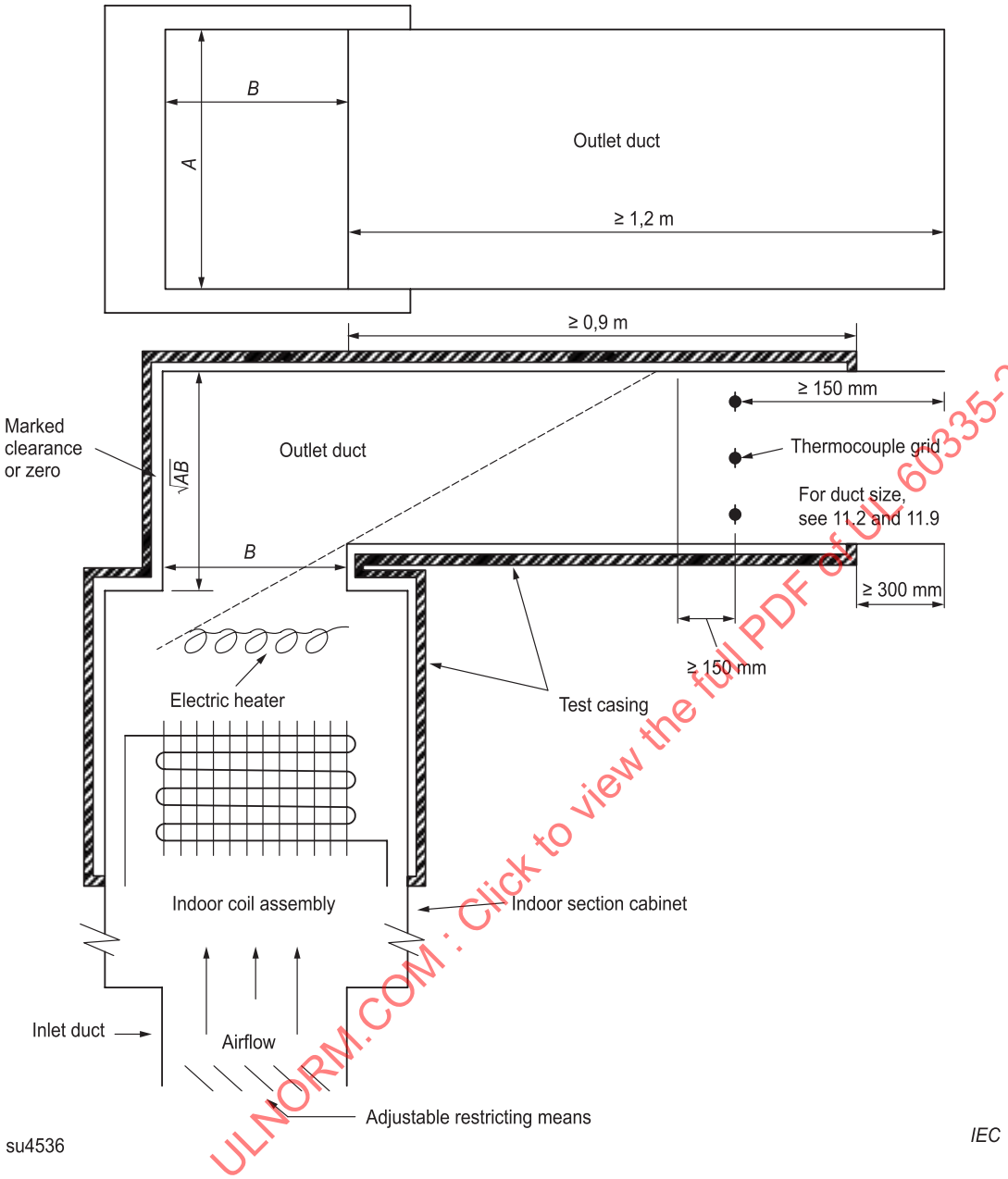


Figure 102ADV

The required distance from the radiance of divergence of the heater and the outlet thermal couple grid shall be ≤ 150 mm.

Figure 102BDV D1 ***Modify Figure 102 of the Part 2 for downflow application:***

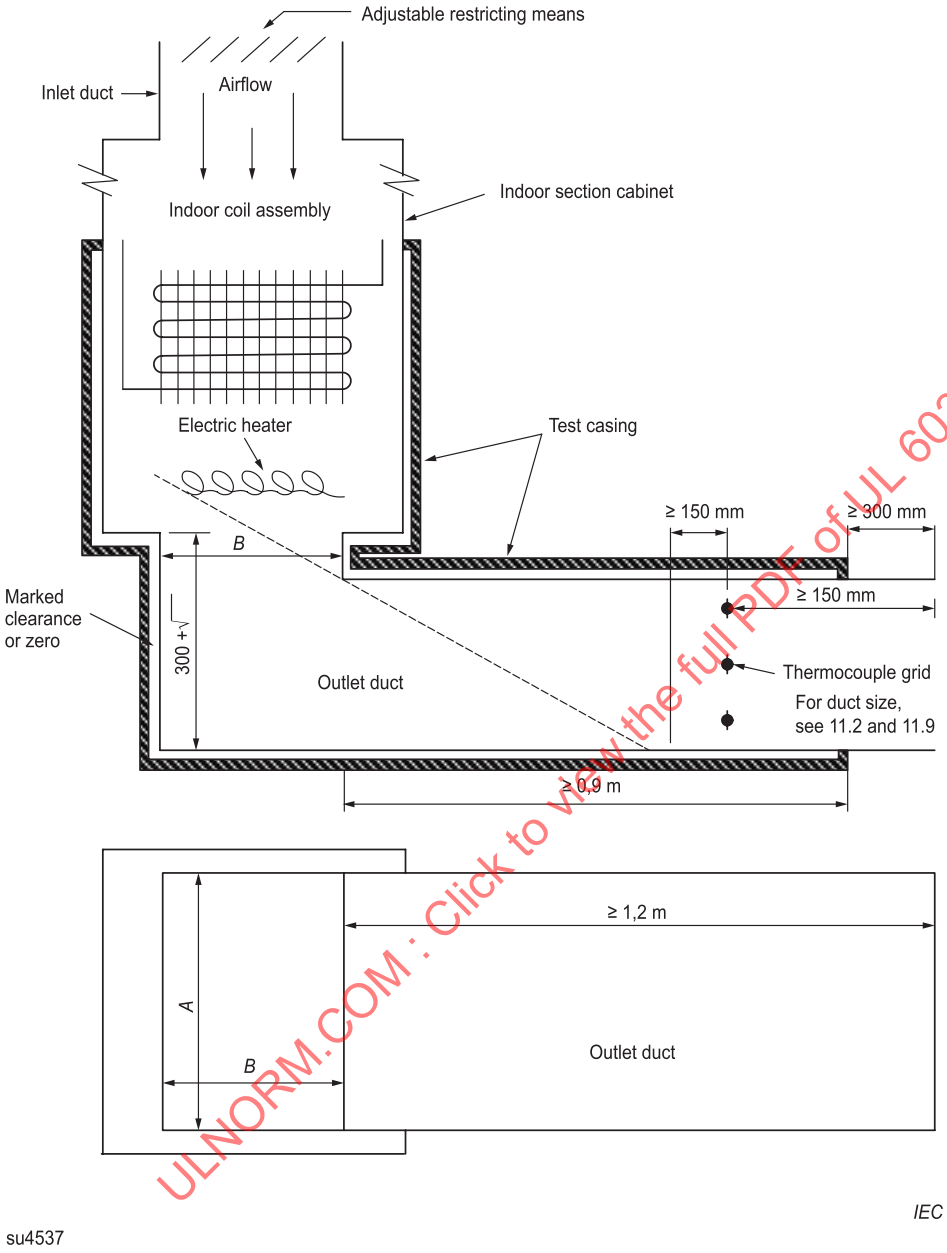
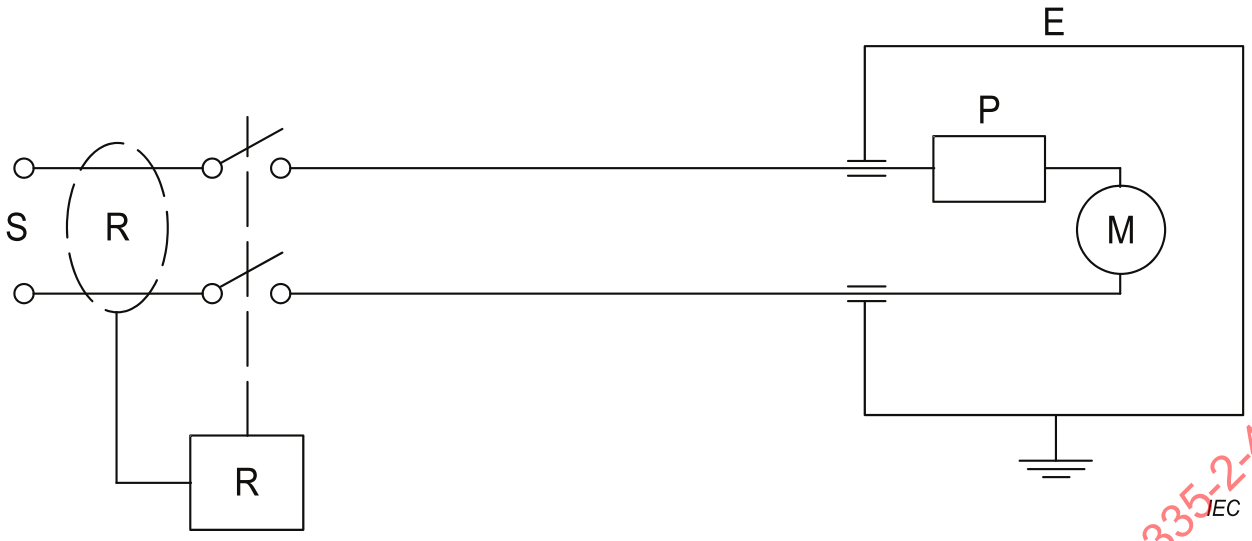


Figure 102BDV

Arrangement for heating test of appliances with supplementary heater



su0260a

Key

S supply

E motor enclosure

R residual current device ($I_{\Delta n}$ = 30 mA)

(RCCB or RCBO)

P protective device (external or internal)

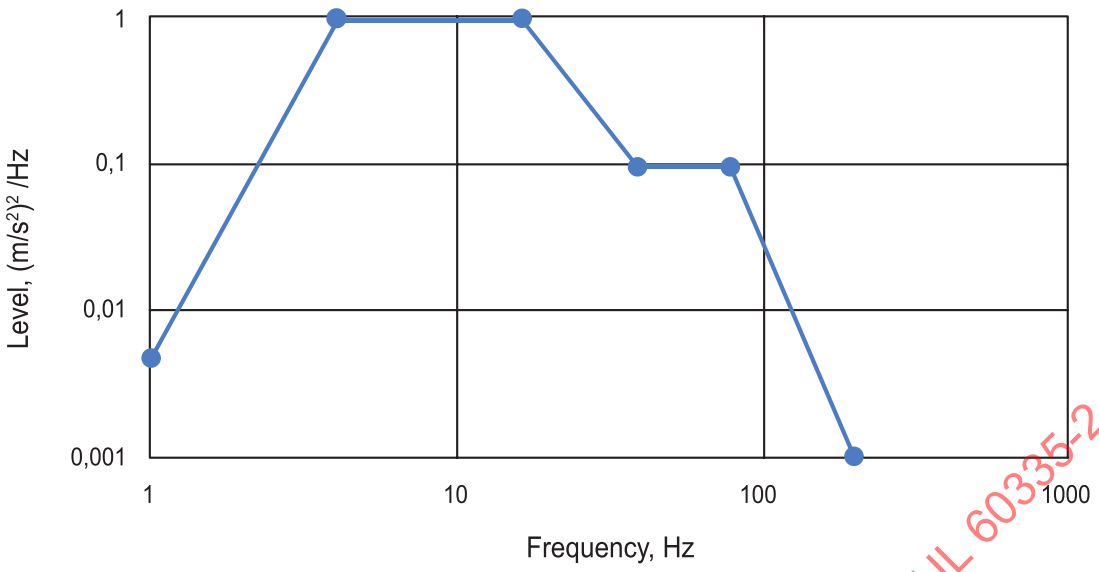
M motor

Care has to be taken to complete the earthing system to permit the correct operation of the RCCB/RCBO.

Figure 103

Supply circuit for locked-rotor test of a motor of the single-phase type – Revise as needed for three-phase test

Figure 104DV D1 ***Add the following figure to the Part 2:***



su4538

Dimensions in millimeters

Figure 104DV

Power spectral density profile for vibration test in Clause 21.101DV

Figure 105DV D1 ***Add the following figure to the Part 2:***

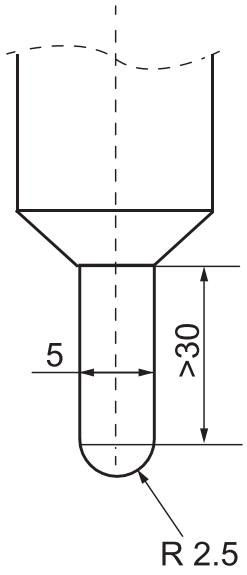


Figure 105DV

Dimensional details for the weight in the area of the pressure ball

Figure 106DV D1 ***Add the following figure to the Part 2:***

Measurement 1: Height specimen unloaded

Measurement 2: Height specimen after loading

su4540

Figure 106DV

Measurement before and after the test

Figure 107DV D1 ***Add the following figure to the Part 2:***

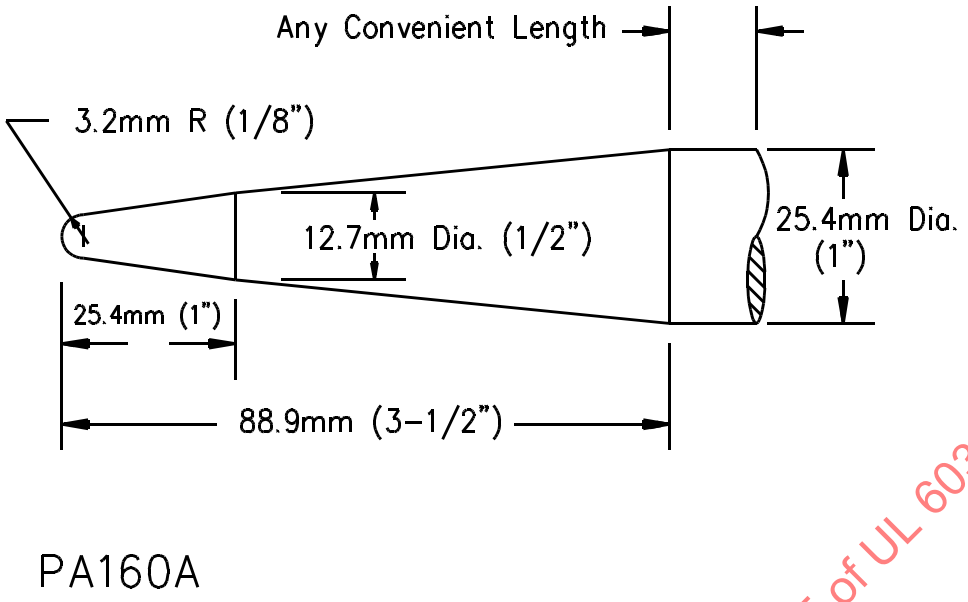


Figure 107DV

Test probe for moving parts

Annexes

The annexes of Part 1 are applicable except as follows.

Annex ADV
(informative)

Routine Tests

Annex ADV D1 ***Modification of Annex A in the Part 1:***

Above the title, replace "(informative)" with "(normative)" and add the following:

ADV.1 For Class I appliances, the insulation of the appliance shall be subjected to a voltage of substantially sinusoidal waveform having a frequency of approximately 50 Hz or 60 Hz for 1 min. The value of the test voltage shall be two times rated voltage plus 1 000 V. The time period may be reduced to 1 s if the applied voltage is increased by 20 %. The points of application shall be between live parts and accessible metal parts separated from live parts by basic insulation.

ADV.2 If a unit employs components such as a solid-state control that can be damaged by the dielectric potential, the test may be conducted before such components are electrically connected. However, a sample selected at random from production each day shall be tested to verify compliance The circuitry may be rearranged for the test on the randomly selected sample to reduce the possibility of component damage while retaining representative dielectric stress of the circuit.

ADV.3 Components providing a direct current path in parallel with the insulation to be tested (primary to dead-metal) may be disconnected during the test. Examples of such components are discharge resistors for filter capacitors and voltage limiting devices such as transient voltage suppressors (other than capacitors).

ADV.4 A DC potential equivalent to 1,414 times the test voltage in ADV.2 may be applied. The time period may be reduced to one second, if the applied voltage is increased by 20 %.

ADV.101 D1 ***Add subclauses ADV.101.1 to ADV.11 to Annex A in the Part 1:***

ADV.101 Pressure tests for leakage and strength

ADV.101.1 All refrigerant-containing parts of each unit shall be tested and proved tight at no less than the maximum allowable pressure as determined in Clause EE.2DV on the high pressure side and Clause EE.3DV on the low pressure side, but not less than the saturated pressure at 51,7 °C on the high pressure side and 26,5 °C on the low pressure side.

NOTE A method other than pressure testing at the design pressure may be employed if it can be demonstrated that the alternative test method produces results that are at least equivalent to the pressure test method.

ADV.101.2 If the test described in Clause ADV.101.1 is conducted prior to reforming or bending of the coil assembly, the test shall be repeated on at least one finished coil assembly from each production run, but no less than four times per year. Records of such tests shall be made available for review.

ADV.101.3 The leakage test on the complete unit may be conducted at the maximum allowable pressure as determined in Clause EE.2DV if final assembly of the unit is completed with flare-type fittings or telescoped tubing joints that are sealed with silver solder, brazing, welding, or equivalent means. In this case, any components located on higher pressure sections of the system shall be individually tested by either the unit manufacturer or the manufacturer of the part at no less than the marked design pressure in which those components are used.

ADV.101.4 Sample refrigerant-containing parts of the shell type, including compressor shells, that have an inside diameter greater than 76 mm shall be subjected to the strength test in Clause ADV.101.5. Pressure vessels bearing the ASME Code U or UM symbol need not be tested.

ADV.101.5 The test specified in Clause ADV.101.4 shall be conducted on at least one sample of each size and type. The sample shall not fail when subjected to pressures specified in the requirements for the strength test. These tests shall be conducted at least once every three months on current production and at least once a year on limited production. Records of such tests shall be made available for review.

ADV.101.6 Each centrifugal liquid chiller with a design pressure of 103 kPa or less shall be tested at a pressure not less than 1-1/3 times the maximum allowable pressure and shall be tested and proved tight at not less than the maximum allowable pressure of the low side of the system.

ADV.101.7 Each refrigerant-containing component of a centrifugal liquid chiller with a maximum allowable pressure greater than 103 kPa shall be tested at a pressure not less than the maximum allowable pressure of the component, and the chiller shall be tested and proved tight at not less than the maximum allowable pressure of the low side of the system.

ADV.101.8 For appliances or components applied in compliance with Clause EE.4DV continued compliance shall be demonstrated periodically by testing of randomly sampled appliance from production at least one time per year.

ADV.101.9 For multi-split appliances using flammable refrigerants in compliance with Clause 22.125DV and Annex GG, compliance with Clause EE.4DV indoor coil assemblies shall be demonstrated periodically by testing of indoor coil assemblies randomly sampled from production at least three times per year.

ADV.101.10 For the periodic tests of Clause ADV.101.2, ADV.101.5, ADV.101.8 and ADV.101.9, in the event of failure, corrective action shall be taken and randomly selected samples from production shall be tested at least once per month until three consecutive samples pass the test.

ADV.101.11 The refrigeration system of each indoor unit shall be tightness tested at the factory. There shall be no leak when checked with an instrument having a sensitivity of 3 g/year or less when tested at 25 % of the maximum allowable pressure when checking individual joints with an instrument having a sensitivity of 3 g/year or less when tested 25 % of the maximum allowable pressure. When testing an assembly, there shall be no leak when checked with an instrument having a sensitivity of 10 g/year or less when tested at 25 % of the maximum allowable pressure.

Annex D
(normative)

Thermal motor protectors

This annex of Part 1 is not applicable.

Annex I
(normative)

Motors having basic insulation that is inadequate for the rated voltage of the appliance

This annex of Part 1 is not applicable.

Annex AA
(informative)

Examples for operating temperatures of the appliance

Table AA.1
Examples for operating temperatures of the appliance

Function of appliance	Classification		Heating				Cooling			
			Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)		Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)	
			DB[a]	WB[b]	DB[a]	WB[b]	DB[a]	WB[b]	DB[a]	WB[b]
Outside air/ Recycled air	A7	A20	7	6	20	12	35	24	27	19
Exhaust air/ Recycled air	A20	A20	20	12	20	12	–	–	–	–
Exhaust air/ Fresh air	A20	A7	20	12	7	6	–	–	–	–
Outside air/Water	A7	W50	7	6	Water	50	35	24	Water	7
Exhaust air/Water	A20	W50	20	12	Water	50	–	–	–	–
Water/Water	W10	W50	Water	10	Water	50	Water	15	Water	7
Brine/Water	B0	W50	Brine	0	Water	50	Brine	15	Water	7
Brine/ Recycled air	B0	A20	Brine	0	20	12	–	–	–	–
Water/ Recycled air	W10	A20	Water	10	20	12	–	–	–	–
Water/ Recycled air	W20	A20	Water	20	20	12	–	–	–	–
Dehumidification	Comfort		–	–					27	21
	Process								12	9
	Heat recovery (air cooled)						27	21	27	21
	Heat recovery (water cooled)						Water	24	27	21
SANITARY HOT WATER HEAT PUMP										
Outside air/Water	A7	W45	7	6	Water	45	–	–	–	–
Ambient air/Water	A15	W45	15	12	Water	45	–	–	–	–
Exhaust air/Water	A20	W45	20	12	Water	45	–	–	–	–
Brine/Water	B0	W45	Brine	0	Water	45	–	–	–	–

NOTE Appliance can be classified according to function and temperature application as noted below:

Source	Outside air	Sink	Recycled air	Classification	A –	A *
Exhaust air		Recycled air		A –	A –	
Exhaust air		Outside air		A –	A –	
Outside air		Water		A –	W –	
Exhaust air		Water		A –	W –	

Table AA.1 Continued on Next Page

Table AA.1 Continued

Function of appliance	Classification	Heating				Cooling			
		Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)		Outdoor assembly °C (inlet)		Indoor assembly °C (outlet)	
		DB[a]	WB[b]	DB[a]	WB[b]	DB[a]	WB[b]	DB[a]	WB[b]
Water	Water					W –		W –	
Water	Recycled air					W –		A –	
Brine	Recycled air					B –		A –	
Brine	Water					B –		W –	
* For example, A7 A20 indicates an appliance designed for an outside air operating temperature of 7 °C DB and an inside air operating temperature of 20 °C DB.									
[a] DB: dry bulb									
[b] WB: wet bulb									

Annex BB
(normative)

Selected information about refrigerants

NOTE This annex is not a complete list of suitable refrigerants. This International Standard applies to any refrigerants as defined in the scope.

Table BB.1
Selected information about refrigerants

Refrigerant designation [a]	Description	Formula (nominal composition mass fraction %)	Safety group [f]	Auto ignition temperature	Hot surface ignition temperature [g]	Maximum allowable surface temperature [g]	Density [b]	Molar mass[c] at nominal composition [h]	Molar mass[c] at worst case formulation [i]	Lower flammable limit[b,d] at nominal composition [h]	Lower flammability limit[b,d] at worst case formulation [i]
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3	kg/m^3
R32	Difluoromethane	CH_2F_2	A2L	648	> 800	700	2,13	52,0	NA	0,307	NA
R50	Methane	CH_4	A3	645		545	0,65	16,0	NA	0,032	NA
R143a	1,1,1 – Trifluoroethane	CF_3CH_3	A2L	750		650	3,43	84,0	NA	0,282	NA
R152a	1, 1 – Difluoroethane	CHF_2CH_3	A2	455		355	2,70	66,0	NA	0,130	NA
R170	Ethane	CH_3CH_3	A3	515		415	1,23	30,1	NA	0,038	NA
R290	Propane	$CH_3CH_2CH_3$	A3	470		370	1,80	44,1	NA	0,038	NA
R600	n-Butane	CH_3CH_2 CH_2CH_3	A3	365		265	2,37	58,1	NA	0,038	NA
R600a	Isobutane	$CH(CH_3)_3$	A3	460		360	2,37	58,1	NA	0,043	NA
R1150	Ethylene	$CH_2=CH_2$	A3	425			1,15	28,1	NA	0,036	NA
R1270	Propylene	$CH_2=CHCH_3$	A3	455		355	1,72	42,1	NA	0,046	NA
E170	Dimethylether	$(CH_3)_2O$	A3	235		135	1,88	46,1	NA	0,064	NA
R142b	1-chloro-1,1-difluoroethane	CH_3CCIF_2	A2L	750[e]		650	4,11	100,5	NA	0,329	NA
R1234yf	2,3,3,3-tetrafluoro-1-propene	$CF_3CF=CH_2$	A2L	405	> 800	700	4,66	114,0	NA	0,289	NA
R1234ze(E)	Trans-1,3,3,3-tetrafluoro-1-propene	$CF_3CF=CHF$	A2L	368	> 800	700	4,66	114,0	NA	0,303	NA
R-444A	R-32/152a/1234ze(E)	(12/5/83)	A2L	ND	> 800	700	4,03	98,7	95,2	0,324	0,323
R-444B	R-32/152a/1234ze(E)	(41.5/10/48.5)	A2L	ND	> 800	700	3,02	72,8	73,0	0,277	0,277
R-447A	R-32/125/1234ze(E)	(68/3.5/28.5)	A2L	ND			2,61	63,0	63,1	0,304	0,330
R-447B	R-32/125/1234ze(E)	(68/8/24)	A2L	ND	> 800	700	2,58	63,1	63,1	0,312	0,312
R-451A	R-1234yf/134a	(89.8/10.2)	A2L	ND	> 800	700	4,61	112,7	112,7	0,322	0,346
R-451B	R-1234yf/134a	(88.8/11.2)	A2L	ND	> 800	700	4,60	112,6	112,6	0,322	0,341
R-452B	R-32/125/1234yf	(67/7/26)	A2L	ND	> 800	700	2,60	63,5	63,7	0,309	0,310
R-454A	R-32/1234yf	(35/65)	A2L	ND	> 800	700	3,29	80,5	81,8	0,273	0,278
R-454B	R-32/1234yf	(68.9/31.1)	A2L	ND	> 800	700	2,56	62,6	63,0	0,307	0,301
R-454C	R-32/1234yf	(21.5/78.5)	A2L	ND	> 800	700	3,71	90,8	92,5	0,286	0,291
R-457A	R-32/1234yf/152a	(18/70/12)	A2L	ND			3,58	87,6	88,0	0,215	0,216

If any data in this table is missing or in conflict with the data in ISO 817 then the value in ISO 817 shall take precedence.

ND means non-determined. Consult the safety data sheet of the manufacturer.

NA means not applicable.

[a] The refrigerant designations are in accordance with ISO 817.

Table BB.1 Continued on Next Page

Table BB.1 Continued

Refrigerant designation [a]	Description	Formula (nominal composition mass fraction %)	Safety group [f]	Auto ignition temperature	Hot surface ignition temperature [g]	Maximum allowable surface temperature [g]	Density [b]	Molar mass[c] at nominal composition [h]	Molar mass[c] at worst case formulation [i]	Lower flammable limit[b,d] at nominal composition [h]	Lower flammability limit[b,d] at worst case formulation [i]
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3	kg/m^3

[b] These values are at 25 °C and at 1 013,2 mbar.

[c] For comparison, the molecular mass of air is taken equal to 28,8 kg/kmol.

[d] Multiply % *v/v* by the corresponding molar mass × 0,000 409 to give the flammability limit in kg/m^3.

[e] Estimated from molecular structure.

[f] Safety group of refrigerants based upon ISO 817.

[g] For FLAMMABLE REFRIGERANTS, the maximum allowable surface temperature is determined by AIT reduced by 100 K.

For A2L REFRIGERANTS, the maximum allowable surface temperature is determined by the highest of AIT reduced by 100 K or if tested per Annex KK, the HOT SURFACE IGNITION TEMPERATURE reduced by 100 K, but not higher than 700 °C.

[h] Nominal composition means design composition as stated in the refrigerant blend application, excluding any tolerances.

[i] Worst case formulation means the composition that results from application of the tolerances to the nominal composition resulting in the most toxic or most flammable formulation.

Table BB.1DV D1 ***Modification of Table BB.1 of the Part 2 by replacing it with the following:***

Table BB.1DV
Selected information about refrigerants

Refrigerant designation[a]	Description	Formula (nominal composition mass fraction %)	Safety group[f]	Auto ignition temperature	Hot surface ignition temperature[g]	Maximum allowable surface temperature[g]	Density[b]	Molar mass[c] at nominal composition[h]	Molar mass[c] at worst case formulation[i]	Lower flammable limit[b,d] at nominal composition[h]	Lower flammability limit[b,d] at worst case formulation[i]	Burning velocity, S_u, at 23 °C 50 % relative humidity at nominal composition	Burning velocity, S_u, at 27 °C dew point at nominal composition
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3	kg/m^3	cm/s	cm/s
R-32	Difluoromethane	CH_2F_2	A2L	648	> 800	700	2,13	52,0	NA	0,306	NA	6,7	6,7
R-50	Methane	CH_4	A3	645	NA	645	0,65	16,0	NA	0,033	NA		
R-143a	1,1,1 – Trifluoroethane	CF_3CH_3	A2L	750	NA	750	3,43	84,0	NA	0,282	NA		
R-152a	1, 1 – Difluoroethane	CHF_2CH_3	A2	455	NA	455	2,70	66,0	NA	0,130	NA		
R-170	Ethane	CH_3CH_3	A3	515	NA	515	1,23	30,1	NA	0,038	NA		
R-290	Propane	$CH_3CH_2CH_3$	A3	470	NA	470	1,80	44,1	NA	0,038	NA		
R-600	n-Butane	CH_3CH_2 CH_2CH_3	A3	365	NA	365	2,37	58,1	NA	0,048	NA		
R-600a	Isobutane	$CH(CH_3)_3$	A3	460	NA	460	2,37	58,1	NA	0,038	NA		
R-1150	Ethylene	$CH_2=CH_2$	A3	425	NA	ND	1,15	28,1	NA	0,036	NA		
R-1132a	1,1-difluoroethylene	$CF_2=CH_2$	A2	ND	NA	ND	2,61	64,0	NA	0,131	NA		
R-1270	Propylene	$CH_2=CHCH_3$	A3	455	NA	455	1,72	42,1	NA	0,046	NA		
R-E170	Dimethylether	$(CH_3)_2O$	A3	235	NA	235	1,88	46,1	NA	0,064	NA		
R-142b	1-chloro-1,1-difluoroethane	CH_3CClF_2	A2L	750[e]	ND	750	4,11	100,5	NA	0,329	NA		
R-1234yf	2,3,3,3-tetrafluoro-1-propene	$CF_3CF=CH_2$	A2L	405	> 800	700	4,66	114,0	NA	0,289	NA		
R-1234ze(E)	Trans-1,3,3,3-tetrafluoro-1-propene	$CF_3CF=CHF$	A2L	368	> 800	700	4,66	114,0	NA	0,303	NA		
R-444A	R-32/152a/1234ze(E)	(12,0/5,0/83,0)	A2L	ND	> 800	700	4,03	96,7	95,2	NA	0,325		
R-444B	R- 32/152a/ 1234ze(E)	(41,5/10,0/48,5)	A2L	ND	> 800	700	3,02	72,8	73,0	NA	0,277		
R-445A	R-744/134a/1234ze(E)	(6,0/9,0/85,0)	A2L	ND	ND	ND	4,29	103,1	104,7	NA	0,347		
R-446A	R-32/1234ze(E)/600	(68,0/29,0/3,0)	A2L	ND	> 800	700	2,60	62,0	62,4	NA	0,237		
R-447A	R-32/125/1234ze(E)	(68,0/3,5/28,5)	A2L	ND	> 800	700	2,61	63,0	63,1	NA	0,331		
R-447B	R-32/125/1234ze(E)	(68,0/8,0/24,0)	A2L	ND	> 800	700	2,58	63,1	63,1	NA	0,331		

Table BB.1DV Continued on Next Page

Table BB.1DV Continued

Refrigerant designation[a]	Description	Formula (nominal composition mass fraction %)	Safety group[f]	Auto ignition temperature	Hot surface ignition temperature[g]	Maximum allowable surface temperature[g]	Density[b]	Molar mass[c] at nominal composition[h]	Molar mass[c] at worst case formulation[i]	Lower flammable limit[b,d] at nominal composition[h]	Lower flammability limit[b,d] at worst case formulation[i]	Burning velocity, S_u, at 23 °C 50 % relative humidity at nominal composition	Burning velocity, S_u, at 27 °C dew point at nominal composition
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3	kg/m^3	cm/s	cm/s
R-451A	R-1234yf/134a	(89,8/10,2)	A2L	ND	> 800	700	4,71	112,7	112,7	NA	0,327		
R-451B	R-1234yf/134a	(88,8/11,2)	A2L	ND	> 800	700	4,70	112,6	112,6	NA	0,327		
R-452B	R-32/125/1234yf	(67,0/7,0/26,0)	A2L	509	> 800	700	2,63	63,5	63,5	NA	0,310	< 4,0	
R-454A	R-32/1234yf	(35,0/65,0)	A2L	457	> 800	700	3,34	80,5	81,8	NA	0,294	< 4,0	
R-454B	R-32/1234yf	(68,9/31,1)	A2L	496	> 800	700	2,59	62,6	63,0	NA	0,296	5,7	
R-454C	R-32/1234yf	(21,5/78,5)	A2L	444	> 800	700	3,78	90,8	92,5	NA	0,291	< 4,0	
R-455A	R-744/32/1234yf	(3,0/21,5/75,5)	A2L	ND	> 800	700	3,64	87,5	89,4	NA	0,432		
R-457A	R-32/1234yf/152a	(18,0/70,0/12,0)	A2L	ND	ND	ND	3,65	87.6	88,0	0,215	0,216		

Note: See Clause 4DV.1 for general requirements about *LFL*.

If any data in this table is missing or in conflict with the data in ASHRAE 34 or ISO 817 then the value in ASHRAE 34 shall take precedence, or if missing in ASHRAE 34 then ISO 817 shall take precedence.

Where the *LFL* at nominal composition is not given, the LFL at worst case formulation shall be used

The tables with ASHRAE 34 refrigerant data are provided at https://www.ashrae.org/technical-resources/standards-and-guidelines and https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda. The tables with ISO 817 refrigerant data are provided at http://standards.iso.org/iso/817/ed-3/en.

Note: Care must be taken to use WCF data from ASHRAE 34 as sometimes data is listed that is WCFF.

ND means non-determined. Consult the safety data sheet of the manufacturer.

NA means not applicable.

[a] The refrigerant designations are in accordance with ISO 817.

[b] These values are at 25 °C and at 1 013,2 mbar.

[c] For comparison, the molecular mass of air is taken equal to 28,8 kg/kmol.

[d] Multiply % *v/v* by the corresponding molar mass × 0,000 409 to give the flammability limit in kg/m^3.

[e] Estimated from molecular structure.

[f] Safety group of refrigerants based upon ISO 817.

[g] For **FLAMMABLE REFRIGERANTS**, the maximum allowable surface temperature is determined by **AIT** reduced by 100 K.

For **A2L REFRIGERANTS**, the maximum allowable surface temperature is determined by the highest of **AIT** reduced by 100 K or if tested per Annex KK, the **HOT SURFACE IGNITION TEMPERATURE** reduced by 100 K, but not higher than 700 °C.

[h] Nominal composition means design composition as stated in the refrigerant blend application, excluding any tolerances.

[i] Worst case formulation means the composition that results from application of the tolerances to the nominal composition resulting in the most toxic or most flammable formulation.

Annex CC
(informative)

Transportation, marking and storage for units that employ flammable refrigerants

CC.1 General

The following information is provided for units that employ FLAMMABLE REFRIGERANTS.

CC.2 Transport of equipment containing flammable refrigerants

Attention is drawn to the fact that additional transportation regulations may exist with respect to equipment containing flammable gas. The maximum number of pieces of equipment or the configuration of the equipment permitted to be transported together will be determined by the applicable transport regulations.

CC.3 Marking of equipment using signs

Signs for similar appliances used in a work area are generally addressed by local regulations and give the minimum requirements for the provision of safety and/or health signs for a work location.

All required signs are to be maintained and employers should ensure that employees receive suitable and sufficient instruction and training on the meaning of appropriate safety signs and the actions that need to be taken in connection with these signs.

The effectiveness of signs should not be diminished by too many signs being placed together.

Any pictograms used should be as simple as possible and contain only essential details.

CC4 Disposal of equipment using flammable refrigerants

See national regulations.

CC.5 Storage of equipment/appliances

The storage of the appliance should be in accordance with the applicable regulations or instructions, whichever is more stringent.

CC.6 Storage of packed (unsold) equipment

Storage package protection should be constructed in such a way that mechanical damage to the equipment inside the package will not cause a leak of the REFRIGERANT CHARGE.

The maximum number of pieces of equipment permitted to be stored together will be determined by local regulations.

Annex DD
(normative)

Requirements for operation, service and installation manuals of appliances using flammable refrigerants

DD.1 General

Each service manual shall include requirements of clauses according to Table DD.1. Different manuals can be combined into one manual.

DD.1DV.1 DR *Modification of Clause DD.1 General with the following:*

Each manual shall include requirements of clauses according to Table DD.1. Different manuals can be combined into one manual.

Numerical values needed for proper installation, service, maintenance and repair, and decommissioning shall be in the form of a single figure or a table without reference to an equation.

For factory sealed single package units Installation manual do not need to include material from Clauses DD.4.8 and DD.9.

An equation may additionally be provided in the manual for ITE COOLING APPLIANCES.

DD.1DV.2 DR *Modification of Clause DD.1 of the Part 2 by adding the following:*

For appliances that are not intended to be serviced, the following shall apply:

a) Maintenance and repair manuals and decommissioning manuals are not required.

b) Installation instructions do not need to include content of Clauses DD.9, DD.10, DD.11, or DD.13.

Table DD.1DV DR *Modification of Table DD.1 of the Part 2 by adding the word "service" to the heading of column 3 and, as applicable, in the Table DD.1.*

Table DD.1
Mandatory clauses in each manual

Clause	Installation	Maintenance and repair	Decommissioning	Note
DD.2	Yes	Yes	Yes	
DD.3.1	Yes	Yes	No	
DD.3.2	Yes	Yes	No	User manual also
DD.3.3	Yes	Yes	Yes	
DD.4	No	Yes	Yes	
DD.4.1	No	Yes	Yes	
DD.4.2	No	Yes	Yes	

Table DD.1 Continued on Next Page

Table DD.1 Continued

Clause	Installation	Maintenance and repair	Decommissioning	Note
DD.4.3	No	Yes	Yes	
DD.4.4	No	Yes	Yes	
DD.4.5	No	Yes	Yes	
DD.4.6	No	Yes	Yes	
DD.4.7	No	Yes	Yes	
DD.4.8	Yes	Yes	No	
DD.4.9	No	Yes	No	
DD.5.1	No	Yes	No	
DD.5.2	No	Yes	No	
DD.6	No	Yes	No	
DD.7	Yes	Yes	No	
DD.8	Yes	Yes	Yes	
DD.9	Yes	Yes	Yes	
DD.10	Yes	Yes	No	
DD.11	No	No	Yes	
12	No	No	Yes	
DD.13	Yes	Yes	Yes	

DD.2 Symbols

The symbols referred to in 7.6 (without colours is permitted) and the information of the warning marking shall be provided as follows:

WARNING

Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.

The appliance shall be stored in a room without continuously operating ignition sources (for example: open flames, an operating gas appliance or an operating electric heater.

Do not pierce or burn.

Be aware that refrigerants may not contain an odour.

The manufacturer may provide other suitable examples or may provide additional information about the refrigerant odour.

DD.3 Information in manual

DD.3.1 General

The following information shall be specified in the manual where the information is needed for the function of the manual and as applicable to the appliance:

– information for spaces where refrigerant pipes are allowed, including statements

- that the installation of pipe-work shall be kept to a minimum;

that pipe-work shall be protected from physical damage and, in the case of FLAMMABLE REFRIGERANTS, shall not be installed in an unventilated space, if that space is smaller than A_{min} in Annex GG, except for A2L REFRIGERANTS where the installed pipes comply with 22.116. In case of field charge, the effect on REFRIGERANT CHARGE caused by the different pipe length has to be quantified;

• that compliance with national gas regulations shall be observed;

• that mechanical connections made in accordance with 22.118 shall be accessible for maintenance purposes;

• that, for appliances containing FLAMMABLE REFRIGERANTS, the minimum floor area of the room shall be mentioned in the form of a table or a single figure without reference to a formula;

– the MAXIMUM REFRIGERANT CHARGE (m_{max});

– instructions how to determine the additional REFRIGERANT CHARGE and how to complete the REFRIGERANT CHARGE on the label provided by the manufacturer considering the requirements in 7.107;

– the minimum rated airflow, if required by Annex GG;

– information for handling, installation, cleaning, servicing and disposal of refrigerant;

– for appliances using FLAMMABLE REFRIGERANTS, instructions shall include the minimum INSTALLED HEIGHT h_{inst} (when required to calculate A_{min}), REFRIGERANT CHARGE m_c and minimum room area of the space A_{min} or a minimum room area of conditioned space TA_{min} where applicable. Additional minimum room area data may be provided based on other INSTALLED HEIGHTS and/or charge levels.

– detailed instructions on how to install the appliance to ensure that the release height h_0 as determined in Clause GG.2 of the installed appliance is not lower than h_0 used for the calculation of A_{min};

– a warning to keep any required ventilation openings clear of obstruction;

– a notice that servicing shall be performed only as recommended by the manufacturer;

– a warning that ducts connected to an appliance shall not contain a POTENTIAL IGNITION SOURCE;

– instructions for wiring to external zoning dampers and/or mechanical ventilation, if required to comply with Clause GG.9, to ensure that upon detection of a leak, the zoning dampers are driven fully open and additional mechanical ventilation is activated;

– for appliances relying on safety measures according to GG.8.3 instructions for wiring to external ventilation;

– when a remote located refrigerant sensor is specified by the manufacturer, the instructions shall state when it is required and how to install and connect the sensor;

– for appliances using A2L REFRIGERANTS, connected via an air duct system to one or more rooms, the supply and return air shall be directly ducted to the space. Open areas such as false ceilings shall not be used as a return air duct;

– the following information requirements apply FOR ENHANCED TIGHTNESS REFRIGERATING SYSTEMS using A2L REFRIGERANTS:

• Equipment piping in the occupied space shall be installed in such a way to protect against accidental damage in operation and service.

• Precautions shall be taken to avoid excessive vibration or pulsation to refrigerating piping.

• Protection devices, piping and fittings shall be protected as far as possible against adverse environmental effects, for example, the danger of water collecting and freezing in relief pipes or the accumulation of dirt and debris.

• Provision shall be made for expansion and contraction of long runs of piping.

• Piping in REFRIGERATING SYSTEMS shall be so designed and installed to minimize the likelihood hydraulic shock damaging the system.

• Solenoid valves shall be correctly positioned in the piping to avoid hydraulic shock.

• Solenoid valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.

• Steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation.

• Flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces. They should be checked for mechanical damage annually.

• The indoor equipment and pipes shall be securely mounted and guarded such that accidental rupture of equipment cannot occur from such events as moving furniture or reconstruction activities.

• Where safety shut off valves are specified, the minimum room area may be determined based on the maximum amount of refrigerant that can be leaked as determined in GG.12.2.

• Where safety shut off valves are specified, the location of the valve in the REFRIGERATING SYSTEM relative to the occupied spaces shall be as described in GG.12.1.

• Field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of 5 grams per year of refrigerant or better under a pressure of at least 0,25 times the MAXIMUM ALLOWABLE PRESSURE. No leak shall be detected.

– For mechanical ventilation as specified in GG.8.3, the air extraction opening from the room shall be located equal or below the refrigerant release point. For floor mounted units, it shall be as low as practicable. The air extraction openings shall be located in a sufficient distance from the air intake openings to prevent re-circulation to the space.

DD.3.1DV D1 ***Modification of Clause DD.3.1 of the Part 2 by replacing it with the following:***

The following information shall be specified in the manual where the information is needed for the function of the manual and as applicable to the appliance:

– information for spaces where refrigerant pipes are allowed, including

• that pipe-work including piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local codes and standards, such as ASHRAE 15, ASHRAE 15.2, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed;

– that, for appliances containing FLAMMABLE REFRIGERANTS, the minimum floor area of the room shall be mentioned in the form of a table or a single figure without reference to a formula; and

– that after completion of field piping for split systems, the field pipework shall be pressure tested with an inert gas and then vacuum tested prior to refrigerant charging, according to the following requirements;

The minimum test pressure for the low side of the system shall be the low side design pressure and the minimum test pressure for the high side of the system shall be the high side design pressure, unless the high side of the system, cannot be isolated from the low side of the system in which case the entire system shall be pressure tested to the low side design pressure.

– field-made refrigerant joints indoors shall be tightness tested. The test method shall have a sensitivity of 5 grams per year of refrigerant or better under a pressure of at least 0,25 times the maximum allowable pressure. No leak shall be detected;

– where addition of charge is required to complete installation, instructions on how to determine the additional REFRIGERANT CHARGE and how to complete the REFRIGERANT CHARGE on the label provided by the manufacturer considering the requirements in Clause 7.107. Interconnecting refrigerant piping length and diameter shall be taken into consideration.

– the minimum rated airflow, if required by Annex GG;

– information for handling, installation, cleaning, servicing and disposal of refrigerant;

– for appliances using FLAMMABLE REFRIGERANTS, instructions shall include the minimum INSTALLED HEIGHT h_{inst} (when required to calculate A_{min}), REFRIGERANT CHARGE m_c and minimum room area of the space A_{min} or a minimum room area of conditioned space TA_{min} where applicable. Additional minimum room area data may be provided based on other INSTALLED HEIGHTS or charge levels;

– detailed instructions on how to correctly install the appliance including piping and SAFETY SHUT-OFF VALVES for every space in which refrigerant can leak (where applicable), including the following information:

• minimum room area A_{min}, or minimum room area of conditioned space TA_{min}, as a function of the refrigerant charge, m_c, or as a function of the releasable charge, m_{REL};

• if the releasable charge, m_{REL}, has been determined, a warning that the minimum room area or minimum room area of conditioned space is based on releasable charge and is not related to total system refrigerant charge;

• the refrigerant charge, m_c, and, if the releasable charge, m_{REL}, has been determined, the RELEASABLE CHARGE, m_{REL};

• required INSTALLED HEIGHT, h_{inst};

• minimum ventilation airflow volume Q_{min}; and

• minimum opening area for natural ventilation A_{nv};

– for ITE COOLING APPLIANCES complying with Annex 101.DVN, the following information shall be specified:

• the minimum EFFECTIVE DISPERSAL VOLUME V_{ED}, as a function of the refrigerant charge, m_c, or as a function of the releasable charge, m_{REL};

• if the releasable charge, m_{REL}, has been determined, a warning that the minimum EFFECTIVE DISPERSAL VOLUME V_{ED} is based on releasable charge and is not related to total system refrigerant charge;

• the refrigerant charge, m_c, and, if the releasable charge, m_{REL}, has been determined, the RELEASABLE CHARGE, m_{REL};

• minimum ventilation airflow volume Q_{min}; and

• additional minimum V_{ED} data may be provided based on other charge levels.

– instructions shall include how to correct the minimum room area of the space A_{min} or a minimum room area of conditioned space TA_{min}, as applicable from Annex GG, by multiplying by an altitude adjustment factor (AF) based on for building site ground level altitude (H_{alt}) in meters.

– for mechanical ventilation as specified in Clause GG.8.3, the lower edge of the air extraction opening where air is exhausted from the room shall not be more than 100 mm above the floor. The location where the mechanical ventilation air extracted from the space is discharged shall be separated by a sufficient distance, but not less than 3 m, from the mechanical ventilation air intake openings, to prevent re-circulation to the space.

– for mechanical ventilation as specified in Clause GG.8.3 or for enhanced tightness REFRIGERATING SYSTEMS Clause GG.11.3, information on installation of the mechanical ventilation air extraction and air intake openings per Clause GG.8.3.3 or Clause GG.11.3.3;

– instruction to verify actuation of mitigation actions per Annex GG or Annex 101.DVN as applicable.

All installation instruction information required to comply with Annex GG shall be provided in the form of a table or a single figure without reference to a formula.

For add on heat pumps with flammable refrigerants, the instructions shall include the following:

– instruction for installation of the critical-to-safety wiring connection of the leak detection sensor or leak detection system to the furnace assembly. The wiring shall be not less than 18 AWG with a minimum insulation thickness of 1.58 mm or protected from damage. Critical-to-safety wiring is any field installed wiring necessary to fulfill the requirements of Annex GG in the event of detection of a leak;

– shall not be installed on furnaces with an inductive electrical greater than L_e as calculated in Clause 22.116; and

– detection of a leak shall turn on the indoor fan at the highest available speed or turn it on to not less than Q_{min} as determined in Annex GG. Consult furnace manufacturer.

For ADD ON HEAT PUMP applications the declared maximum operating temperature shall be marked on the unit.

For appliances with REFRIGERANT DETECTION SYSTEMS, the instructions shall include the following:

– for REFRIGERANT DETECTION SYSTEMS, the function and operation and required servicing measures;

– for LIMITED LIFE REFRIGERANT SENSORS used in REFRIGERANT DETECTION SYSTEMS, the specified end-of-life and replacement instructions;

– REFRIGERANT SENSORS for REFRIGERANT DETECTION SYSTEMS shall only be replaced with sensors specified by the appliance manufacture; and

– instructions to verify actuation of mitigation actions per Annex GG or Annex 101.DVN as applicable.

The following additional information shall be specified in the manual for ITE COOLING APPLIANCES that are in compliance with Annex 101.DVN using A2L refrigerants where the information is needed for the function of the manual and as applicable to the appliance:

– the instructions shall provide the minimum rated airflow of the appliance;

– instructions shall include the REFRIGERANT CHARGE m_c and minimum EFFECTIVE DISPERSAL VOLUME of the space to which the appliance can be utilized for the cooling of ITE AREAS. All dimensional data shall be provided in both SI and IP units. The minimum EFFECTIVE DISPERSAL VOLUME of the room shall be mentioned in the form of a table or a single figure. An equation may be additionally included;

– instructions shall state the proper installation of the appliance connecting to areas such as false ceilings, raised floors, or other partitioned air spaces, for use as the supply or return airflow, if the equipment is designed for such use in cooling an ITE AREA;

– instructions shall be provided for the calculation of the EFFECTIVE DISPERSAL VOLUME in accordance with Clause 101.DVN.8.1;

– a wiring diagram shall be provided with all ITE COOLING APPLIANCES to include all connections, logic diagrams and point to point diagrams;

– instructions for the proper use and installation of SAFETY SHUT-OFF VALVES shall be provided for an appliance with a REFRIGERANT CHARGE less than m_2;

– if the appliance has been evaluated to Annex 101.DVN and not Annex GG, instructions shall state that the appliances suitable for use in ITE applications such as for the cooling of ITE, DATACENTERS, COMPUTER ROOMS, ITE ROOMS, or other ITE AREAS only;

– instructions shall state that a service schedule shall be made to verify the safety systems of the appliance are working as intended, at a minimum interval of once per year;

– instructions shall recommend conducting a design failure mode and effects analysis of the circulation airflow path, in the ITE AREA, to ensure the velocity is at least 1 m/s for all operating conditions expected for the life of the ITE AREA;

– instructions shall state that equipment which contains refrigerant containing components and fans intended for the continuous circulation of air within the ITE AREAS may have power removed from the circulating air fans only for the purposes of servicing the equipment. If the appliances fans must be de-energized for more than 8 h, and the appliance's releasable amount of charge is greater than m_1, then the refrigerant charge shall be removed from the sections of the equipment that could release into the ITEF space;

– instructions shall state that when an output signal is provided for use in notifying the user that airflow is reduced according to Clause 101.DVN.6 or if a LEAK DETECTION SYSTEM or REFRIGERANT DETECTION SYSTEM has been activated according to Clause 101.DVN.7, that the user shall provide a notification means of receiving the output signal;

– instructions shall state that when an output signal is provided for use in notifying the user that airflow is reduced according to Clause 101.DVN.6 or if a LEAK DETECTION SYSTEM or REFRIGERANT DETECTION SYSTEM has been activated according to Clause 101.DVN.7, and if that signal is used for an alarm, the alarm shall comply with all national and local codes; and

– for units containing refrigerant parts that are intended for indoor applications away from the systems circulating air fans, the instruction shall state that the unit shall be:

• located in the CIRCULATION AIRFLOW of the space to connect the refrigerant containing components to that space;

• located in the CIRCULATION AIRFLOW of the space and use its incorporated mechanical fans to connect the refrigerant containing components to that space; or

• located in a room that is mechanically ventilated to another indoor space or to the outdoors in accordance with Clause 101.DVN.11.

DD.3.2 Unventilated areas

For appliances containing more than m_1 for any refrigerating circuit, the manual shall include a statement advising that an unventilated area where the appliance using FLAMMABLE REFRIGERANTS is installed shall be so constructed that should any refrigerant leak, it will not stagnate so as to create a fire or explosion hazard. This shall include:

– a warning that the non-FIXED APPLIANCE shall be stored in an area where the room size corresponds to the room area as specified for operation;

– a warning that the non-FIXED APPLIANCE shall be stored in a room without continuously operating open flames (for example an operating gas appliance) or other POTENTIAL IGNITION SOURCES (for example an operating electric heater, hot surfaces);

– a warning that if appliances with A2L REFRIGERANTS connected via an air duct system to one or more rooms are installed in a room with an area less than A_{min} as determined in Clause GG.2, that room shall be without continuously operating open flames (for example an operating gas appliance) or other POTENTIAL IGNITION SOURCES (for example an operating electric heater, hot surfaces). A flame-producing device may be installed in the same space if the device is provided with an effective flame arrest;

– for appliances using A2L REFRIGERANTS connected via an air duct system to one or more rooms, a warning with the substance of the following: “Auxiliary devices which may be a POTENTIAL IGNITION SOURCE shall not be installed in the duct work. Examples of such POTENTIAL IGNITION SOURCES are hot surfaces with a temperature exceeding X °C and electric switching devices”;

NOTE X is the maximum allowable surface temperature as defined in 22.117.

– for appliances using A2L REFRIGERANTS connected via an air duct system to one or more rooms, a warning that only auxiliary devices approved by the appliance manufacturer or declared suitable with the refrigerant shall be installed in connecting ductwork. The manufacturer can list in the instructions all approved auxiliary devices by the manufacturer and model number for use with the specific appliance, if those devices have a potential to become an ignition source.

The manufacturer should specify other potential continuously operating sources known to cause ignition of the refrigerant used.

The appliance shall be stored so as to prevent mechanical damage from occurring.

DD.3.2DV.1 D1 ***Modification of Clause DD.3.2 of the Part 2 by replacing the fifth dashed item with the following:***

– for appliances using A2L refrigerants connected via an air duct system to one or more rooms, a warning that only auxiliary devices approved by the appliance

manufacturer or declared suitable with the refrigerant shall be installed in connecting ductwork. The manufacturer shall list in the instructions all approved auxiliary devices by manufacturer and model number for use with the specific appliance, if those devices have a potential to become an ignition source.

DD.3.2DV.2 D1 *Modification of Clause DD.3.2 of the Part 2 by adding the following dashed items:*

– non-duct connected appliances containing A2L refrigerants with the supply and return air openings in the conditioned space may have the body of the appliance may be installed in open areas such as false ceilings not being used as return air plenums, as long as the conditioned air does not directly communicate with the air of the false ceiling.

– for duct connected appliances, false ceilings or drop ceilings may be used as a return air plenum if a REFRIGERANT DETECTION SYSTEM is provided in the appliance and any external connections are also provided with a sensor immediately below the return air plenum duct joint.

The preceding two dashed items do not apply to ITE COOLING APPLIANCES complying with Annex 101.DVN.

DD.3.2DV.3 D1 *Modification of Clause DD.3.2 of the Part 2 by replacing the third dashed item with the following:*

– a warning that if appliances connected via an air duct system to one or more rooms with A2L REFRIGERANTS are installed in a room with an area less than A_{min} as determined in Clause GG.2, or installed in a room with an EFFECTIVE DISPERSAL VOLUME V_{ED} less than the minimum as determined by Clause 101.DVN.8, that room shall be without continuously operating open flames (e.g. an operating gas appliance) or other POTENTIAL IGNITION SOURCES (for e.g. an operating electric heater, hot surfaces). A flame-producing device may be installed in the same space if the device is provided with an effective flame arrest.

DD.3.2DV.4 D1 *Modification of Clause DD.3.2 of the Part 2 by replacing the first dashed item with the following:*

– a warning that the NON-FIXED APPLIANCE shall be stored in an area where the room size corresponds to the room area, or room volume if complying with Annex 101.DVN, as specified for operation;

DD.3.2DV.5 D1 *Modification of Clause DD.3.2 of the Part 2 by adding the following:*

For equipment that requires connection to a water supply, the manufacturers installation instructions shall specify the quality of water that is required for this operation. Additionally, the instructions shall specify that if a potable water source is used for the equipment's water supply, the source water supply shall be protected against back siphonage by the equipment.

DD.3.3 Qualification of workers

The manual shall contain specific information about the required qualification of the working personnel for maintenance, service and repair operations. Every working procedure that affects safety means shall only be carried out by competent persons according to Annex HH.

Examples for such working procedures are:

• breaking into the refrigerating circuit;

• opening of sealed components;

• opening of ventilated enclosures.

DD.4 Information on servicing

DD.4.1 General

The manual shall contain specific information for service personnel according to DD.4.2 to DD.4.10.

DD.4.2 Checks to the area

Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimised. For repair to the REFRIGERATING SYSTEM, DD.4.3 to DD.4.7 shall be completed prior to conducting work on the system.

DD.4.3 Work procedure

Work shall be undertaken under a controlled procedure so as to minimise the risk of a flammable gas or vapour being present while the work is being performed.

DD.4.4 General work area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

DD.4.5 Checking for presence of refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

DD.4.6 Presence of fire extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO_2 fire extinguisher adjacent to the charging area.

DD.4.7 No ignition sources

No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the

surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. “No Smoking” signs shall be displayed.

DD.4.8 Ventilated area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

DD.4.9 Checks to the refrigerating equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer’s maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer’s technical department for assistance.

The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

– the actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed;

– the ventilation machinery and outlets are operating adequately and are not obstructed;

– if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;

– marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;

– refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

DD.4.10 Checks to electrical devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

Initial safety checks shall include:

• that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;

• that no live electrical components and wiring are exposed while charging, recovering or purging the system;

• that there is continuity of earth bonding.

DD.5 Repairs to sealed components

DD.5.1 During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to

have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

DD.5.2 Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatus is mounted securely.

Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications.

DD.5DV D1 ***Modification of Clause DD.5 of the Part 2 by replacing it with the following:***

Sealed electrical components shall be replaced.

DD.6 Repair to intrinsically safe components

Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use.

Intrinsically safe components are the only types that can be worked on while live in the presence of a flammable atmosphere. The test apparatus shall be at the correct rating.

Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.

NOTE The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

DD.6DV D1 ***Modification of Clause DD.6 of the Part 2 by replacing it with the following:***

Intrinsically safe components must be replaced.

DD.7 Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

DD.8 Detection of flammable refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the *LFL*

of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

NOTE Examples of leak detection fluids are

– bubble method,

– fluorescent method agents.

If a leak is suspected, all naked flames shall be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to Clause DD.9.

DD.9 Removal and evacuation

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for FLAMMABLE REFRIGERANTS it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to:

• remove refrigerant;

• purge the circuit with inert gas (optional for A2L);

• evacuate (optional for A2L);

• purge with inert gas (optional for A2L);

• open the circuit by cutting or brazing.

The REFRIGERANT CHARGE shall be recovered into the correct recovery cylinders. For appliances containing FLAMMABLE REFRIGERANTS other than A2L REFRIGERANTS, the system shall be purged with oxygen-free nitrogen to render the appliance safe for FLAMMABLE REFRIGERANTS. This process may need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing FLAMMABLE REFRIGERANTS, other than A2L REFRIGERANTS, REFRIGERANTS purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum. This process shall be repeated until no refrigerant is within the system. When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. This operation is absolutely vital if brazing operations on the pipe-work are to take place.

Ensure that the outlet for the vacuum pump is not close to any POTENTIAL IGNITION SOURCES and that ventilation is available.

DD.9DV D1 ***Modification of the Clause DD.9 in the Part 2 by replacing it with the following:***

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:

– safely remove refrigerant following local and national regulations;

– evacuate;

– purge the circuit with inert gas (optional for A2L);

– evacuate (optional for A2L);

– continuously flush or purge with inert gas when using flame to open circuit; and

– open the circuit.

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.

The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

DD.10 Charging procedures

In addition to conventional charging procedures, the following requirements shall be followed.

• Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimise the amount of refrigerant contained in them.

• Cylinders shall be kept in an appropriate position according to the instructions.

• Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.

• Label the system when charging is complete (if not already).

• Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

DD.11 Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

a) Become familiar with the equipment and its operation.

b) Isolate system electrically.

c) Before attempting the procedure, ensure that:

- mechanical handling equipment is available, if required, for handling refrigerant cylinders;
- all personal protective equipment is available and being used correctly;
- the recovery process is supervised at all times by a competent person;
- recovery equipment and cylinders conform to the appropriate standards.

d) Pump down refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with instructions.

h) Do not overfill cylinders (no more than 80 % volume liquid charge).

i) Do not exceed the maximum working pressure of the cylinder, even temporarily.

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

DD.12 Labelling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

DD.13 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, FLAMMABLE REFRIGERANTS. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt.

The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that FLAMMABLE REFRIGERANT does not remain within the lubricant. The evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

DD.13DV D1 ***Modification of Clause DD.13 of the Part 2 by replacing the third, fourth and fifth paragraphs with the following:***

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the flammable refrigerant. If in doubt, the manufacturer should be consulted. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition.

The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Annex EE
(normative)

Pressure tests

EE.1 General

All REFRIGERATING SYSTEM parts shall withstand the MAXIMUM ALLOWABLE PRESSURE expected in NORMAL OPERATION, abnormal operation, and standstill.

A compressor tested for compliance with IEC 60335-2-34 need not be additionally tested.

Compliance is checked by the following tests.

For all tests of Clause 21, if the refrigerant is a blend, the test pressure of EE.4.2 shall be carried out at the highest pressure under the specified temperature.

The test value that is the maximum of Clauses EE.2, EE.3 or EE.4 shall be used for the test of EE.4.2, respectively, for the high side and the low side components.

EE.2 Pressure test value determined under testing carried out in Clause 11

A REFRIGERATING SYSTEM component that is exposed to pressure shall be subjected to measurement of the MAXIMUM ALLOWABLE PRESSURE developed in the REFRIGERATING SYSTEM when tested under the conditions specified in Clause 11.

The pressure test value shall be at least three times the MAXIMUM ALLOWABLE PRESSURE developed during operation under Clause 11.

EE.3 Pressure test value determined under testing carried out in Clause 19

A refrigerating system component that is exposed to pressure shall be subjected to measurement of the maximum allowable pressure developed in the refrigerating system when tested under the conditions specified in Clause 19

The pressure test value shall be at least three times the maximum allowable pressure developed during abnormal operation (see Clause 19).

EE.4 Pressure test value determined under testing carried out under standstill conditions

EE.4.1 In order to determine the standstill pressure, the appliance shall be soaked in the highest operating temperature specified by the manufacturer for 1 h with power off.

A REFRIGERATING SYSTEM component that is exposed only to low side pressure shall be subjected to measurement of the MAXIMUM ALLOWABLE PRESSURE developed in the REFRIGERATING SYSTEM under the condition of standstill.

The pressure test value shall be at least three times the MAXIMUM ALLOWABLE PRESSURE developed during standstill.

Pressure gauges and control mechanisms need not be subjected to the test, provided the parts meet the requirements of the component.

EE.4.2 The pressure test shall be carried out on three samples of each component. The test samples are filled with a liquid, such as water, to exclude air and are connected in a hydraulic pump system. The

pressure is raised gradually until the required test pressure is reached. The pressure is maintained for at least 1 min, during which time the sample shall not leak.

Where gaskets are employed for sealing parts under pressure, leakage at gaskets is acceptable, provided the leakage only occurs at a value greater than 120 % of the MAXIMUM ALLOWABLE PRESSURE and the test pressure is still reached for the specified time. Additional sealing measures, such as an “O” ring, for pressure testing may be provided.

EE.5 Fatigue test option for Clause EE.1 and EE.4.2

EE.5.1 The components shall be subjected to a test at 66,7 % of the test pressure determined by Clauses EE.2, EE.3 or EE.4, provided the components comply with the fatigue test in Clause EE.5. This test is conducted on a separate sample.

EE.5.2 Three samples of each refrigerant-containing part shall be tested at the cyclic pressure values specified in EE.5.7 and EE.5.8 for the number of cycles specified in EE.5.6, as described in EE.5.4.

EE.5.3 The samples shall be considered to comply with EE.5.5 on completion of the test and if they do not rupture, burst, or leak.

EE.5.4 The 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. The pressure shall reach the specified upper and lower values during each cycle. The shape of the pressure cycle shall be such that the upper and lower pressure values shall be maintained for at least 0,1 s.

NOTE For safety purposes, it is suggested that a non-compressible fluid is used for the test. The fluid fills the sample completely to prevent any significantly remaining gas.

If the operating temperatures of the appliance under the conditions of steady state operation of Clause 11 are less than or equal to 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the component part or assembly shall be at least 20 °C. If the continuous operating temperature of the component exceeds 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the parts or assemblies that are at these temperatures, and subjected to the pressure, shall be at least 25 °C greater than the temperature of the part measured during the test of Clause 11 for copper or aluminium and 60 °C higher for steel. For other materials, the effects of temperature on the material fatigue characteristics shall be evaluated by conducting the test at the higher temperatures and considering the material characteristics at the higher temperatures.

EE.5.5 The pressure for the first cycle shall be the maximum evaporating pressure for LOW-PRESSURE SIDE components or the maximum condensing pressure for the HIGH-PRESSURE SIDE components.

EE.5.6 The total number of cycles shall be 250 000. The test pressures shall be determined by EE.5.7 (except the first and last cycles as noted in EE.5.5 and EE.5.8).

EE.5.7 The pressure for the test cycles shall be as follows:

a) For components subject to high side pressures, the upper pressure value shall not be less than the saturated vapour pressure of the refrigerant at 50 °C and the lower pressure value shall not be greater than the saturated vapour pressure of the refrigerant at 5 °C. For hot water HEAT PUMPS, the upper pressure shall not be less than 80 % of the MAXIMUM ALLOWABLE PRESSURE under the conditions of Clause 11.

b) For components subjected to only low side pressures, the upper pressure value shall be not less than the saturated vapour pressure of the refrigerant at 30 °C and the lower pressure value shall be between 0 bar and the greater of 4,0 bar or the saturated vapour pressure of the refrigerant at –13 °C.

EE.5.8 For the final test cycle, the test pressure shall be increased to two times the minimum upper pressure specified in EE.5.7.

NOTE The objective is to avoid a test value that is a negative pressure but to require a lower pressure value of the saturated vapour pressure at –13 °C or 4,0 bar, whichever is greater.

EE.1DV D1 *Modification of Annex EE of the Part 2 by replacing with the following:*

EE.1DV General

All REFRIGERATING SYSTEM parts shall withstand the maximum pressure in NORMAL OPERATION, abnormal operation, and standstill.

The maximum allowable pressure marked on the system shall be not less than the maximum pressure developed during operation under Clause 11, under Clause 19 and during standstill. See Clause EE.2DV.

A compressor tested and found to comply with UL 60335-2-34 or CSA C22.2 No. 60335-2-34 need not be additionally tested.

Compliance is checked by the tests in Clause EE.3DV or EE.4DV.

All tested samples shall not leak. Where gaskets are employed for sealing parts under pressure, leakage at gaskets is acceptable, provided the leakage only occurs at a value greater than 120 % of the maximum allowable pressure and the test pressure is still reached for the specified time. Additional sealing measures, such as an "O" ring, for pressure testing may be provided.

Pressure gauges and control mechanisms need not be subjected to the test, provided the parts meet the requirements of the component.

EE.2DV Determination of standstill pressure

In order to determine the standstill pressure, the appliance shall be soaked at the highest operating temperature specified by the manufacturer for 1 h with power off.

A REFRIGERATING SYSTEM component that is exposed only to low side pressure can be exposed to a higher pressure under the condition of standstill than under NORMAL OPERATION.

CO_2 (R744) systems are exempt from the requirements of this Clause.

EE.3DV Strength pressure test

The test pressure shall be at least three times the marked maximum allowable pressure.

The pressure test shall be carried out on three samples of each component. The test samples are filled with a liquid, such as water, to exclude air and are connected in a hydraulic pump system. The pressure is raised gradually until the required test pressure is reached. The pressure is maintained for at least 1 min.

EE.4DV Fatigue test

The components shall be subjected to a test at 2 times the marked maximum allowable pressure, provided the components comply with the fatigue test. This test is conducted on a separate sample.

Three samples of each refrigerant-containing part shall be tested. The total number of cycles shall be 500 000.

The 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. The pressure shall reach the specified upper and lower values during each cycle. The shape of the pressure cycle shall be such that the upper and lower pressure values shall be maintained for at least 0,1 s.

If the operating temperatures of the appliance under the conditions of steady state operation of Clause 11 are less than or equal to 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the component part or assembly shall be at least 20 °C. If the continuous operating temperature of the component exceeds 125 °C for copper or aluminium, or 200 °C for steel, the test temperature of the parts or assemblies that are at these temperatures, and subjected to the pressure, shall be at least 25 K greater than the temperature of the part measured during the test of Clause 11 for copper or aluminium and 60 K higher for steel. For other materials, the effects of temperature on the material fatigue characteristics shall be evaluated by conducting the test at the higher temperatures and considering the material characteristics at the higher temperatures.

The pressure for the first cycle shall be the marked maximum allowable pressure.

The pressure for the test cycles shall be as follows:

a) For components subject to high side pressures, the upper pressure value shall not be less than the saturated vapor pressure of the refrigerant at 50 °C and the lower pressure value shall not be greater than the saturated vapor pressure of the refrigerant at 5 °C. For sanitary hot water heat pumps, the upper pressure shall not be less than 80 % of the marked maximum allowable pressure under the conditions of Clause 11.

b) For components subjected to only low side pressures, the upper pressure value shall be not less than the saturated vapor pressure of the refrigerant at 30 °C and the lower pressure value shall be between 0 bar and the greater of 4,0 bar or the saturated vapor pressure of the refrigerant at –13 °C.

NOTE The objective is to avoid a test value that is a negative pressure but to require a lower pressure value of the saturated vapor pressure at –13 °C or 4,0 bar, whichever is greater.

For the final test cycle, the test pressure shall be to two times the pressure determined in a) or b).

Note: If parts meet the national standard for their intended use and have a pressure rating of at least the value of the maximum pressure in normal operation, abnormal operation, and stand still the part is considered to comply with Annex EE.

Annex FF
(normative)

Leak simulation tests

FF.1 General

A leakage of refrigerant is simulated at the most critical point in the REFRIGERATING SYSTEM. The method to simulate a leakage at the most critical point is to inject refrigerant vapour through a suitable capillary tube at that point. A critical point is a joint in the refrigerant system tubing, a bend of more than 90°, or other point judged to be a weak point in the refrigerant containing system due to the thickness of the metal, exposure to damage, sharpness of a bend or the manufacturing process. A quantity of refrigerant leaked is equal to the rated REFRIGERANT CHARGE or the amount that will leak as determined by test. The refrigerant is injected at the most critical point and the most unfavourable direction at ambient temperature (20 °C to –25 °C). Where *LFL* is referenced in this annex, the *LFL* shall be taken at the nominal composition as specified in ISO 817.

FF.2 Test methods

FF.2.1 The appliance is modified by introducing a simulated leak through a capillary tube. The leak rate shall be maintained at 25 % ± 5 % of the REFRIGERANT CHARGE in 1 min.

FF.2.2 During this test, the appliance is switched off or operated under NORMAL OPERATION at RATED VOLTAGE, whichever gives the most unfavourable result unless a prepurge is activated prior to energizing any loads, in which case the test shall be conducted with the appliance operating. During a test where the appliance is operating, refrigerant gas injection is started at the same time as the appliance is switched on.

FF.2.3 For refrigerant blends, the test shall be carried out using the nominal composition as defined in ISO 817.

If a zeotropic blend is used, the test is conducted maintaining the composition within a reasonable range. It is acceptable to use liquid phase of the blend extracted from the bottle then evaporated. Gas phase release with the pressure regulator from a large mixed gas tank is the best method, but care has to be taken to avoid any condensation occurring in the vessel.

FF.2.4 The test is conducted in a room that is draft free and of sufficient size to conduct the test.

The minimum volume (V) is:

$$V = (15 \times m_c) / LFL \qquad \text{(FF.1)}$$

where

V is the minimum volume in m^3 with a ceiling height not less than 2,2 m;

m_c is the REFRIGERANT CHARGE in kg;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3.

The quantity of gas injected shall be measured with acceptable accuracy. Weighing the bottle is required.

Care shall be taken that the installation of the capillary tube does not unduly influence the results of the test and that the structure of the appliance does not unduly influence the results of the test.

The instrument used for monitoring the refrigerant gas concentration shall have a fast response to the gas concentration, typically 2 s to 3 s and shall be located so as to not unduly influence the results of the test.

If gas chromatography is used to measure the refrigerant gas concentrations, the gas sampling in confined areas shall not exceed 2 ml every 30 s.

FF.2.5 The measured concentration of refrigerant gas surrounding the component shall not exceed 25 % of the *LFL* of the refrigerant gas, and shall not exceed 15 % of the *LFL* of the refrigerant gas for a time period of 5 min or the duration of the test if less than 5 min during and after the amount has been injected. The measured concentration of refrigerant gas surrounding a component that will not function during the prepurge time may exceed the 25 % of the *LFL* during the prepurge time. The *LFL* is as specified in Annex BB for the refrigerant used.

Annex FF.DV D1 ***Modification of Annex FF of the Part 2 by replacing with the following.***

FF.1DV General

A leakage of refrigerant is simulated in the REFRIGERATING SYSTEM at the POTENTIAL LEAK POINTS. The method to simulate a leakage at the POTENTIAL LEAK POINTS is to inject refrigerant vapor through a suitable tubing at that point.

Piping is not considered to be POTENTIAL LEAK POINTS within the area of the appliance to be evaluated if it complies with all of the following:

– is protected from potential damage during NORMAL OPERATION, service and maintenance;

– has no connecting joints; and

– has no bends with centreline bend radius less than 2,5 times the external pipe diameter.

Note: For general requirements about *LFL* and composition of refrigerants used for tests see Clause 1DV.4, Clause 4DV.1, and Table BB.1DV.

FF.2DV Test methods

FF.2.1DV ***The appliance is modified by introducing a simulated leak through a tube with an internal diameter that results in a refrigerant gas velocity of (30 -5/+0) m/s.***

The quantity of refrigerant leaked, m_{FF}, is the releasable charge at the POTENTIAL LEAK POINT, equal to the smallest of:

– the refrigerant charge, m_c;

– the releasable charge, m_{REL}, as determined by Annex 101.DVQ or 101.DVN; or

– for parts of ENHANCED TIGHTNESS REFRIGERATING SYSTEMS using A2L REFRIGERANT which can leak into the appliance, 10 kg.

The leak rate shall be maintained at the smallest of either:

– 25 % of the refrigerant leaked per minute (25 % × m_{FF} / min);

– 10 kg/min; or

– for parts of ENHANCED TIGHTNESS REFRIGERATING SYSTEMS using A2L REFRIGERANTS which can leak into the appliance, 10 kg/h.

The leak shall be maintained until the quantity of refrigerant leaked, m_{FF}, has leaked. The average leak rate over the duration of the release time shall be within ± 5 % of the required rate. When evaluated over a time interval not to exceed 10 s, the instantaneous or short-term average leak rate shall be within ± 25 % of the required rate.

The ambient temperature shall be (15 °C to 35 °C) and the refrigerant shall be injected at the most unfavourable POTENTIAL LEAK POINT and the most unfavourable direction.

F.2.2DV *During this test, the appliance is switched off or operated under NORMAL OPERATION at RATED VOLTAGE. If airflow is activated before any potential ignition sources are activated, then the test is not conducted with the appliance switched off. During a test where the appliance is operating, refrigerant gas injection is started at the same time as the appliance is switched on.*

In "switched off" mode, the appliance shall remain connected to the mains and safety mitigation controls such as REFRIGERANT DETECTION SYSTEM and CIRCULATION AIRFLOW or SAFETY SHUT-OFF VALVES shall be allowed to function as intended.

FF.2.3DV *For refrigerant blends, the test shall be carried out using the nominal composition as defined in Clause 4DV.1.*

If a zeotropic blend is used, the test is conducted maintaining the composition within a reasonable range. It is acceptable to use liquid phase of the blend extracted from the bottle then evaporated. Gas phase release with the pressure regulator from a large mixed gas tank is the best method, but care has to be taken to avoid any condensation occurring in the vessel.

FF.2.4DV *The test is conducted in a room that is draft-free (less than 0.5 m/s airflow velocity prior to starting the simulated leak) and of sufficient size to conduct the test.* **The draft-free condition is intended to avoid undue influence on the test result.**

The room volume shall be:

– large enough that the concentration in the room above a horizontal plane defined by 100 mm below the potential ignition source shall not exceed 5 % of LFL during the test; or

– not exceed the volume determined per Equation FF.1.

For ducted appliances, the minimum room volume requirements do not apply, but the minimum room space for conducting the test shall extend not less than 1 m from any supply or return duct opening and a minimum ceiling height of 2.2 m. No obstruction is allowed within 1 m from the return and supply air duct openings.

$$V = \frac{(15 \times m_{\mathrm{FF}})}{LFL} \qquad \textbf{(FF.1DV)}$$

where

V **is the volume in m^3 with a ceiling height not less than 2,2 m**

m_{FF} **is the quantity of refrigerant leaked as defined in FF.2.1DV in kg**

LFL **is the lower flammability limit in kg/m^3**

The leak rate and total quantity of gas injected shall be measured.

NOTE 1DV For example, use a mass flow meter with totalizer function, or a scale to weigh the refrigerant cylinder versus time at suitable time increments.

Care shall be taken that the installation of the simulated leak tubing does not unduly influence the results of the test and that the structure of the appliance does not unduly influence the results of the test.

The instrument used for monitoring the refrigerant gas concentration shall have a t(90) response time of faster than 3 s ≤ t(90) ≤ 15 s and shall be located so as to not unduly influence the results of the test.

Note: If an instrument has response time to a step change of *t*(90) < 3 s, then a low pass filter may be applied to reduce the effective response time.

If gas chromatography is used to measure the refrigerant gas concentrations, the gas sampling in confined areas shall not exceed 2 ml every 30 s.

FF.2.5DV ***The concentration of refrigerant gas surrounding any component that can be an ignition source shall be measured during the simulated leak and for a period of 5 min after the end of the release. The measured concentration shall not exceed the values in Table FF.1DV.***

Table FF.1DV
(normative)

For appliances using	A2L REFRIGERANTS	A2 or A3 refrigerants
Instantaneously at any time during the test duration	≤ 75 % of *LFL*	≤ 25 % of *LFL*
Continuously during any time period of 5 min	≤ 50 % of *LFL*	≤ 15 % of *LFL*

Annex GG
(normative)

Charge limits, ventilation requirements and requirements for secondary circuits

GG.1 Requirements for refrigerant charge limits

GG.1.1 General

When a FLAMMABLE REFRIGERANT is used, the requirements for installation space of appliance and/or ventilation requirements are determined according to

– the REFRIGERANT CHARGE (m_c) used in the appliance,

– the installation location,

– the type of ventilation of the location or of the appliance.

Symbol m_c denotes the REFRIGERANT CHARGE of a single REFRIGERATING SYSTEM. Where multiple REFRIGERATING SYSTEMS are servicing the same space, the REFRIGERATING SYSTEM with the largest REFRIGERANT CHARGE shall be used.

Where the parameters LOWER FLAMMABILITY LIMIT (*LFL*) and molecular weight (*M*) are referenced in Annex GG, the values used shall be based on WCF – Worst Case Formulation as defined in ISO 817.

NOTE 1 Table GG.1 is provided as guidance when applying Annex GG.

NOTE 2 The factors in the formulas are in cubic meters and are the incremental room sizes that relate to increasing REFRIGERANT CHARGE and the type of ventilation permitted or required for the room that avoid reaching the LOWER FLAMMABILITY LIMIT, if the entire REFRIGERANT CHARGE is released and mixed with the room air. The formulas governing the REFRIGERANT CHARGE are based on a consideration of non-uniform mixing, if the refrigerant is heavier or lighter than air.

NOTE 3 For the *LFL* of a refrigerant not included in Annex BB, it is referred to ISO 817. If the *LFL* is also not listed in ISO 817, the method to determine the *LFL* of a blend refrigerant is defined in ISO 817.

NOTE 4 Determine the column for indoor or outdoor application. The requirements are identified in the appropriate box and the product and installation requirements are identified.

NOTE 5 The requirements applicable to a higher REFRIGERANT CHARGE are permitted for each range in Table GG.1.

Table GG.1
Outline of Annex GG (informative)

Refrigerant charge	Direct system [a]				Indirect system [b]
	Indoor space			Outdoors	
	Refrigerant charge and room area	Refrigerant charge, room area and additional requirements	Additional ventilation		
$m_c \leq m_1$	No room size restriction			No room size restriction	No room size restriction, GG.6
$m_1 < m_c \leq 2 \times m_1$ (NON-FIXED APPLIANCE)	Not allowed	GG.7	Not allowed		
$m_1 < m_c \leq m_2$	GG.2.1	G.G.2.2[c], GG.9[c], GG.10[c,d]	GG.3, GG.8[c], GG.10[c,d]		
$m_2 < m_c \leq m_3$	Not allowed	GG.9[c], GG.10[c,d]	GG.3, GG.8[c], GG.10[c,d]		
$m_c > m_3$	Beyond the scope of this standard. National standards apply				

[a] Direct system means a REFRIGERATING SYSTEM in which a single rupture of the refrigerant circuit results in a refrigerant release to a space, irrespective of the location of the refrigerant circuit.

[b] Indirect system means a REFRIGERATING SYSTEM in which a single rupture of the refrigerant circuit does not leak into an indoor space, irrespective of the location of the refrigerant circuit.

[c] These clauses are only applicable to appliances with A2L REFRIGERANT.

[d] REFRIGERANT CHARGE is limited to $m_1 < m_c \leq 4 \times m_2$.

GG.1.1DV.1 D2 ***Modification of Clause GG.1.1 of the Part 2 by adding a new dashed item after the first dashed item:***

– the releasable charge (m_{REL}),

GG.1.1DV.2 D2 ***Modification of Class GG.1.1 by adding the following after the last dashed item:***

For appliances with multiple REFRIGERATING SYSTEMS, each REFRIGERATING SYSTEM shall be evaluated independently

Where multiple values of A_{min} are found based on different operating states, the highest value shall be A_{min} for the appliance.

NOTE 1 This can be the case when different measures are used under different operating states. (e.g. When continuous airflow is applied during an active operation state, and releasable charge is applied during standstill.)

Where the parameters LOWER FLAMMABILITY LIMIT (*LFL*) and molecular weight (*M*) are referenced in Annex GG, the values used shall be based on Worst Case Formulation (WCF) as specified in Annex BB.

Toxicity charge limits shall be determined per ISO 5149-1. If the toxicity-based charge limits are less than the flammability-based charge limits, the toxicity charge limits shall take precedence.

For appliances with a refrigerant charge of $m_c \leq m_1$, no minimum room area is required and Clause GG.6 does not apply.

For appliances where leaked refrigerant does not enter the indoor space, no minimum room area is required.

If RELEASABLE CHARGE is determined by Annex 101.DVQ or GG.10:

– for RELEASABLE CHARGE $m_{REL} \leq m_1$, there is no requirement for minimum room area, A_{min}, and Clause GG.6 does not apply.

– for RELEASABLE CHARGE $m_{REL} > m_1$, each operating state of the REFRIGERATING SYSTEM shall comply with at least one of the clauses: GG.2, GG.3, GG.4, GG.7, GG.9. The refrigerant charge mc may be replaced by the releasable charge m_{REL} in the equations of Annex GG.

NOTE 2 Table GG.1 is provided as guidance when applying Annex GG. Determine the column for indoor or outdoor application. The requirements are identified in the appropriate box where the product and installation requirements are identified.

NOTE 3 The requirements applicable to a higher refrigerant charge are permitted for each range in Table GG.1.

Table GG.1DV D2 *Modification of Table GG.1 of the Part 2 by replacing it with the following:*

Table GG.1DV
Outline of Annex GG (informative)

Refrigerant charge	Direct system [a,e]				Indirect system [b]
	Indoor space			Outdoors	
	Refrigerant charge and room area	Refrigerant charge, room area and additional requirements	Additional ventilation		
$m_c \leq m_1$ or $m_{REL} \leq m_1$	No room size restriction			No room size restriction	No room size restriction, GG.2.1DV; GG.6
$m_1 < m_c \leq 2 \times m_1$ (appliances which are not FIXED APPLIANCES)	Not allowed	GG.7	Not allowed		
$m_1 < m_c \leq m_2$	GG.2.1	G.G.2.2[c], GG.2.3[e], GG.9[c], GG.10[c,d]	GG.3, GG.8[c], GG.10[c,d]		
$m_2 < m_c \leq m_3$	Not allowed	GG.9[c], GG.10[c,d]	GG.3, GG.8[c], GG.10[c,d]		
$m_c > m_3$	ITE Annex 101.DVN; Machinery Room; Clause GG.2.1DV				

[a] Direct system means a REFRIGERATING SYSTEM in which a single rupture of the refrigerant circuit results in a refrigerant release to an indoor space, irrespective of the location of the refrigerant circuit.

[b] Indirect system means a REFRIGERATING SYSTEM in which a single rupture of the refrigerant circuit does not leak into an indoor space, irrespective of the location of the refrigerant circuit.

[c] These clauses are only applicable to appliances with A2L REFRIGERANT.

[d] Refrigerant charge is limited to $m_1 < m_c \leq m_3$.

[e] For ITE COOLING APPLIANCES using A2L REFRIGERANTS with REFRIGERANT CHARGE $m_c > m_1$, Annex 101.DVN shall apply as applicable.

GG.1.1DV.3 D2 *Modification of Clause GG.1.1 of the Part 2 by adding the following:*

In no case shall the refrigerant charge limit determined in accordance with Annex GG or Annex 101.DVN exceed the refrigerant charge limit determined in accordance with ANSI/ASHRAE 15 (USA), ANSI/ASHRAE 15.2 (USA) or CSA B52 (Canada).

NOTE 4: The refrigerant charge limit determined in accordance with ANSI/ASHRAE 15, ANSI/ASHRAE 15.2, and CSA B52 accounts for the flammability, toxicity, and oxygen depriving properties of the refrigerant.

GG.1.1DV.4 D2 *Modification of Clause GG.1.1 of the Part 2 by replacing the third paragraph with the following note:*

Note: For general requirements about *LFL* and molar mass (*M*) see Clause 1DV.4, Clause 4DV.1, and Table BB.1DV.

GG.1.2 Determination of the case applicable

Determine the case applicable based on the relationship of the REFRIGERANT CHARGE (m_c) and m_1, m_2, m_3, defined as follows:

$$m_1 = 4 \times LFL \quad \text{(GG.1)}$$

$$m_2 = 26 \times LFL \quad \text{(GG.2)}$$

$$m_3 = 130 \times LFL \quad \text{(GG.3)}$$

where *LFL* is the LOWER FLAMMABILITY LIMIT in kg/m^3 for the refrigerant used.

For A2L REFRIGERANTS, m_1, m_2, m_3 is defined as follows:

$$m_1 = 6 \times LFL \quad \text{(GG.4)}$$

$$m_2 = 52 \times LFL \quad \text{(GG.5)}$$

$$m_3 = 260 \times LFL \quad \text{(GG.6)}$$

where *LFL* is the LOWER FLAMMABLE LIMIT in kg/m^3 for the refrigerant used.

If an appliance with A2L REFRIGERANT has more than one REFRIGERATING SYSTEM, REFRIGERANT CHARGE (m_c) refers to the REFRIGERATING SYSTEM with the largest charge serving the same space.

GG.1.2DV.1 D2 *Modification of Clause GG.1.2 of the Part 2 by replacing equation (GG.1) with the following:*

$$m_1 = 3 \times LFL \quad \textbf{(GG.1DV)}$$

GG.1.2DV.2 D2 *Modification of Clause GG.1.2 of the Part 2 by adding the following:*

For an appliance using A2L refrigerants, if the appliance is a NON-FIXED SEALED SINGLE PACKAGE UNIT. Equation GG.4 shall be replaced with:

$$m_1 = 3 \times LFL \quad \textbf{(GG.2DV)}$$

GG.1.3 Determination of unventilated room area for appliances using A2L refrigerants

For the purpose of determination of room area (A) when used to calculate the MAXIMUM allowable REFRIGERANT CHARGE (m_{max}) in an unventilated space, the following shall apply.

The room area (A) shall be defined as the room area enclosed by the projection to the floor of the walls, partitions and doors of the space in which the appliance is installed.

Spaces connected by only drop ceilings, ductwork, or similar connections shall not be considered a single space.

For units mounted higher than 1,6 m, and in compliance with G.G.2.2, spaces divided by partition walls which are no higher than 1,6 m shall be considered a single space.

For FIXED APPLIANCES, rooms on the same floor and connected by an open passageway between the spaces can be considered a single room when determining compliance to A_{min}, if the passageway complies with all of the following.

• It is a permanent opening.

• It extends to the floor.

• It is intended for people to walk through.

For FIXED APPLIANCES, the area of the adjacent rooms, on the same floor, connected by permanent opening in the walls and/or doors between occupied spaces, including gaps between the wall and the floor, can be considered a single room when determining compliance to A_{min}, provided all of the following are met.

• The space shall have appropriate openings according to GG.1.4.

• The minimum opening area for natural ventilation Anv_{min} shall not be less than the following:

$$Anv_{min} = \frac{m_c - m_{max}}{LFL \times 104} \times \sqrt{\frac{A}{g \times m_{max}} \times \frac{M}{M - 29}} \qquad \text{(GG.7)}$$

where

Anv_{min} is the minimum opening for natural ventilation in m^2;

m_c is the actual REFRIGERANT CHARGE of refrigerant in the system in kg;

m_{max} is the allowable MAXIMUM REFRIGERANT CHARGE in the system in kg, calculated according to Clause GG.2 or m_2, whichever is lower;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3;

A is the room area in m^2;

M is the molar mass of the refrigerant

g is the gravity acceleration of 9,81 m/s^2;

29 is the average molar mass of air in kg.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.1.3DV.1 D1 ***Modification of Clause GG.1.3 of the Part 2 by replacing "Clause GG.2 or m_2" with "Clause GG.2.1.1DV or m_2"***

GG.1.3DV.2 D1 ***Modification of Clause GG.1.3 of the Part 2 by adding the following bullet items after the last bullet in the sixth paragraph.***

• The room into which refrigerant can leak, plus the connected adjacent room(s) shall have a total area of not less than A_{min} per Clause GG.2.1.

• The room area in which the unit is installed shall be not less than 20 % A_{min} as determined in Clause GG.2.1.

GG.1.3DV.3 D1 ***Modification of the fourth paragraph of Clause GG.1.3 of the Part 2 by replacing the first occurrence of "1.6 m" with "1.8 m".***

GG.1.3.DV.4 D1 ***Modification of Clause GG.1.3 of the Part 2 by adding the statement "104 is a constant" after the "29 is the average molar mass of air in kg".***

GG.1.4 Opening conditions for connected rooms and natural ventilation

When the openings for connected rooms or natural ventilation are required, the following conditions shall be applied.

• The area of any openings above 300 mm from the floor shall not be considered in determining compliance with Anv_{min}.

• At least 50 % of the required opening area Anv_{min} shall be below 200 mm from the floor.

• The bottom of the lowest openings shall not be higher than the point of release when the unit is installed and not more than 100 mm from the floor.

• Openings are permanent openings which cannot be closed.

• The height of the openings between the wall and floor which connect the rooms are not less than 20 mm.

• A second higher opening shall be provided. The total size of the second opening shall not be less than 50 % of minimum opening area for Anv_{min} and shall be at least 1,5 m above the floor.

NOTE The requirement for the second opening can be met by drop ceilings, ventilation ducts, or similar arrangements that provide an airflow path between the connected rooms.

GG.1.4DV D1 ***Modification of Clause GG.1.4 of the Part 2 by replacing the fifth bullet with the following:***

– For openings extending to the floor the height shall not be less than 20 mm above the surface of the floor covering.

GG.2 Requirements for charge limits in unventilated areas

GG.2.1 General

Clause GG.2 is applicable for appliances with a REFRIGERANT CHARGE $m_1 < m_c \leq m_2$ and for NON-FIXED FACTORY SEALED SINGLE PACKAGE UNITS with a REFRIGERANT CHARGE of $m_1 < m_c \leq 2 \times m_1$:

See Figure GG.1.

For NON-FIXED FACTORY SEALED SINGLE PACKAGE UNITS with a REFRIGERANT CHARGE of $m_1 < m_c \leq 2 \times m_1$, the requirements of Clause GG.7 apply.

For systems using A2L REFRIGERANTS with a REFRIGERANT CHARGE of $m_1 < m_c \leq m_3$ that comply with the conditions in 22.125, the requirements of Clause GG.10 can apply.

For other appliances with a REFRIGERANT CHARGE of $m_1 < m_c \leq m_2$:

The MAXIMUM REFRIGERANT CHARGE in a room shall be in accordance with the following:

$$m_{\max} = 2{,}5 \times (LFL)^{(5/4)} \times h_0 \times (A)^{1/2}, \text{ not to exceed } m_{\max} = SF \times LFL \times h_0 \times A \quad \text{(GG.8)}$$

or the required minimum floor area A_{min} to install an appliance with REFRIGERANT CHARGE m_c (kg) shall be in accordance with following:

$$A_{\min} = (m_c / (2{,}5 \times (LFL)^{(5/4)} \times h_0))^2, \text{ not less than } A_{\min} = m_c / (SF \times LFL \times h_0) \quad \text{(GG.9)}$$

where

m_{max} is the allowable MAXIMUM REFRIGERANT CHARGE in a room, in kg;

m_c is the REFRIGERANT CHARGE in appliance, in kg;

A_{min} is the required minimum room area, in m^2;

A is the room area, in m^2;

LFL is the LOWER FLAMMABILITY LIMIT, in kg/m^3;

SF is a safety factor with a value of 0,75;

h_0 is the release height, the vertical distance in meters from the floor to the point of release when the appliance is installed (see Figure GG.5).

$h_0 = (h_{inst} + h_{rel})$ or 0,6 m, whichever is higher.

h_{rel} is the RELEASE OFFSET in meters from the bottom of the appliance to the point of release (see Figure GG.5). Cumulative openings smaller than 5 cm^2 and openings with a single dimension of not more than 0,1 mm are not considered as openings where leaking refrigerant can escape. Openings for routing of wires and tubing which are not sealed openings shall include the total area of the opening without consideration of the area occupied by the tubing or wire.

h_{inst} is the INSTALLED HEIGHT in meters of the unit (see Figure GG.5).

Reference INSTALLED HEIGHTS are given below:

h_{inst} = 0,0 m for portable and floor mounted;

h_{inst} = 1,0 m for window mounted;

h_{inst} = 1,8 m for wall mounted;

h_{inst} = 2,2 m for ceiling mounted.

If the minimum INSTALLED HEIGHT given by the manufacturer is higher than the reference INSTALLED HEIGHT, then in addition A_{min} and m_{max} for the reference INSTALLED HEIGHT have to be given by the manufacturer. An appliance may have multiple reference INSTALLED HEIGHTS. In this case, A_{min} and m_{max} calculations shall be provided for all applicable reference INSTALLED HEIGHTS.

For appliances serving one or more rooms with an air duct system, the lowest opening of the duct connection to each conditioned space or any opening of the indoor unit greater than 5 cm^2, at the lowest position to the space, shall be used for h_0. However, h_0 shall not be less than 0,6 m. A_{min} shall be calculated as a function of the opening heights of the duct to the spaces and the REFRIGERANT CHARGE for the spaces where leaked refrigerant may flow to, considering where the unit is located. A_{min} shall be calculated for the spaces where a duct is connected or an indoor unit is located. If all spaces have room area more than respective A_{min}, no further measure is required. If any room area of spaces is below A_{min}, measures according to Clause GG.8 or GG.9 shall be provided for appliances using A2L REFRIGERANTS.

NOTE This formula is not applicable for refrigerants lighter than 42 kg/kmol.

GG.2.1DV D2 ***Modification of Clause GG.2.1 of the Part 2 by replacing with the following:***

GG.2.1DV General

The REFRIGERANT CHARGE (m_c) in each REFRIGERATING SYSTEM employing A2 and A3 REFRIGERANTS shall not exceed m_1.

The REFRIGERANT CHARGE (m_c) in each REFRIGERATING SYSTEM employing A2L refrigerants shall not exceed m_3 except as follows:

For appliances installed in machinery rooms as defined in ANSI/ASHRAE 15 (USA) or CSA B52 (Canada) with a refrigerant charge of $m_c > m_3$, the requirements of ANSI/ASHRAE 15 (USA) or CSA B52 (Canada) shall apply. The subsequent Clauses GG.2.1.1DV through GG.13 shall not apply. All other requirements of this standard shall apply.

For appliances where leaked refrigerant cannot enter the space or the air-stream connected to the space, no additional active mitigation is required and GG.6 shall apply. The requirements of ANSI/ASHRAE 15 (USA) or CSA B52 (Canada) shall apply when $m_c > m_3$.

For ITE COOLING APPLIANCES with a refrigerant charge of $m_c > m_3$, the requirements of Annex 101.DVN shall apply.

The REFRIGERANT CHARGE in each refrigerant system for non-fixed factory sealed single package units using A2L REFRIGERANTS shall not exceed 2 × m_1. For charges of $m_1 < m_c \leq 2 \times m_1$, the requirements of Clause GG.7 shall apply.

ITE COOLING APPLIANCES using A2L refrigerants with charge $m_c \leq m_3$, shall comply with Annex GG or Annex 101.DVN as specified by the manufacturer.

For the determination of m_{max} as used in equation (GG.7) in Clause GG.1.3 of the Part 2, Clause GG.2.1.1DV applies.

For fixed appliances using A2L REFRIGERANT with a refrigerant charge of $m_1 \leq m_c \leq m_2$, the requirements of Clause GG.2.1.1 apply. If each space has room area more than A_{min}, no further measure is required. If the room area is less than A_{min}, additional mitigation is required.

For fixed appliances serving a single room using A2L REFRIGERANT with a refrigerant charge of $m_2 \leq m_c \leq m_3$ or when additional mitigation is required by GG.2.1.1DV, Clause G.G.2.2 shall apply if applicable. For fixed appliances with a refrigerant charge of $m_1 \leq m_c \leq m_3$, Clause GG.8, GG.9, or GG.10 shall apply if applicable.

For fixed appliances serving one or more rooms with an air duct system, using A2L refrigerant with a refrigerant charge of $m_1 < m_c \leq m_3$, the requirements of Clauses GG.2.1.1DV and GG.9 shall apply if applicable. If the total conditioned space has an area more than TA_{min}, no further measure is required. If the total conditioned space is less than TA_{min}, Clause GG.8 shall apply if applicable.

For non-fixed factory sealed single package units with a refrigerant charge of $m_1 < m_c \leq 2 \times m_1$, the requirements of Clause GG.7 shall apply.

For ENHANCED TIGHTNESS REFRIGERANT SYSTEM APPLIANCES, including non-ducted and those serving one or more rooms with an air duct system, using A2L refrigerants with a refrigerant charge of $m_1 < m_c \leq m_3$ that comply with the conditions in Clause 22.125. the requirements of Clause GG.10 can apply.

For appliances with a refrigerant charge of $m_c \leq m_1$ no mitigation is required. Appliances with a refrigerant releasable charge of $m_{REL} \leq m_1$ no additional mitigation is required.

GG.2.1.1DV Charge limits for appliance in unventilated areas

The maximum refrigerant charge in a room shall be in accordance with the following:

$$m_{max} = 2{,}5 \times (LFL)^{(5/4)} \times h_0 \times (A)^{1/2}, \text{ not to exceed } m_{max} = SF \times LFL \times h_0 \times A \quad \textbf{(GG.3DV)}$$

Alternatively, the required minimum floor area A_{min} to install an appliance with refrigerant charge m_c (kg) shall be in accordance with following:

$$A_{min} = (m_c / (2{,}5 \times (LFL)^{(5/4)} \times h_0))^2, \text{ not less than } A_{min} = m_c / (SF \times LFL \times h_0) \quad \textbf{(GG.4DV)}$$

where

m_{max} is the allowable maximum refrigerant charge in a room, in kg

m_c is the refrigerant charge in the appliance, in kg

A_{min} is the required minimum room area, in m_2

A is the room area, in m_2

2,5 is a constant

LFL **is the lower flammability limit, in kg/m^3**

SF **is a safety factor with a value of 0,50**

h_0 is the release height, the vertical distance in meters from the floor to the point of release when the appliance is installed (see Figure GG.5)

$h_0 = (h_{inst} + h_{rel})$ or 0,6 m whichever is higher

h_{rel} is the release offset in meters from the bottom of the appliance to the point of release (see Figure GG.5). Cumulative openings smaller than 5 cm^2 and openings with a single dimension of not more than 0,1 mm are not considered as openings where leaking refrigerant can escape. Openings for routing of wires and tubing which are not sealed openings shall include the total area of the opening without consideration of the area occupied by the tubing or wire

h_{inst} is the installed height in meters of the unit (see Figure GG.5)

Reference installed heights are given below:

h_{inst} = 0,0 for floor mounted

h_{inst} = 1,0 m for window mounted

h_{inst} = 1,8 m for wall mounted

h_{inst} = 2,2 m for ceiling mounted

If the minimum installed height given by the manufacturer is higher than the reference installed height, then in addition A_{min} and m_{max} for the reference installed height shall be given by the manufacturer. An appliance may have multiple reference installed heights. In this case, A_{min} and m_{max} calculations shall be provided for all applicable reference installed heights.

For appliances serving one or more rooms with an air duct system, the lowest opening of the duct connection to each conditioned space or any opening or cumulative openings in the indoor unit greater than 5 cm^2, at the lowest position to the space, shall be used for h_0. Amin shall be calculated as a function of the opening heights of the duct to the spaces and the refrigerant charge for the spaces where leaked refrigerant can flow to, considering where the unit is located. A_{min} shall be calculated for the spaces where a duct is connected, or an indoor unit is located. If all spaces have room area more than A_{min}, no further measure is required.

G.G.2.2 Appliances using A2L refrigerants with incorporated circulation airflow

G.G.2.2.1 General

Incorporated CIRCULATION AIRFLOW applies to fixed appliances only.

When the fan incorporated to an appliance is continuously operated or operation is initiated by a REFRIGERANT DETECTION SYSTEM with a sufficient CIRCULATION AIRFLOW rate (see also Table GG.2), the MAXIMUM REFRIGERANT CHARGE can be increased or minimum room area can be reduced according to the following:

The MAXIMUM REFRIGERANT CHARGE in a room shall be in accordance with the following:

$$m_{max} = 0{,}75 \times LFL \times h_{ra} \times A \quad \text{(GG.10)}$$

or the required minimum room area A_{min} of installed appliance with REFRIGERANT CHARGE m_c (kg) shall be in accordance with following;

$$A_{min} = m_c / (0{,}75 \times LFL \times h_{ra}) \quad \text{(GG.11)}$$

where

m_{max} is the allowable MAXIMUM REFRIGERANT CHARGE in the system in kg;

m_c is the actual REFRIGERANT CHARGE in the system in kg;

A_{min} is the required minimum room area in m^2;

h_{ra} is the estimate reaching height of airflow in m;

A is the room area in m^2;

LFL is the lower flammability limit in kg/m^3.

Table GG.2
Circulation airflow

Appliances	Airflow direction φ[c] (°)	Airflow		Estimated reaching height h_{ra}[b] (m)
		Minimum velocity[a] v (m/s)	Minimum airflow rate (m^3/h)	
All	Downwards $-90° \le \varphi \le 0°$	1	$30 \times m_c/LFL$	h_a
Installed with lower edge of air inlet within 0,2 m from the floor	Upwards $0° < \varphi \le 90°$			$h_a + h_d$
h_a is the air delivery height in upper side in m. h_d is the dynamic reaching height of airflow in m.				
[a] Velocity shall be calculated as airflow divided by the nominal face area of the outlet. The grill area shall not be deducted. [b] h_{ra} shall not exceed 2,2 m. [c] See Figure GG.6 for examples.				

$$h_d = \left(1 + \frac{2{,}35}{LFL(1 - \frac{1{,}2}{\rho}) + 0{,}05}\right) \times (0{,}0183 \times v^2 \times \sin^2\varphi) \quad \text{(GG.12)}$$

where

v is the CIRCULATION AIRFLOW velocity in m/s;

φ is the CIRCULATION AIRFLOW elevation angle from horizontal in degrees (0° ≤ φ ≤ 90°);

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3;

ρ is the gas density of the refrigerant at atmospheric pressure and 25 °C in kg/m^3.

See Figure GG.6.

GG.2.2.1DV D2 *Modification of Clause GG.2.2.1 of the Part 2 by replacing with the following:*

When the fan incorporated in an appliance is

– initiated by a refrigerant detection system with a sufficient circulation airflow rate; or

- continuous when the indoor releasable charge is greater than m_1.

the maximum refrigerant charge can be increased or minimum room area can be reduced according to following.

The minimum circulation airflow velocity shall be 1 m/s. The velocity shall be calculated as airflow divided by the nominal face area of the outlet. The grill area shall not be deducted.

The minimum circulation airflow shall be;

$$Q_{\min} = 30 \times m_c / LFL \qquad \textbf{(GG.5DV)}$$

where

Q_{min} is the minimum circulation airflow in m_3h

m_c is the actual refrigerant charge amount in the system in kg

***LFL* is the lower flammability limit in kg/m^3**

The maximum refrigerant charge in a room shall be in accordance with the following:

$$m_{\max} = SF \times LFL \times h_0 \times A \qquad \textbf{(GG.6DV)}$$

Alternatively, the required minimum room area A_{min} of installed appliance with refrigerant charge m_c (kg) shall be in accordance with following:

$$A_{\min} = m_c / (SF \times LFL \times h_0) \qquad \textbf{(GG.7DV)}$$

where

m_{max} is the allowable maximum refrigerant charge in the system in kg

m_c is the actual refrigerant charge in the system in kg

A_{min} is the required minimum room area in m^2

h_o is the release height, the vertical distance from the floor to the point of release when the appliance is installed in *m*

A is the room area in m^2

***SF* is a safety factor with a value of 0,50**

***LFL* is the lower flammability limit in kg/m^3**

Compliance with Q_{min} shall be determined by the fan table for the unit.

GG.2.2.2 Continuous circulation airflow

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

• Disable the compressor operation.

• Warn user that airflow is reduced.

Compliance is checked by inspection.

GG.2.2.2DV D1 *Modification of Clause GG.2.2.2 of the Part 2 by replacing it with the following:*

Continuous circulation airflow

The indoor fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced below Q_{min}, the following actions shall be taken:

– provide an output signal that airflow is reduced;

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

Compliance is checked by inspection

GG.2.2.3 Circulation airflow activated by a refrigerant detection system

If a REFRIGERANT DETECTION SYSTEM is activated per Annex LL, the following actions shall be taken and continue for at least 5 min after the REFRIGERANT DETECTION SYSTEM has reset:

• The fan shall be switched on.

• Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

Where a remote REFRIGERANT DETECTION SYSTEM is used in a room with multiple units, all of the detection system activated safety measures shall be applied to all units in the room which rely on the remote REFRIGERANT DETECTION SYSTEM.

Compliance is checked by inspection.

GG.2.2.3DV D2 *Modification of Clause GG.2.2.3 of the part 2 by replacing with the following:*

If a LEAK DETECTION SYSTEM is activated, the following actions shall be taken and continue for at least 5 min after the LEAK DETECTION SYSTEM has reset:

– the fan shall be energized within 10 s following the input signal to turn on the fan

– Q_{min} shall be confirmed by fan curve analysis at 0.0" or lowest listed external static pressure.

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

Compliance is checked by inspection.

GG.3 Requirements for charge limits in areas with mechanical ventilation

Clause GG.3 is applicable for appliances with a REFRIGERANT CHARGE of $m_1 < m_c \leq m_3$.

See Figure GG.2.

Mechanical ventilation applies to FIXED APPLIANCES only.

Mechanical ventilation occurs when the appliance enclosure or the room is provided with a ventilating system that, in the event of a leak, is intended to vent refrigerant into an area where there is not a POTENTIAL IGNITION SOURCE and the gas can be readily dispersed. The appliance enclosure shall have a ventilation system that produces airflow within the appliance enclosure and meets the requirements of Clause GG.4 or is intended to be installed in a room that meets the requirements of Clause GG.5.

GG.3DV DR *Modification of Clause GG.3 of the Part 2 by replacing the last sentence of the last paragraph with the following:*

The appliance enclosure shall have a ventilation system that produces airflow within the appliance enclosure and meets the requirements of Clause GG.4, or if installed in a machinery room meets the requirements of Clause GG.5.

GG.4 Requirements for mechanical ventilation within the appliance enclosure

The refrigerating circuit is provided with a separate enclosure that does not allow flow from inside the enclosure to the room. The appliance enclosure shall have a ventilation system that produces airflow from the appliance interior to the outside through a ventilation shaft. The manufacturer shall specify the ventilation shaft width and height, the maximum length and number of bends. The negative pressure measurement in the interior of the appliance enclosure shall be 20 Pa or more and the flow rate to the exterior shall be at least Q_{min}.

$$Q_{\min} = S \times 15\,(24{,}5 \times m_c / M) \ \text{(with a minimum of } 2 m^3/h) \qquad \text{(GG.13)}$$

where

S is a safety factor of 4;

M is the molar mass of refrigerant in g/mol;

Q_{min} is the minimum required volume flow of the ventilation in m^3/h;

m_c is the REFRIGERANT CHARGE;

24,5 is the gas constant in l/mol;

15 is the conversion from per minute to per hour with 4 min scenario.

NOTE 1 The constant 15 above is based on the assumptions used for the charge size formulas, i.e. releasing the full REFRIGERANT CHARGE within 4 min.

NOTE 2 For blends, the molar mass is the mole fraction weighted average of the molar masses of the components.

Compliance for the appliance ventilation system is checked by the following tests.

The appliance shall be installed in accordance with the instructions and the ventilation shaft shall not exceed the maximum length and number of bends specified by the manufacturer.

The room shall be at least 10 times the volume of the appliance and with sufficient make-up air to replace any air exhausted during the test. The air pressure differential is measured between the interior of the appliance enclosure and the room. The airflow rate shall be measured at the outside end of the ventilation shaft.

Ventilation shall be to the outside or to a room with a minimum volume as specified under the unventilated area case.

The airflow is detected continuously or monitored continuously and the appliance or the motor compressor is switched off within 10 s in the event that the airflow is reduced below Q_{min},

or

The ventilation is switched on by a refrigerant detection system before 25 % of the LFL (LOWER FLAMMABILITY LIMIT) is obtained. The sensor shall be suitably located considering the density of the refrigerant and periodically proved in accordance to the instructions. The airflow is periodically checked and detected and the appliance or the motor compressor is switched off within 10 s in the event that the airflow is reduced below Q_{min}.

GG.4DV D1 *Modification of Clause GG.4 of the Part 2 by replacing it with the following:*

Requirements for mechanical ventilation within the appliance enclosure

The refrigerating circuit is provided with a separate enclosure that does not allow flow from inside the enclosure to the room. The appliance enclosure shall have a ventilation system that produces airflow from the appliance interior to the outside through an exhaust ventilation duct. The manufacturer shall specify the exhaust ventilation duct dimensions, the maximum length and number of bends. The negative pressure measurement in the interior of the appliance enclosure shall be 20 Pa or more and the flow rate to the exterior shall be at least Q_{min}:

$$Q_{\min} = 3\ 600 \times 1 / CF \times 24{,}5 / M \times \dot{m}_{\text{leak}} \ (\text{with a minimum of } 2\text{m}^2 / \text{h}) \qquad \textbf{(GG.8DV)}$$

where

3 600 is a conversion of seconds to hours

CF is a concentration factor with a value of 0,25

M is the molar mass of refrigerant in kg/kmol

Q_{min} is the minimum required volume flow of the ventilation in m^3/h

24,5 is the universal gas constant R multiplied by temperature of 25 °C and divided by pressure of 101,325 kPa in l/mol

$\dot{m}_{leak}$ is the leak rate in kg/s

For REFRIGERATING SYSTEMS which are not enhanced tightness REFRIGERATING SYSTEMS, the leak rate, $\dot{m}_{leak}$, shall be determined as follows:

$$\dot{m}_{leak} = m_c / 240 \qquad \text{(GG.9DV)}$$

where

m_c is the refrigerant charge in kg

240 is the 4 min release time in s

For enhanced tightness REFRIGERATING SYSTEMS, the leak rate, $\dot{m}_{leak}$, shall be determined as:

$\dot{m}_{leak}$ = 0,00278 kg/s

Ventilation shall be to the outside or to a room with a minimum volume as specified in GG.2, Equation (GG.4DV).

The ventilation shall run continuously, other than for short periods for maintenance and service. The airflow shall be monitored continuously. Within 10 s in the event that the airflow is reduced below Q_{min}, the following actions shall be taken:

– provide output signal that airflow is reduced; or

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released into the enclosure.

The ventilation is switched on by a REFRIGERANT DETECTION SYSTEM and the following actions shall be taken and continue for at least 5 min after the REFRIGERANT DETECTION SYSTEM has reset:

– energize the fan(s) of the appliance to deliver airflow at or above the minimum airflow Q_{min}; or

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the enclosure.

Compliance for the appliance ventilation system is checked by the following tests.

The appliance shall be installed in accordance with the instructions and the ventilation shaft shall not exceed the maximum length and number of bends specified by the manufacturer.

The room shall be at least 10 times the volume of the appliance and with sufficient make-up air to replace any air exhausted during the test. The air pressure differential is measured between the interior of the appliance enclosure and the room. The airflow rate shall be measured at the outside end of the ventilation shaft.

GG.5 Requirements for mechanical ventilation for rooms complying with ISO 5149

Machinery rooms shall meet the requirements of Clause 5 of ISO 5149-3:2014.

GG.5DV D1 ***Modification of Clause GG.5 of the Part 2 by replacing with the following:***

Requirements for mechanical ventilation for machinery rooms.

Ventilation for machinery rooms shall comply with applicable sections of ANSI/ASHRAE 15 (USA) or CSA B52 (Canada).

GG.6 Requirements for refrigerating systems employing secondary heat exchangers

If a FLAMMABLE REFRIGERANT is used and the system contains a secondary HEAT EXCHANGER, the HEAT EXCHANGER shall not allow the release of refrigerant into areas served by the secondary HEAT EXCHANGER fluid if these areas are covered by Annex GG. The following may be considered to comply with this requirement:

– an open loop secondary system vented to the outside; or

– an automatic air/refrigerant separator and pressure relief valve is placed in the secondary circuit on the outlet pipe from the EVAPORATOR or the CONDENSER. The air/refrigerant separator and pressure relief valve is at a high level relative to the outlet of the HEAT EXCHANGER where leaked refrigerant may accumulate. The pressure relief valve shall have a flow rating rated to discharge the refrigerant that can be released through the HEAT EXCHANGER. The air/refrigerant separator and pressure relief valve shall discharge the refrigerant into a space compliant with the charge limitations in Annex GG or to the outside; or

– a double wall HEAT EXCHANGER, or

– a refrigerant system where the pressure of the secondary circuit is always greater than the pressure of the primary circuit in the area of contact, or

– the bursting of the secondary HEAT EXCHANGER is avoided by

1) the use of a freezing protection device (testing of which is described in item 2) below) which considers

- fluid freezing point;
- distribution through the HEAT EXCHANGER;
- glide of the evaporating refrigerant;
- service procedures that could lead to freeze damage, for example adding or removing the refrigerant in liquid phase from a HEAT EXCHANGER containing standing water;

2) specifying requirements for specific properties of the secondary HEAT EXCHANGER fluid to prevent corrosion, including:

• water: the manufacturer shall specify in the installation manual the water quality necessary for the specified HEAT EXCHANGER;

• brine: the manufacturer shall specify in the installation manual the type of brine and its permitted concentration range for which the HEAT EXCHANGER is suitable.

An appliance whose HEAT EXCHANGERS may be damaged as a result of freezing (i.e. water to water HEAT PUMPS, water to air HEAT PUMPS or chillers) shall be tested as follows:

a) The appliance shall be allowed to run under stable conditions. The volume flow through the EVAPORATOR shall be monitored.

b) The circulation pump will be switched off.

c) The freezing protection device shall switch off the compressor.

d) After 1 min, the circulation pump will be switched on again and the compressor will restart.

e) The procedures of items b) and d) shall be repeated 10 times.

f) After 10 repetitions, the volume flow through the EVAPORATOR shall not be lower than the flow measured in item a). Allowance for the measurement tolerance has to be taken into account.

g) The appliance shall be tested with the minimum water flow at the RATED VOLTAGE and frequency under the following temperature conditions.

• The water outlet is set just above the lowest cut out (taking into account tolerances) of the safety devices for protection against freezing of the EVAPORATOR.

• The CONDENSER side is set so as to get the lowest condensation temperature within the NORMAL OPERATION range.

• The test equipment shall be set so that there is no automatic adjustment of the water flow on the EVAPORATOR side.

• The appliance shall operate continuously for a period of 6 h. During 6 h, none of the following conditions, indicating the start of freezing, shall appear:

1) the water flow on the EVAPORATOR side will not drop more than 5 % compared to the initial water flow;

2) the evaporating temperature will not drop more than 2 K;

3) the temperature difference between inlet and outlet water temperature of the EVAPORATOR will not drop more than 30 % compared to the initial temperature difference.

The appliance shall then be tested with a maximum water flow under the conditions described in item g).

GG.6DV D1 *Modification of Clause GG.6 of the Part 2 by replacing it with the following:.*

If a FLAMMABLE REFRIGERANT is used and the system contains a secondary HEAT EXCHANGER, the HEAT EXCHANGER shall not allow the release of refrigerant into areas served by the secondary HEAT EXCHANGER fluid.

Compliance shall be by at least one of the following:

– an open loop secondary system vented to the outside;

– an automatic air/refrigerant separator and pressure relief valve placed in the secondary circuit on the outlet pipe from the EVAPORATOR or the CONDENSER. The air/refrigerant separator and pressure relief valve is at a high level relative to the outlet of the HEAT EXCHANGER where leaked refrigerant can accumulate. The pressure relief valve shall have a flow rating rated to discharge the refrigerant that can be released through the HEAT EXCHANGER. The air/refrigerant separator and pressure relief valve shall discharge the refrigerant into a space compliant with the charge limitations in Annex GG, or Annex 101.DVN, or to the outside;

– a double wall HEAT EXCHANGER;

– a refrigerant system where the pressure of the secondary circuit is always greater than the pressure of the primary circuit in the area of contact; or

– the bursting of the secondary HEAT EXCHANGER is avoided by

1. specifying requirements for specific properties of the secondary HEAT EXCHANGER fluid to prevent corrosion, including:

• water: the manufacturer shall specify in the installation manual the water quality necessary for the specified HEAT EXCHANGER; and

• brine: the manufacturer shall specify in the installation manual the type of brine and its permitted concentration range for which the HEAT EXCHANGER is suitable.

2. the use of a freezing protection device which considers

• fluid freezing point;

• distribution through the HEAT EXCHANGER;

• glide of the evaporating refrigerant; and

• service procedures that could lead to freeze damage, (e.g. adding or removing the refrigerant in liquid phase from a HEAT EXCHANGER containing standing water).

An appliance whose HEAT EXCHANGERS may be damaged as a result of freezing (i.e. water to water HEAT PUMPS, water to air HEAT PUMPS or chillers) shall be tested as follows:

a) For unit with freeze or flow protection other than refrigerant temperature or refrigerant pressure-based freeze protection:

– The appliance shall be allowed to run under stable conditions. The volume flow through the EVAPORATOR shall be monitored;

– The circulation pump will be switched off;

– The freezing protection device shall switch off the compressor;

– After 1 min, the circulation pump will be switched on again and the compressor will restart;

– The procedures of items shall be repeated 10 times or until the system requires manual reset;

– After 10 repetitions, or until the system requires manual reset , the volume flow through the EVAPORATOR shall not be lower than the flow

measured in the first dash after item a). Allowance for the measurement tolerance shall be taken into account; and

– The appliance shall be tested with the minimum water flow at the RATED VOLTAGE and frequency under the following temperature conditions:

• The water outlet is set just above the lowest cut out (taking into account tolerances) of the safety devices for protection against freezing of the EVAPORATOR;

• The CONDENSER side is set so as to get the lowest condensation temperature within the NORMAL OPERATION range;

• The test equipment shall be set so that there is no automatic adjustment of the water flow on the EVAPORATOR side;

• The appliance shall operate continuously for a period of 1 h. During this time, none of the following conditions, indicating the start of freezing, shall appear:

1) the water flow on the EVAPORATOR side will not drop more than 5 % compared to the initial water flow;

2) the evaporating temperature will not drop more than 2 K; and

3) the temperature difference between inlet and outlet water temperature of the EVAPORATOR will not drop more than 30 % compared to the initial temperature difference.

b) For units employing a refrigerant temperature and/or refrigerant pressure-based freeze protection system:

– The appliance shall be tested at full load capacity with the minimum water flow at the rated voltage and frequency and under the following temperature condition:

• 'Pure water' freeze protection settings shall be enabled;

• The inlet water temp shall be 5 °C (41 °F) on source heat exchanger evaporators;

• The condenser side water or air temperature and flow is set to get the lowest condensation temperature within the NORMAL OPERATION range declared by the manufacturer; and

• The test equipment shall be set so that there is no automatic adjustment of the water flow on the evaporator side;

– The unit shall be allowed to run under stable conditions at minimum water flow as specified by the manufacturer. The volume flow through the source evaporator heat exchanger shall be monitored and recorded;

– The circulation pump will be switched off or water flow will be stopped;

– The freezing protection system shall switch off the compressor and lock out the unit so that the compressor will not restart without manual resetting of the system;

Note: Some systems can employ a "multiple fault-retry system" before finally locking the unit out.

– The unit lockout shall be manually reset as specified by the manufacturer and simultaneously the original water flow restored. Upon the successful unit compressor restarting, the evaporator flow rate shall be measured at not less than the original evaporator flow rate; and

– The appliance shall be tested with the minimum water flow at the RATED VOLTAGE and frequency under the following temperature conditions:

• The water outlet is set just above the lowest cut out (taking into account tolerances) of the safety devices for protection against freezing of the EVAPORATOR;

• The CONDENSER side is set so as to get the lowest condensation temperature within the NORMAL OPERATION range;

• The test equipment shall be set so that there is no automatic adjustment of the water flow on the EVAPORATOR side;

• The appliance shall operate continuously for a period of 1 h. During 1 h, none of the following conditions, indicating the start of freezing, shall appear:

1) the water flow on the EVAPORATOR side will not drop more than 5 % compared to the initial water flow;

2) the evaporating temperature will not drop more than 2 K; and

3) the temperature difference between inlet and outlet water temperature of the evaporator will not drop more than 30 % compared to the initial temperature difference.

GG.7 Non fixed factory sealed single package units with a refrigerant charge of $m_1 < m_c \leq 2 \times m_1$

GG.7.1 Determination of refrigerant charge

For non-FIXED FACTORY SEALED SINGLE PACKAGE UNITS (i.e. one functional unit in one enclosure) with a REFRIGERANT CHARGE of $m_1 < m_c \leq 2 \times m_1$, the MAXIMUM REFRIGERANT CHARGE in a room shall be in accordance with the following:

$$m_{max} = 0{,}25 \times A \times LFL \times 2{,}2 \qquad \text{(GG.14)}$$

or the required minimum floor area, A_{min}, to install an appliance with REFRIGERANT CHARGE m_c shall be in accordance with the following:

$$A_{min} = m_c / (0{,}25 \times LFL \times 2{,}2) \qquad \text{(GG.15)}$$

where

m_{max} is the allowable MAXIMUM REFRIGERANT CHARGE in a room in kg;

m_c is the REFRIGERANT CHARGE in the appliance in kg;

A_{min} is the required minimum room area in m^2;

A is the room area in m^2;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3, as referred in Annex BB;

2,2 is the minimum ceiling height employed in meters (m);

0,25 is a safety factor.

The appliance can be placed at any height above the floor.

When the appliance is switched on, a fan shall operate continuously supplying a minimum airflow as under normal steady state conditions, even when the compressor is switched off by the THERMOSTAT.

Compliance is checked by inspection.

GG.7.1DV.1 D1 ***Modify the statement that begins "LFL is the LOWER FLAMMABILITY LIMIT in kg/m³" in Clause GG.7.1 of the Part 2 by deleting ", as referenced in Annex BB".***

GG.7.1DV.2 D1 ***Modify Clause GG.7.1 of the Part 2 by replacing the last two paragraphs with the following:***

The minimum circulation airflow velocity shall be 1 m/s. The velocity shall be calculated as airflow divided by the nominal face area of the outlet. The grill area shall not be deducted.

The appliance shall incorporate a fan to provide a minimum CIRCULATION AIRFLOW of

$$Q_{min} = 30 \times m_c / LFL \qquad \textbf{(GG.10DV)}$$

where

Q_{min} is the minimum CIRCULATION AIRFLOW in m^3/h

***m_c* is the actual refrigerant charge amount in the system in kg**

***LFL* is the lower flammability limit in kg/m^3**

the fan shall either run continuously, even when the compressor is switched off by the THERMOSTAT, or the fan shall be activated by a REFRIGERANT DETECTION SYSTEM per Annex LL.

If a REFRIGERANT DETECTION SYSTEM is activated, the following actions shall be taken and continue for at least 5 min after the REFRIGERANT DETECTION SYSTEM has reset:

- **the fan shall be switched on; and**
- **disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.**

GG.7.2 Mechanical requirements

GG.7.2.1 General

The appliance shall withstand the effects of dropping and vibration during transport and normal use without leaking refrigerant.

The appliance is subjected to the tests of GG.7.2.2 to GG.7.2.5. There shall be no refrigerant leakage.

Compliance is checked by the following:

The use of detection equipment having an equivalent sensitivity of 3 g/year of refrigerant shall reveal no leaks.

The tests of GG.7.2.2, GG.7.2.3 and GG.7.2.4 may be carried out on the appliance charged with a non-FLAMMABLE REFRIGERANT or a non-hazardous gas.

GG.7.2.2 Random vibration test

The appliance is tested in its final packaging for transport and shall withstand a random vibration test for 180 min according to ASTM D 4728-06. The power spectral density profiles to be applied are those specified in Figure X1.1 and Table X1.1 of ASTM D 4728-06:2012 for truck transportation.

GG.7.2.3 Drop test with packaging

The appliance is tested in its final packaging for transport and shall withstand the following number of drops on a horizontal hardwood board 20 mm thick placed on a concrete or similar hard surface:

• one with the appliance held upright;

• one for each of the four edges of the bottom side, with the bottom side forming an angle of about 30° to the horizontal.

The drop height depends on the weight of the appliance according to the following Table GG.3:

Table GG.3
Appliance with packaging

Appliance weight kg	Drop height cm
< 10	80
≥ 10 and < 20	60
≥ 20 and < 30	50
≥ 30 and < 40	40
≥ 40 and < 50	30
≥ 50	20

GG.7.2.4 Drop test without packaging

The tests of GG.7.2.3 are repeated on the appliance without its packaging and with the drop height according to the following Table GG.4:

Table GG.4
Appliance without packaging

Appliance weight kg	Drop height cm
< 10	20
≥ 10 and < 20	17
≥ 20 and < 30	15
≥ 30 and < 40	12
≥ 40	10

GG.7.2.5 Test after installation

The appliance is installed in accordance with the installation instructions. It is supplied at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE and operated at ambient temperature.

The appliance is operated for 960 cycles, each cycle consisting of the compressor running for 10 min minimum followed by a rest period of 5 min minimum.

This test may be made on a separate sample.

GG.7.2.5DV D1 *Modification of Clause GG.7.2.5 of the Part 2 by adding the following:*

At the end of the test there shall be no refrigerant leak detected when checked with detection equipment with a capability of detecting 3 g per year of refrigerant, when measured in the off condition at ambient temperature.

GG.7.3 Vibration test

The appliance shall be constructed so that its operation does not cause resonance points in the piping connected to the compressor.

Compliance is checked by the following test:

The appliance is installed in accordance with the installation instructions. It is supplied at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE and operated at ambient temperature.

The supply frequency is increased in steps of 1 Hz between 0,9 times and 1,1 times the RATED FREQUENCY.

The vibration amplitude is measured at critical points in the piping. There shall be no sudden increase of the amplitude when increasing the supply frequency within the specified range.

NOTE 1 The vibration amplitude can be measured, for example, by sliding an arrow gauge along the piping. The arrow gauge is an isosceles triangle with a height equal to 10 times the base (see Figure GG.3) and is held against the piping with the arrow axis perpendicular to the direction of the vibration to be measured. The amplitude is the value of *A* (see Figure GG.4) divided by 10.

NOTE 2 Critical points are those with a larger vibration amplitude.

This test may be made on a separate sample.

GG.7.3DV D1 ***Modification of Clause GG.7.3 of the Part 2 by replacing with the following:***

Under NORMAL OPERATION, vibrations in refrigerant containing piping shall not exceed 0,30 G rms, when measured with a low pass filter at 200 Hz. The vibration acceleration shall be measured at critical points on the piping.

Compliance is checked by the following test.

The appliance is installed in accordance with the installation instructions. It is supplied at rated voltage or at the upper limit of the rated voltage range and operated at ambient temperature. The appliance shall be positioned in accordance with the manufacturer's instructions. Testing shall be conducted in the fan-only mode and in the heating and cooling mode, if applicable.

Vibration levels shall be measured over the full range, +5 % of the maximum speed and -5 % of the minimum speed, of the compressor and indoor fan speeds as allowed by the controls at +10 % and -10 % input frequency, in consideration of the operation modes. For compressors and fans with discrete steps in speed, the vibration shall be measured at each step, +10 % and -10 %. If the equipment trips on a protective device, the maximum speed and frequency may be reduced until the equipment stays on line as intended. Care should be taken that the measurement sensors do not influence the line vibration level, and that the rate of change of speed is sufficiently slow that the maximum vibration is captured.

This test may be made on a separate sample.

NOTE Critical points are those with a larger vibration amplitude.

GG.8 Ventilated area requirements for appliances using A2L refrigerants

GG.8.1 General

Clause GG.8 is applicable for appliances with a REFRIGERANT CHARGE $0 < m_c \leq m_3$.

Ventilation shall be employed when REFRIGERANT CHARGE is $m_c > m_{max}$.

Natural and mechanical ventilation apply to FIXED APPLIANCES only.

GG.8.2 Natural ventilation requirements for appliances using A2L refrigerants

GG.8.2.1 General

Natural ventilation shall be permitted for A2L refrigerants on the conditions as outlined in GG.8.2.2 and GG.8.2.3.

Subclause GG.8.2 is applicable for appliances with a REFRIGERANT CHARGE of $m_c < m_3$.

GG.8.2.2 Natural ventilation to occupied indoor space

If natural ventilation is applied in occupied space, all of the following shall be met.

– Natural ventilation shall be made to a room where sufficient air is available to dilute the refrigerant below the *LFL*.

– Natural ventilation from an occupied space shall not be made to outdoor.

NOTE User can block the natural ventilation to the outside if it is cold outside.

– For natural ventilation opening provided to an unoccupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation shall have a room area more than A_{min} according to Clause GG.2 for m_c. If the total room area is not large enough, the measure of GG.3 or Clause GG.9 shall be taken.

– The openings for natural ventilation shall comply with GG.1.4.

The minimum opening area for natural ventilation shall be calculated using the following equation:

$$Anv_{min} = \frac{m_c - m_{max}}{LFL \times 104} \times \sqrt{\frac{A}{g \times m_{max}} \times \frac{M}{M - 29}} \quad \text{(GG.16)}$$

where

Anv_{min} is the minimum opening area for natural ventilation in m^2;

m_c is the actual REFRIGERANT CHARGE in the system in kg;

m_{max} is the allowable MAXIMUM REFRIGERANT CHARGE for a system in kg calculated in accordance with Clause GG.2 or m_2, whichever is lower;

LFL is the LOWER FLAMMABILITY LIMIT (*LFL*) in kg/m^3;

A is the room area in m^2;

M is the molar mass of the refrigerant;

g is the gravity acceleration of 9,81 m/s^2.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.8.2.3 Natural ventilation to outdoors or unoccupied indoor space

If natural ventilation is applied in occupied space, all of the following shall be met.

– Natural ventilation to the outside is not allowed below ground level.

– For natural ventilation opening provided to an unoccupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation, shall have a room area more than A_{min} according to Clause GG.2 for m_c. If the total room area is not large enough, other measure of GG.8.3 or Clause GG.9 shall be taken.

– The openings for natural ventilation shall comply with GG.1.4.

– The minimum opening area for natural ventilation shall be calculated using the following equation:

$$m_{\max} = \frac{\left(\frac{Anv_{\min}}{0,14}\right)^2}{\frac{0,04}{LFL}} \quad \text{(GG.17)}$$

$$Anv_{\min} = 0,14 \times \sqrt{m_c \times \frac{0,04}{LFL}} \quad \text{(GG.18)}$$

where

m_c is the REFRIGERANT CHARGE of a system in kg;

m_{max} is the maximum REFRIGERANT CHARGE for a system in kg;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3;

Anv_{min} is the total minimum opening area in m^2;

0,14 is a constant derived from the gravity acceleration, flow coefficient, etc.;

0,04 is the conversion constant from hydrocarbon to other *LFL*.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.8.2.3DV D1 *Modification of Clause GG.8.2.3 by replacing it with the following:*

Natural ventilation to outdoors requirements for appliances using A2L refrigerants

NOTE Requirements for natural ventilation to the indoors can be found in GG.1.3 and GG.1.4.

If natural ventilation to outdoors is applied, all of the following shall be met.

– Natural ventilation to outdoors is not allowed below ground level.

– Natural ventilation from an occupied space shall not be made to outdoors.

NOTE User can block the natural ventilation to the outside if it is cold outside.

– The openings for natural ventilation shall comply with GG.1.4.

– The maximum refrigerant charge of a system, m_{max}, and minimum opening area, $A_{nv,min}$, for natural ventilation to outdoors shall be calculated using the following equations:

$$m_{\max} = \frac{\left(\frac{A_{nv}}{0,14}\right)^2}{\left(\frac{0,04}{LFL}\right)} \quad \textbf{(GG.11DV)}$$

$$A_{nv} = 0{,}14 \times \sqrt{m_c \times \frac{0{,}04}{LFL}} \qquad \textbf{(GG.12DV)}$$

where

m_c is the refrigerant charge of a system in kg

m_{max} is the maximum refrigerant charge for a system in kg

***LFL* is the lower flammability limit in kg/m^3**

A_{nv} is the opening area in m^2

0,14 is a constant derived from the gravity acceleration, flow coefficient, etc.

0,04 is the conversion constant from hydrocarbon *LFL* to other *LFL*

GG.8.3 Mechanical ventilation requirements for rooms with appliances using A2L refrigerants

GG.8.3.1 Operation of mechanical ventilation

Where mechanical ventilation is required, GG.8.3.1.1 or GG.8.3.1.2 shall apply.

GG.8.3.1DV D1 *Modify the title of Clause GG.8.3.1 of the Part 2 by adding "system" after the word "ventilation".*

GG.8.3.1.1 Continuous operation of the fan

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

– Warn user that airflow is reduced.

GG.8.3.1.1DV D1 *Modify Clause GG.8.3.1.1 of the Part 2 by replacing it with the following:*

The mechanical ventilation system fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced below Q_{min}, the following actions shall be taken:

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

– provided an output signal that airflow is reduced.

Compliance is checked by inspection.

GG.8.3.1.2 Fan activated by a refrigerant detection system

If a REFRIGERANT DETECTION SYSTEM is activated per Annex LL, the following actions shall be taken and continue for at least 5 min after the REFRIGERANT DETECTION SYSTEM has reset:

– The fan shall be switched on.

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

The REFRIGERANT DETECTION SYSTEM and controls shall maintain the purge cycle for at least 5 min after the REFRIGERANT DETECTION SYSTEM has reset.

GG.8.3.1.2DV D1 ***Modify Clause GG8.3.1.2 of the Part 2 by replacing it with the following:***

Mechanical ventilation system activated by a REFRIGERANT DETECTION SYSTEM

If a LEAK DETECTION SYSTEM is activated, the following actions shall be taken and continue for at least 5 min after the REFRIGERANT DETECTION SYSTEM has reset:

– energize the mechanical ventilation system of the appliance to deliver indoor airflow at or above the minimum airflow Q_{min};

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

Compliance is checked by inspection.

GG.8.3.2 Required airflow

The airflow shall be calculated using of the formula below. Losses caused by ducts or other components in the air stream shall be considered.

$$Q = \frac{m_c - m_{max}}{4 \times LFL} \times 2 \times 60 \qquad \text{(GG.19)}$$

where

Q is the required airflow volume in m^3/h;

m_{max} is the MAXIMUM REFRIGERANT CHARGE for the system in the room in kg according to Clause GG.2, or m_2, whichever is lower, or Clause GG.9;

m_c is the actual REFRIGERANT CHARGE of a single REFRIGERATING SYSTEM expressed in kg;

4 is the assumed leak time (4 min);

2 is a safety factor of 2;

60 is the conversion minutes to hours;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3.

Mechanical ventilation shall be made to the outdoor or the indoor space where the room volume is larger than the minimum room volume calculated using the following formula:

$$V = 4 \times m_c / LFL \quad \text{(GG.20)}$$

where

m_c is the REFRIGERANT CHARGE in kg;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3;

V is the minimum room volume in m^3;

4 is the assumed leak time (4 min).

GG.8.3.2DV D2 *Modification of Clause GG.8.3.2 of the Part 2 by replacing it with the following:*

The airflow shall be calculated using the equation. Losses caused by ducts or other components in the air stream shall be considered.

$$Q_{min} = \frac{m_c - m_{max}}{4 \times LFL} \times 2 \times 60 \quad \textbf{(GG.13DV)}$$

where

***Q*$_{min}$ is the required airflow volume in m^3/h**

***m*$_{max}$ is the maximum refrigerant charge for the system in the room in kg according to Equation (GG.3DV) or *m*$_2$, whichever is lower, or Clause GG.9, where applicable**

***m*$_c$ is the actual refrigerant charge of a single REFRIGERATING SYSTEM in kg**

4 is the assumed leak time (4 min)

2 is a safety factor of 2

60 is the conversion minutes to hours

***LFL* is the lower flammability limit in kg/m^3**

Mechanical ventilation shall be made to the outdoors or an indoor space where the room area is larger than the minimum area of the room to which the mechanical ventilation exhausts into, *EA*$_{min}$, calculated using the following equation:

$$EA_{min} = (m_c - m_{max}) / (CF \times LFL \times H) \quad \textbf{(GG.14DV)}$$

where

EA_{min} is the minimum area of the room to which the mechanical ventilation exhausts into in m^2

***CF* is the concentration factor with a value of 0,25**

m_c is the refrigerant charge in kg

m_{max} is the allowable maximum refrigerant charge in the system in kg

***H* is the height of the room = 2,2 m**

***LFL* is the lower flammability limit in kg/m^3**

GG.8.3.3 Requirement for opening

The lower edge of the opening of the mechanical ventilation shall not be more than 100 mm above the floor.

The air extraction openings shall be located at sufficient distance from the air intake openings to prevent re-circulation to the space.

GG.8.3.3DV D1 *Modification of Clause GG.8.3.3 of the Part 2 by replacing with the following*

For mechanical ventilation as specified in Clause GG.8.3, the lower edge of openings extracting air from the room shall not be more than 100 mm above the floor.

The openings supplying makeup air to the room shall be located such that the supplied makeup air mixes with the leaked refrigerant.

When makeup air is supplied from the same space where the ventilation air extracted from the space is discharged, ventilation air discharge openings shall be separated by a sufficient distance, but not less than 3 m, from the makeup air intake openings to prevent re-circulation to the space.

GG.9 Charge limits for appliances using A2L refrigerants connected via an air duct system to one or more rooms

GG.9.1 General

Clause GG.9 is applicable for appliances with a REFRIGERANT CHARGE $0 < m_c \leq m_3$. The MAXIMUM REFRIGERANT CHARGE can be increased or the minimum room area can be reduced if the following requirements are met.

• The appliance shall be provided with a REFRIGERANT DETECTION SYSTEM according to Annex LL, or the fan shall operate continuously and the airflow shall be monitored continuously.

• m_{max} shall be determined based on the total area of the conditioned space (*TA*) connected by ducts taking into consideration that the CIRCULATION AIRFLOW distributed to all the rooms by the appliance integral indoor fan will mix and dilute the leaking refrigerant before entering any room. In the case when no REFRIGERANT DETECTION SYSTEM is provided then, spaces where the airflow may be limited by zoning dampers shall not be included in the determination of *TA*.

The minimum airflow shall be determined as:

$$Q_{\min} = 60 \times m_c / LFL \quad \text{(GG.21)}$$

where

Q_{min} is the minimum CIRCULATION AIRFLOW circulated to the total conditioned space in m^3/h;

m_c is the actual REFRIGERANT CHARGE for a single refrigerating system expressed in kg;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^2.

The MAXIMUM REFRIGERANT CHARGE based on the room area for the total conditioned space shall be in accordance with the following:

$$m_{\max} = SF \times LFL \times H \times TA \quad \text{(GG.22)}$$

or

the required minimum total conditioned room area TA_{min} of installed appliance with REFRIGERANT CHARGE m_c (kg) shall be in accordance with following:

$$TA_{\min} = m_c / (SF \times LFL \times H) \quad \text{(GG.23)}$$

where

SF is the safety factor of 0,50;

m_{max} is the allowable MAXIMUM REFRIGERANT CHARGE in the system in kg;

m_c is the REFRIGERANT CHARGE in appliance in kg;

TA_{min} is the required minimum area of the total conditioned space in m^2;

H is the height of the room = 2,2 m;

TA is the area of the total conditioned space in m^2;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3.

If *TA* is smaller than TA_{min}, additional ventilation shall be employed.

The minimum additional mechanical ventilation and fresh air make up airflow shall be determined according to GG.8.3.

The additional mechanical ventilation shall exhaust to the outside or to an area such that the combined area exhausted to and the total conditioned area is greater than TA_{min}.

GG.9.1DV.1 D1 ***Modification of Clause GG.9.1 of the Part 2 as follows:***

In the first paragraph, replace "$0 < m_c \leq m_3$" with "$m_1 < m_c \leq m_3$".

GG.9.1DV.2 D2 ***Replace Clause GG.9.1 after the first paragraph of the Part 2 with the following:***

– The appliances shall be connected via an air duct system to one or more rooms, the supply and return air shall be directly ducted to the space.

– Operation of circulation airflow shall comply with either GG.9.2 or GG.9.3.

– m_{max} shall be determined based on the total area of the conditioned space (*TA*) connected by ducts taking into consideration that the circulation airflow distributed to all the rooms by the appliance integral indoor fan will mix and dilute the leaking refrigerant before entering any room. If no refrigerant detection system is provided then, spaces where the airflow may be limited by zoning dampers shall not be included in the determination of *TA*.

The minimum airflow shall be determined as:

$$Q_{min} = 30 \times m_c / LFL \qquad \textbf{(GG.15DV)}$$

where

Q_{min} is the minimum circulation airflow circulated to the total conditioned space in m^3/h

m_c is the actual refrigerant charge for a single REFRIGERATING SYSTEM in kg

***LFL* is the lower flammability limit in kg/m^3**

Compliance is checked by checking for Q_{min} through confirmation using the fan curve analysis at 0.0 cm (0.0 in) of water or lowest listed external static pressure.

The maximum refrigerant charge based on the room area for the total conditioned space shall be in accordance with the following:

$$m_{max} = CF \times LFL \times H \times TA \qquad \textbf{(GG.16DV)}$$

The required minimum total conditioned room area TA_{min} of installed appliance with refrigerant charge m_c (kg) shall be in accordance with following:

$$TA_{min} = m_c / (CF \times LFL \times H) \qquad \textbf{(GG.17DV)}$$

where

***CF* is the concentration factor with a value of 0,50**

m_{max} is the allowable maximum refrigerant charge in the system in kg

m_c is the refrigerant charge in appliance in kg

TA_{min} is the required minimum area of the total conditioned space in m^2

***H* is the height of the room = 2,2 m**

TA is the area of the total conditioned space in m^2

LFL is the LOWER FLAMMABILITY LIMIT in kg/m3

If TA is smaller than TA_{min}, additional ventilation according to GG.8.3 shall be employed. shall be employed.

GG.9.2 Continuous circulation airflow

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

– Disable the compressor operation.

– Warn user that airflow is reduced.

Compliance is checked by inspection.

GG.9.2DV D1 *Modification of Clause GG.9.2 of the Part 2 by replacing it with the following:*

The indoor fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be monitored continuously. Within 10 s in the event that the airflow is reduced below Q_{min}, the following actions shall be taken:

– provide an output signal that airflow is reduced; and

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

Compliance is checked by inspection.

GG.9.3 Circulation airflow activated by a refrigerant detection system

When a REFRIGERANT DETECTION SYSTEM according to Annex LL operates, the following shall be initiated.

• Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount of charge released to the indoor space.

Fully open all zoning damper of the appliance and energize control signals to open any external zoning dampers if applicable.

• Activate additional mechanical ventilation, if required.

Compliance is checked by inspection.

The REFRIGERANT DETECTION SYSTEM and controls shall maintain the above action until at least 5 min after the REFRIGERANT DETECTION SYSTEM has reset. Building fire and smoke systems may override this function.

If the continuous operation of duct fan is employed, additional ventilation shall also be continuously operated.

GG.9.3DV D1 ***Modification of Clause GG.9.3 of the Part 2 by replacing it with the following:***

If a LEAK DETECTION SYSTEM is activated, the following actions shall be taken and continue for at least 5 min after the LEAK DETECTION SYSTEM has reset:

– energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Q_{min};

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space;

– fully open all zoning dampers of the appliance and energize control signals to open any external zoning dampers if applicable; and

– activate additional mechanical ventilation, if required by Clause GG.8.3.

Compliance is checked by inspection.

Building fire and smoke systems may override this function.

GG.10 Allowable charge for enhanced tightness refrigerating systems

GG.10.1 General

Clause GG.10 is applicable to ENHANCED TIGHTNESS REFRIGERATING SYSTEMS using A2L REFRIGERANTS with REFRIGERANT CHARGE $m_1 < m_c \leq$ number of indoor units × m_2, not to exceed 4 × m_2.

For appliances with more than one indoor unit, individual indoor unit cooling capacity shall not exceed 35 kW when tested in accordance with ISO 5151, ISO 13253, or ISO 15042 at T1 conditions. For heating only appliances with more than one indoor unit, individual indoor unit heating capacity shall not exceed 35 kW when tested in accordance with ISO 5151, ISO 13253, or ISO 15042 at H1 conditions.

The appropriate measures to be taken shall be ventilation (natural or mechanical), safety shut-off valves and safety alarm, in conjunction with REFRIGERANT DETECTION SYSTEMS as specified in GG.10.2 to GG.10.5. A safety alarm alone shall not be considered as an appropriate measure where occupants are restricted in their movement (see Clause 13).

GG.10.2 Requirement for units with incorporated circulation airflow to prevent stagnation

GG.10.2.1 General

For indoor units where h_0 as determined in Clause GG.2 is less than 1,8 m, and for indoor units connected to one or more spaces by ducts which supply or return air from the space at a height less than 1.8 m, CIRCULATION AIRFLOW for the purpose of mixing the air in the room shall be provided. Where mechanical ventilation is required per Subclause GG.10.4 or Subclause GG.10.5, units where h_0 is equal or greater than 1,8 m, air circulation for the purpose of mixing the air in the room shall also be provided.

The circulation shall operate continuously or be turned on by REFRIGERANT DETECTION SYSTEMS. The minimum air velocity and minimum airflow shall be as follows:

• Minimum airflow = 240 m^3/h

• Minimum air velocity

$$V_{min} = (-4{,}0 \times 10^{-5} \times M^2 + 0{,}010\ \ 8 \times M + 1{,}42) / \sin\varphi \quad \text{(GG.24)}$$

where

v_{min} is the minimum air velocity in m/s;

M is the molar mass;

φ is the airflow angle above horizontal in degrees.

The unit air velocity (v) shall be calculated as airflow divided by the nominal face area of the outlet. The grill area shall not be deducted.

NOTE The formula is based on appliances with a refrigerant release on floor level, which represents the most stringent situation.

As an alternative, for airflow angles between 15 degrees and 90 degrees, the minimum air velocity (v_{min}) can be determined by linear interpolation of the values included in Table GG.5.

Compliance is checked by testing.

Where a single REMOTE REFRIGERANT DETECTION system sensor is used in a room with multiple units, this requirement shall apply to all units in the room which do not have a dedicated REFRIGERANT DETECTION SYSTEM.

GG.10.2.2 Continuous circulation airflow

The fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced, the following actions shall be taken:

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

– Warn user that airflow is reduced.

GG.10.2.3 Circulation airflow initiated by a refrigerant detection system

When any REFRIGERANT DETECTION SYSTEM is activated per Annex LL in response to a detected leak into the space, all indoor units in that room which are served by the same outdoor unit shall take the following actions and continue for at least 5 min:

– The fan shall be switched on.

– Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

GG.10.3 Required measures for allowable refrigerant charge

GG.10.3.1 Spaces except lowest underground floor of the building

Where the REFRIGERANT CHARGE does not exceed MAXIMUM REFRIGERANT CHARGE in GG.10.4, no additional measures are required.

Where the charge exceeds the MAXIMUM REFRIGERANT CHARGE in GG.10.4 but is less than or equal to the MAXIMUM REFRIGERANT CHARGE in GG.10.5, then at least one additional measure shall be taken in accordance with Clause GG.11, GG.12, or GG.13.

Where the REFRIGERANT CHARGE exceeds the MAXIMUM REFRIGERANT CHARGE in GG.10.5, at least two additional measures are taken in accordance with Clause GG.11, GG.12, or GG.13.

GG.10.3.2 Lowest underground floor of the building

Where the REFRIGERANT CHARGE exceeds the MAXIMUM REFRIGERANT CHARGE in GG.10.4, two additional measures shall be taken in accordance with Clause GG.11, GG.12, or GG.13.

The REFRIGERANT CHARGE shall not exceed the MAXIMUM REFRIGERANT CHARGE in GG.10.5.

GG.10.4 Maximum refrigerant charge

The MAXIMUM REFRIGERANT CHARGE m_{max} in a room and the required minimum room area A_{min} of the installed appliance with REFRIGERANT CHARGE m_c shall be in accordance with the following:

$$m_{max} = 0{,}25 \times LFL \times H \times A \quad \text{(GG.25)}$$

$$A_{min} = m_c / (0{,}25 \times LFL \times H) \quad \text{(GG.26)}$$

where

m_{max} is the MAXIMUM REFRIGERANT CHARGE in kg;

m_c is the total REFRIGERANT CHARGE in the REFRIGERATING SYSTEM in kg;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3;

H is the room height in m but not more than 2,2 m unless h_0 as determined in Clause GG.2 is higher than 2,2 m;

A is the room floor area in m^2;

A_{min} is the required minimum room area in m^2.

For room areas exceeding 250 m^2, m_{max} shall be calculated with a room area (A) of 250 m^2.

GG.10.5 Maximum refrigerant charge when employing additional measures

The MAXIMUM REFRIGERANT CHARGE m_{max} and minimum room area A_{min} are calculated in accordance with the following:

$$m_{max} = 0{,}50 \times LFL \times H \times A \quad \text{(GG.27)}$$

$$A_{min} = m_c / (0{,}50 \times LFL \times H) \quad \text{(GG.28)}$$

where

m_{max} is the MAXIMUM REFRIGERANT CHARGE in kg;

m_c is the total REFRIGERANT CHARGE in the REFRIGERATING SYSTEM in kg;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3;

H is the room height in m but not more than 2,2 m unless h_0 as determined in Clause GG.2 is higher than 2,2 m;

A is the room floor area in m^2;

A_{min} is the required minimum room area in m^2.

For room areas exceeding 250 m^2, m_{max} shall be calculated with a room area (A) of 250 m^2.

GG.10DV D1 *Modification of Clause GG.10 of the Part 2 by replacing it with the following:*

GG.10DV Allowable charge for enhanced tightness REFRIGERATING SYSTEMS using A2L refrigerant

GG.10.1DV General

Clause GG.10DV is applicable to enhanced tightness REFRIGERATING SYSTEMS in compliance with Clause 22.125 using A2L refrigerants with refrigerant charge of $m_1 < m_c \leq m_3$.

For appliances with more than one indoor unit, individual rated indoor unit cooling capacity shall not exceed 35 kW. For heating only appliances with more than one indoor unit, individual rated indoor unit heating capacity shall not exceed 35 kW.

The appropriate measures to be taken shall be ventilation (natural or mechanical), safety shut-off valves and the requirements of Clauses GG.10.2DV to GG.10.4DV. Appliances with enhanced tightness refrigeration systems that are ducted to one or more rooms may determine maximum refrigerant charge, m_{max} and minimum total conditioned room area TA_{min} in accordance with all requirements in Clause GG.9 with the minimum airflow in Clause GG.10.4DV.

NOTE Clause GG.10DV assumes a leak rate of not more than 10 kg/hr.

GG.10.2DV Required measures for allowable refrigerant charge

For indoor units where h_0 as determined in Clause GG.2.1DV is less than 1,8 m, and for indoor units connected to one or more spaces by ducts which supply or return air from the space at a height less than 1.8 m, CIRCULATION AIRFLOW for the purpose of mixing the air in the room shall be provided in accordance with Clause GG.10.4DV. Where the refrigerant charge does not exceed maximum refrigerant charge in Clause GG.10.3DV, no additional measures are required.

Where the refrigerant charge exceeds the maximum refrigerant charge in Clause GG.10.3DV, one additional measure shall be taken in accordance with Clause GG.10.4DV, GG.11 or GG.12.

GG.10.3DV Maximum refrigerant charge

The maximum refrigerant charge m_{max} in a room and the minimum room area A_{min} of the installed appliance with refrigerant charge mc shall be in accordance with the following:

$$m_{max} = CF \times LFL \times H_r \times A \quad \text{(GG.18DV)}$$

$$A_{min} = m_c / (CF \times LFL \times H_r) \quad \text{(GG.19DV)}$$

where

***CF* is the concentration factor with a value of 0,50**

m_{max} is the maximum refrigerant charge in kg

m_c is the total refrigerant charge in the REFRIGERATING SYSTEM in kg

***LFL* is the lower flammability limit in kg/m^3**

H_r is the effective height of the indoor unit in m

***A* is the room floor area in m^2**

TA_{min} can be used in place of A per Clause GG.9

A_{min} is the required minimum room area in m^2

A_{min} for appliances serving one or more rooms using ductwork shall be calculated for the spaces where a duct is connected or an indoor unit is located. If all spaces have room area more than A_{min}, no further measure is required.

The effective height, H_r, of the unit is determined as follows:

– Where the release height, h_0, as determined in Clause GG.2 is less than 2,2 m and equal to or greater than 1,8 m or the appliance has incorporated CIRCULATION AIRFLOW, in accordance with Clause GG.10.4DV, the effective height, H_r, is the room height in meters but not more than 2,2 m unless h_0 is higher than 2,2 m;

– In all other cases, the effective height, H_r, is the release height, h_0, as determined in Clause GG.2.

For room areas exceeding 250 m^2, m_{max} shall be calculated with a room area (*A*) of 250 m^2.

GG.10.4DV Requirement for units with incorporated circulation airflow to prevent stagnation

GG.10.4.1DV General

The circulation shall operate continuously or be turned on by leak detection systems. The minimum air velocity and minimum airflow shall be as follows:

– Minimum airflow = 240 m^3/h;

– There is no minimum circulation airflow velocity requirement for downwards airflow or ducted units serving one or more rooms;

– Minimum air velocity for upwards airflow:

$$V_{min} = (-4{,}0 \times 10 - 5 \times M\,2 + 0{,}010\ 8 \times M + 1{,}42) / \sin\varphi \qquad \text{(GG.20DV)}$$

where

v_{min} is the minimum air velocity in m/s

M is the molar mass in kg/kmol

φ is the airflow angle above horizontal in degrees; an angle below 15° is considered to be 15°

– The unit air velocity (v) shall be calculated as airflow divided by the nominal face area of the outlet. The grille area shall not be deducted.

NOTE The equation is based on appliances with a refrigerant release on floor level, which represents the most stringent situation.

As an alternative, for airflow angles between 15° and 900°, the minimum air velocity (v_{min}) can be determined by linear interpolation of the values included in Table GG.5.

Compliance is checked by testing.

Operation of circulation airflow shall comply with either Clauses GG.10.4.2DV or GG.10.4.3DV. Where a remote refrigerant detection system REFRIGERANT SENSOR is used in a room with multiple units, all of the detection system activated safety measures shall be applied to all units in the room which rely on the remote refrigerant detection system.

GG.10.4.2DV Continuous circulation airflow

The indoor fan shall run continuously, other than for short periods for maintenance and service. The airflow shall be detected continuously or monitored continuously. Within 10 s in the event that the airflow is reduced below Q_{min}, the following actions shall be taken:

– Compressor operation shall be disabled unless the compressor operation reduces the leak rate or the total amount released to the indoor space.

Compliance is checked by inspection.

GG.10.4.3DV Circulation airflow activated by a LEAK DETECTION SYSTEM

If a leak detection system is activated, the following actions shall be taken When any refrigerant detection system is activated per Annex LL in response to a detected leak into the space, all indoor units in the room that are served by the same outdoor unit shall take the following actions and continue for at least 5 min after the LEAK DETECTION SYSTEM has reset:

– energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Q_{min};

– disable the compressor operation unless the compressor operation reduces the leak rate or the total amount released to the indoor space; and

– fully open all zoning damper of the appliance and energize control signals to open any external zoning dampers if applicable.

Compliance is checked by inspection.

Table GG.5DV
Minimum air velocity

Minimum air velocity v_{min} (m/s)							
h_a (m)	M	Airflow angle above horizontal φ (degrees)					
		15	30	45	60	75	90
< 0,3	50	7,08	3,67	2,59	2,12	1,90	1,83
	60	7,40	3,83	2,71	2,21	1,98	1,92
	70	7,62	3,94	2,79	2,28	2,04	1,97
	80	7,78	4,03	2,85	2,32	2,08	2,01
	90	7,90	4,09	2,89	2,36	2,12	2,04
	100	8,00	4,14	2,93	2,39	2,14	2,07
	110	8,07	4,18	2,96	2,41	2,16	2,09
	120	8,14	4,21	2,98	2,43	2,18	2,11
< 0,60	50	6,47	3,35	2,37	1,93	1,73	1,67
	60	6,76	3,50	2,47	2,02	1,81	1,75
	70	6,96	3,60	2,55	2,08	1,86	1,80
	80	7,10	3,68	2,60	2,12	1,90	1,84
	90	7,21	3,73	2,64	2,16	1,93	1,87
	100	7,30	3,78	2,67	2,18	1,96	1,89
	110	7,37	3,82	2,70	2,20	1,97	1,91
	120	7,43	3,85	2,72	2,22	1,99	1,92
< 0,90	50	5,78	2,99	2,12	1,73	1,55	1,50
	60	6,04	3,13	2,21	1,81	1,62	1,56
	70	6,22	3,22	2,28	1,86	1,67	1,61
	80	6,35	3,29	2,32	1,90	1,70	1,64
	90	6,45	3,34	2,36	1,93	1,73	1,67
	100	6,53	3,38	2,39	1,95	1,75	1,69
	110	6,59	3,41	2,41	1,97	1,77	1,71
	120	6,64	3,44	2,43	1,99	1,78	1,72
< 1,20	50	5,01	2,59	1,83	1,50	1,34	1,30
	60	5,23	2,71	1,92	1,56	1,40	1,35
	70	5,39	2,79	1,97	1,61	1,44	1,39
	80	5,50	2,85	2,01	1,64	1,47	1,42
	90	5,59	2,89	2,04	1,67	1,50	1,45
	100	5,65	2,93	2,07	1,69	1,52	1,46
	110	5,71	2,96	2,09	1,71	1,53	1,48

Table GG.5DV Continued on Next Page

Table GG.5DV Continued

Minimum air velocity v_{min} (m/s)							
h_a (m)	M	Airflow angle above horizontal φ (degrees)					
		15	30	45	60	75	90
	120	5,75	2,98	2,11	1,72	1,54	1,49
< 1,50	50	4,09	2,12	1,50	1,22	1,10	1,06
	60	4,27	2,21	1,56	1,28	1,15	1,11
	70	4,40	2,28	1,61	1,31	1,18	1,14
	80	4,49	2,32	1,64	1,34	1,20	1,16
	90	4,56	2,36	1,67	1,36	1,22	1,18
	100	4,62	2,39	1,69	1,38	1,24	1,19
	110	4,66	2,41	1,71	1,39	1,25	1,21
	120	4,70	2,43	1,72	1,40	1,26	1,22
< 1,80	50	2,89	1,50	1,06	0,86	0,77	0,75
	60	3,02	1,56	1,11	0,90	0,81	0,78
	70	3,11	1,61	1,14	0,93	0,83	0,81
	80	3,18	1,64	1,16	0,95	0,85	0,82
	90	3,23	1,67	1,18	0,96	0,86	0,83
	100	3,26	1,69	1,19	0,98	0,87	0,84
	110	3,30	1,71	1,21	0,99	0,88	0,85
	120	3,32	1,72	1,22	0,99	0,89	0,86
h_a is the air delivery height in upper side in *m*.							

GG.11 Ventilation for enhanced tightness refrigerating systems using A2L refrigerants

GG.11.1 General

Ventilation shall be made to a place where sufficient air is available to dilute the leaked refrigerant such as outdoors or a large space. The indoor place used to provide ventilation air shall have sufficient volume, including the volume of the room in which the indoor unit is installed, to ensure that the MAXIMUM REFRIGERANT CHARGE specified in GG.10.4 is not exceeded.

GG.11.1DV D1 *Modification of Clause GG.11.1 of the Part 2 by replacing it with the following:*

Ventilation shall be made to a place where sufficient air is available to dilute the leaked refrigerant such as outdoors or a large space.

Where ventilation is to an indoor space, the total area of that space and the space in which the appliance is installed shall have a total room area not less than A_{min} according to equation (GG.21DV). If the total room area in Clause GG.11.2 is not large enough, the measure of Clause GG.11.3 shall be taken with ventilation to the outdoors.

$$A_{\min} = m_c / (CF \times LFL \times H_r) \qquad \textbf{(GG.21DV)}$$

Where

***CF* is the concentration factor with a value of 0,50**

m_c is the total refrigerant charge in the REFRIGERATING SYSTEM in kg

***LFL* is the LOWER FLAMMABILITY LIMIT in kg/m^3**

H_r is the effective height of the indoor unit in m

A_{min} is the required minimum room area in m^2

The effective height, H_r, of the unit is determined as follows:

– Where the release height, h_0, as determined in Clause GG.2, is less than 2,2 m and the appliance has incorporated circulation airflow, the effective height, H_r, is the room height (in meters) but not more than 2,2 m.

– In all other cases, the effective height, H_r, is the release height, h_0, as determined in Clause GG.2.

GG.11.2 Natural ventilation

If natural ventilation is applied, all of the following shall be met.

– Natural ventilation from an occupied space shall not be made to outdoors.

NOTE User can block the natural ventilation to the outside if it is cold outside

For natural ventilation opening provided to an occupied space, the total area of the space in which the appliance is installed and the adjacent space which is connected by the natural ventilation shall have a room area more than A_{min} according to Clause GG.2 for m_c. If the total room area is not large enough, the measure of GG.11.3 shall be taken.

– Openings for natural ventilation shall comply with GG.1.4.

– The minimum opening area for natural ventilation shall be calculated using equation (GG.29):

$$Anv_{min} = \frac{1}{720 \times LFL} \times \sqrt{\frac{M}{LFL \times (M - 29)}} \qquad \text{(GG.29)}$$

where

Anv_{min} required natural ventilation opening area in m^2;

M molar mass in kg;

LFL LOWER FLAMMABILITY LIMIT expressed in kg/m^3;

720 is the coefficient resulting from calculating all the constants used to establish the formula;

29 is the average molar mass of air in kg.

The equation is not applicable for refrigerants with a molar mass less than 42, as the equation is based on the principle that the density of the gases generates sufficient driving force to be successfully used with natural ventilation.

GG.11.2DV D1 ***Modification of Clause GG.11.2 of the Part 2 by replacing it with the following:***

If natural ventilation is applied, then the following shall be met:

– Openings for natural ventilation shall comply with Clause GG.1.4.

– Natural ventilation to the outdoors is not allowed below ground level.

– Natural ventilation from an occupied space shall not be made to the outdoors.

NOTE User can block the natural ventilation to the outside if it is cold outside.

The minimum opening area for natural ventilation (A_{nv}) to an indoor space shall be:

$$A_{nv} = \frac{1}{720 \times LFL} \times \sqrt{\frac{M}{LFL \times (M - 29)}} \qquad \textbf{(GG.22DV)}$$

Where

A_{nv} **is the required natural ventilation opening area in m^2**

M **is the molar mass in kg/kmol**

LFL **is the lower flammability limit expressed in kg/m^3**

720 is the coefficient resulting from calculating all the constants used to establish the equation

29 is the average molar mass of air in kg/kmol

The minimum opening area for natural ventilation (A_{nv}) to an outdoor space shall be determined as follows:

$$A_{nv} = 0{,}14 \times \sqrt{m_c \times \frac{0{,}04}{LFL}} \qquad \textbf{(GG.23DV)}$$

where

m_c **is the refrigerant charge of a system in kg**

m_{max} **is the maximum refrigerant charge for a system in kg**

LFL **is the lower flammability limit in kg/m^3**

A_{nv} **is the minimum opening area in m^2**

0,14 is a constant derived from the gravity acceleration, flow coefficient, etc.

0,04 is the conversion constant from hydrocarbon to other *LFL*

GG.11.3 Mechanical ventilation

GG.11.3.1 Operation of mechanical ventilation

Operation shall be according to GG.8.3.1, and for all indoor units in the same space which are served by a single REFRIGERATING SYSTEM, the fan shall be switched on to provide the minimum CIRCULATION AIRFLOW per GG.10.2.

GG.11.3.1DV D1 *Modification of Clause GG.11.3.1 of the Part 2 by replacing it with the following:*

Mechanical ventilation shall be operated continuously or shall be switched on by a leak detection system.

Operation shall be according to Clause GG.8.3.1.

GG.11.3.2 Required airflow

For (Q × 0,25**LFL*)/10 < 1, the airflow of the mechanical ventilation shall be at least the quantity that satisfies the following formula:

$$m_c = -\frac{10 \times V}{Q} In\left(1 - \frac{Q \times 0{,}25 \times LFL}{10}\right) \quad \text{(GG.30)}$$

For (Q × 0,25**LFL*)/10 ≥ 1, the airflow shall be determined according the following formula:

$$Q = \frac{10}{0{,}25 \times LFL} \quad \text{(GG.31)}$$

where

m_c is the REFRIGERANT CHARGE, expressed in kg;

V is the room volume in m^3;

10 is the expected maximum leak rate in kg/h;

Q is the ventilation airflow in m^3/h;

LFL is the LOWER FLAMMABILITY LIMIT in kg/m^3.

Losses caused by ducts or other components in the air stream shall be considered.

GG.11.3.3 Mechanical ventilation openings

The upper edge of the air extraction opening from the room shall be located equal or below the refrigerant release point. For floor mounted units, openings shall be according to GG.8.3.3.

GG.11.3.3DV D1 ***Modification of Clause GG.11.3.3 of the Part 2 by replacing it with the following:***

The upper edge of the air extraction opening from the room shall be located equal or below the refrigerant release point.

The mechanical ventilation air extracted from the space shall be positioned relative to the mechanical ventilation air intake openings such that the makeup air will mix with the leaked refrigerant.

Where CIRCULATION AIRFLOW according to Clause GG.10.4 is not provided, the openings shall comply with Clause GG.8.3.3.

GG.11.3.4 Operation of mechanical ventilation

Mechanical ventilation shall be operated continuously or shall be switched on by a REFRIGERANT DETECTION SYSTEM.

GG.11.3.4DV D1 ***Delete GG.11.3.4 of the Part 2:***

The requirements in Clause GG.11.3.4 do not apply.

NOTE: This is now in Clause GG.11.1DV

GG.12 Safety shut-off valves for enhanced tightness refrigerating systems using A2L refrigerants

GG.12.1 Location

Safety shut-off valves shall be located in a space with a room volume large enough so that the MAXIMUM REFRIGERANT CHARGE complies with GG.10.4, GG.10.5, or outside. Safety shutoff valve shall be positioned to enable access for maintenance by an authorized person.

GG.12.1DV D1 ***Modification of Clause GG.12.1 of the Part 2 by replacing it with the following:***

GG.12.1DV General

Safety shut-off valves shall be positioned to enable access for maintenance by an authorized person.

The releasable charge as determined by Clauses GG.12.3DV, GG.12.4DV, or GG.12.7DV shall be limited to:

$$m_{\mathrm{REL}} < CF \times LFL \times H_{\mathrm{r}} \times A \qquad \textbf{(GG.24DV)}$$

where

CF is the concentration factor with a value of 0,50

m_{REL} is the releasable charge in kg

LFL is the lower flammability limit in kg/m^3

H_r is the effective height of the indoor unit as determined in Clause GG.10.3 in m

A is the room floor area in m^2

GG.12.2 Design

Safety shut-off valves shall be designed to close in the event of an electric power failure, e.g. spring return solenoid valves.

If safety shut-off valves are used to comply with GG.10.4 or GG.10.5 then the released amount of refrigerant shall be limited to 0,5 × LFL × room volume.

The amount of refrigerant that can be leaked shall consider the response time of the sensor and the controller that activates the valves and the remaining amount of refrigerant that is contained in each section of the REFRIGERATING SYSTEM after the valves are closed.

NOTE Liquid migration in the off cycle may be the worst case condition for determination of the charge contained in the systems after closing of the safety shut-off valves.

GG.12.2DV D1 *Delete GG.12.2 of the Part 2:*

Clause GG.12.2 is not applicable.

GG.12.3DV D1 *Add the following subclause to Clause GG.12 of the Part 2:*

GG.12.3.1DV Determination of releasable charge

The releasable charge, m_{REL}, shall be determined by the test of Clauses GG.12.3.2DV and GG.12.3.3DV.

GG.12.3.2DV Test set-up

The appliance, including safety shut-off valves, shall be installed according to the instructions, in the smallest room as specified by the instructions, with the set-up that will create the largest releasable charge for that room.

NOTE 1 Tests set ups that give a larger releasable charge can be considered representative for setups that give a lower releasable charge: A test set-up with indoor units with a larger inner volume can be representative for units with a smaller inner volume. A test set set-up with piping with a larger inner volume can be representative for piping with a smaller inner volume.

NOTE 2 It is possible for the instructions to cover different room sizes for different set-ups, if so, each set-up will be considered separately.

The REFRIGERATING SYSTEM shall be evacuated prior to each test, and then charged with refrigerant equal to m_c, where m_c is the refrigerant charge in kg.

A calibrated leak opening shall be installed in the refrigerating on system that would result in the greatest amount of refrigerant released in the occupied space. A valve to enable opening and closing of the calibrated leak opening shall be installed between the appliance and the calibrated leak opening. The calibrated leak shall be at the point in the circuit that has the highest saturated pressure in the indoor unit during steady state operation.

The calibrated leak opening shall vent into a volume at atmospheric pressure.

NOTE 3 The volume can be a room, or a pressure vessel kept at atmospheric pressure, to avoid the refrigerant released into the atmosphere.

The calibrated opening shall be a capillary or orifice that leaks at 2,8 g/s from saturated liquid at a saturated pressure of 63 °C.

GG.12.3.3DV Test method

The REFRIGERATING SYSTEM shall operate according to the operating state until steady state is reached for at least 30 min, prior to opening the valve of the calibrated leak opening.

NOTE 1 The same applies for standstill condition.

The test shall be repeated at least three times and the releasable charge shall be 2 standard deviations above the mean result.

NOTE 2 The calculation of the mean value and the standard deviations apply to each operating state separately.

The valve to the calibrated leak opening shall be opened.

The refrigerating system shall operate normally for t_{r1} time with the calibrated leak open, where t_{r1} is the time before the leak is detected as determined in Clause GG.12.5DV.

After the t_{r1} time, the refrigerant charge limited system shall simulate a detected leak.

NOTE 3 This can be done by any method, e.g. putting the REFRIGERANT SENSOR in the refrigerant concentration above the output signal set point of the sensor, C_{set}.

After the safety shut-off valves are closed, the remaining charge m_{rm} contained in the part of the refrigerating system which is closed by the safety shut-off valves is measured.

The releasable charge (kg) is determined as follows:

$$m_{REL} = m_c - m_{rm} \qquad \text{(GG.25DV)}$$

where

m_c is the refrigerant charge (kg)

m_{rm} is the remaining charge (kg)

GG.12.4DV Determination of releasable charge by calculation and test

GG.12.4.1DV General

The releasable charge, m_{REL}, shall be calculated as the sum of the refrigerant released in the separate stages as follows:

$$m_{REL} = t_{r1} \times 0{,}002\ 8 + m_{REL2} + m_{REL3} \quad \text{(GG.26DV)}$$

where

t_{r1} is the time before leak is detected as determined in Clause GG.12.5DV (s)

m_{REL2} is the charge between detection and closing the shut-off valves as determined in Clause GG.12.4.2DV (kg)

m_{REL3} is the refrigerant released after closing the shut-off valves in part of the system that can leak into the occupied space as determined in Clause GG.12.4.3DV

0,002 8 is the assumed leak rate in kg/s

GG.12.4.2DV Refrigerant release between detection and closing the safety shut-off valves

The refrigerant amount released between the leak detection system sends an output signal and closing the safety shut-off valves, m_{REL2}, shall be determined as:

$$m_{REL2} = 0{,}002\ 8 \times t_{cl} \quad \text{(GG.27DV)}$$

where

t_{cl} is the time from the leak detection system gives an output signal to the shut-off valves closing in s

0,002 8 is the assumed leak rate in kg/s

Compliance is checked by inspection and test to determine the value of t_{cl}.

GG.12.4.3DV Determine apparent volumetric density, $\rho_{part,i}$, by default values

GG.12.4.3.1DV General

To determine the releasable charge after closing the shut-off valves, m_{REL3}, which can leak into the occupied space, determine the releasable charge for each part (unit or piping), m_{REL3}, that can leak into the occupied space after closing the shut-off valves by one of the following methods:

- determine the apparent volumetric density, $\rho_{part,i}$, by measuring the pressure according to Clause GG.12.4.3.2DV;
- determine the apparent volumetric density, $\rho_{part,i}$, by applying default values according to Clause GG.12.4.3.3DV; or
- determine the apparent volumetric density, $\rho_{part,i}$, according to Clause GG.12.4.3.4DV.

NOTE 1 The apparent volumetric density is the total mass of refrigerant in the part being evaluated divided by the total free internal volume of that part.

NOTE 2 These methods can be combined for evaluating each part.

A part shall be the piping or the indoor unit between the field connection points.

NOTE 3 The apparent volumetric densities that are determined in a part can be used to calculate the releasable charge after closing the shut-off valves for different configurations. For instance, the apparent volumetric density determined in the piping can be used for the calculation with different piping lengths that operates under the same condition.

The releasable charge after closing the shut-off valves, m_{REL3}, shall be the sum of the charge of each part that can leak into the occupied space after closing the shut-off valves:

$$m_{REL3} = \Sigma V_{part,i} \times \rho_{part,i} \quad \text{(GG.28DV)}$$

where

$V_{part,i}$ is the free internal volume in the evaluated $_{part\ i}$ in m^3

$\rho_{part,i}$ is the apparent volumetric density internal volume of the evaluated $_{part\ i}$ in kg/m^3

GG.12.4.3.2DV Determine apparent volumetric density, $\rho_{part,i}$, by measuring the pressure

To determine the apparent volumetric density, $\rho_{part,i}$ of the releasable charge after closing the shut-off valves for the evaluated part of the system by measuring the pressure, the following procedure shall be applied.

The appliance shall be installed according to the manufacturer's instructions. The most unfavorable combination of test samples shall be chosen.

NOTE The most unfavorable combination is the set-up that will create the highest apparent volumetric density.

For the test in cooling or heating mode, the system is operated according to the condition specified in Clause GG.12.6DV. The REFRIGERATING SYSTEM shall operate according to the operating state until steady state is reached for at least 30 min.

For the test in standby mode, the system shall be stopped for 8 h after the cooling operation according to the condition specified in Clause GG.12.6DV for 30 min.

The refrigerant state (liquid, gas or mixture) for the evaluated part of the system shall be determined as follows.

The pressure shall be measured at the refrigerant entering side for units and piping.

The apparent volumetric density for the evaluated part of the system, $\rho_{part,i}$, shall be determined as:

- for liquid piping: the density of saturated liquid at the pressure that is measured;
- for gas piping: the density of saturated gas at the pressure that is measured;
- for piping containing a mixture of gas and liquid: the density of saturated liquid at the pressure that is measured; and
- for indoor units: the density of saturated liquid at the pressure that is measured.

GG.12.4.3.3DV Determine apparent volumetric density, $\rho_{part,i}$, by default values

When no test is executed, the following method shall be applied.

The refrigerant state (liquid, gas or mixture) for the evaluated part of the system shall be determined.

The apparent density for the evaluated part of the system, $\rho_{part,i}$, shall be determined as:

for liquid piping: the density of saturated liquid at 10 °C;

for gas piping: the density of saturated gas at 42 °C;

for piping containing mixture of gas and liquid: the density of saturated liquid at 10 °C; or

for indoor units: the density of saturated liquid at 10 °C.

GG.12.4.3.4DV Determine apparent volumetric density, $\rho_{part,i}$, by measuring the recovered refrigerant amount from the unit or piping

To determine the apparent volumetric density, $\rho_{part,i}$, of the releasable refrigerant after closing the shut-off valves for the evaluated indoor unit or piping by measuring the recovered refrigerant amount, the following procedure shall be applied.

The appliance including safety shut-off valves shall be installed according to the manufacturer's instructions. The most unfavourable combination of test samples shall be chosen.

NOTE 1 If in doubt, multiple samples can be measured.

Shut-off valves for testing shall be installed upstream and downstream of the part where the apparent volumetric density is measured. Shut-off valves for testing shall be of the same type of as the safety shut-off valves used for the appliances. The action to shut-off shall be made in accordance with the NORMAL OPERATION of the safety shut-off valves.

For the test in cooling or heating mode, the system is operated according to the condition specified in Clause GG.12.6DV. The REFRIGERATING SYSTEM shall operate according to the operating state until steady state is reached for at least 30 min prior to closing the shut-off valves for testing.

For the test in standby mode, the system shall be operated in cooling mode according to the condition specified in Clause GG.12.6DV for 30 min, and then stopped for 8 h.

The refrigerant containing part of the unit which is to be evaluated is shut off completely from upstream and downstream by shut-off valves. The shut-off valves used for testing shall close simultaneously when the last safety shut-off valve closes during the safety shut-off sequence.

The part being evaluated shall then be evacuated and the recovered refrigerant amount, m_{rm}, shall be measured.

The test shall be repeated at least three times and the measured refrigerant amount, m_{rm},releasable charge shall be 2 standard deviations above the mean result.

NOTE 2 The calculation of the mean value and the standard deviations apply to each operating state separately.

The apparent volumetric density, $\rho_{part,i}$, of the evaluated $\rho_{part,i}$ is determined as follows:

$$\rho_{\mathrm{part,i}} = m_{\mathrm{rm}} / V_{\mathrm{part,i}} \qquad \text{(GG.29DV)}$$

where

m_{rm} is the measured refrigerant amount in the evaluated part i in kg

$V_{part,i}$ is the internal free volume in the evaluated part i in m^3

GG.12.5DV Time before the leak is detected, t_{r1}

GG.12.5.1DV General

Each operating state as indicated in Clause GG.12.6DV, shall be considered separately, as applicable.

The time before a leak is detected, t_{r1}, in seconds (s) is determined by one of the following:

– where the REFRIGERANT SENSOR location is in compliance with Annex MM when tested at the maximum airflow for the operating state;

– where the leak detection system is in compliance with Annex 101.DVP, Clause GG.12.5.2DV applies; or

– for all other cases where the REFRIGERANT SENSOR location is not in compliance with Annex MM when tested at the at maximum airflow for the operating state, or the REFRIGERANT SENSOR is remotely located, then Clause GG.12.5.3DV applies.

GG.12.5.2DV Determination of t_{r1} by default time

The time for the leak detection system to give an output signal, t_{r1}, shall be 120 s.

NOTE The time 120 s = 90 s + 30 s. 90 is the time delay in seconds as specified in Annex MM, and 30 is the maximum response time of the REFRIGERANT SENSOR in seconds as specified in Clause LL.3. The time delay in seconds specified in Annex 101.DVP is 90 s, which is less than the 120 s time.

GG.12.5.3DV Determination of t_{r1} based on effective room concentration

The time for the refrigerant detection system to give an output signal, t_{r1}, in seconds shall be determined as follows:

$$t_{r1} = (H_r \times A_{min} \times LFL \times C_{set} / 0{,}002\ 8) + 30 \qquad \text{(GG.30DV)}$$

where

H_r is the effective height of the indoor unit as determined in Clause GG.10.3DV in m

A_{min} is the required minimum room area in m^2

LFL is the lower flammability limit in kg/m^3

C_{set} is the alarm set point of the sensor in % of *LFL*, including the sensor tolerances that results in the highest C_{set}

0,002 8 is the assumed leak rate in kg/s

30 is a constant

NOTE 1 The constant 1 000 is a conversion from g to kg, 0,002 ,8 is the release rate in g/s for the enhanced tightness REFRIGERATING SYSTEMS under Clause GG.10, and 30 is the maximum response time of the REFRIGERANT SENSOR in seconds specified in Clause LL.4.

NOTE 2 Detection is assumed when the room concentration reaches the alarm set point of the refrigerant detection system. Installing the appliance in a room larger than A_{min} will result in an overall safer situation, even though t_{r1} will be underestimated.

NOTE 3 This calculation method is typically used for remote refrigerant sensors and for appliances where there is too much airflow to detect a leak during the tests of Annex MM or Annex 101.DVP.

NOTE 4 It is assumed that the REFRIGERANT SENSOR is able to detect the refrigerant concentration in the room where it is installed, for instance by being installed in the airstream of the unit or close to the floor.

GG.12.6DV Test conditions

For releasable charge limited system, the following operating states and conditions specified in the instructions shall be applied as applicable:

a) Compressor off with indoor temperature 27 °C and outdoor temperature 35 °C, with indoor fan ON;

b) Compressor off with indoor temperature 27 °C and outdoor temperature 35 °C, with indoor fan OFF;

c) Cooling mode with:

i) the compressor running at maximum speed allowed by the controls at the specified temperature;

ii) the highest outdoor air temperature and highest airflow allowed by the controls, or the highest entering fluid temperature and highest fluid flow rate; and

iii) the highest indoor air temperature and highest indoor fan airflow allowed by the controls, or the highest entering fluid temperature and highest fluid flow rate; and

d) Heating mode with:

i) the compressor running at the maximum speed allowed by the controls at the specified temperature;

ii) the highest outdoor air temperature and highest airflow allowed by the controls, or the highest entering fluid temperature and highest fluid flow rate; and

iii) the highest indoor air temperature and highest indoor fan airflow allowed by the controls, or the highest entering fluid temperature and highest fluid flow rate.

NOTE The fan can have a different maximum speed depending on the operating state and working temperature, the highest speed in that condition is relevant.

GG.12.7DV Alternative method for determination of RELEASABLE CHARGE

GG.12.7.1DV General

RELEASABLE CHARGE shall be the largest value of calculation results determined by Clauses GG.12.7.2DV, GG.12.7.3DV and GG12.7.4DV.

GG.12.7.2DV RELEASABLE CHARGE in Heating Mode

The RELEASABLE CHARGE in the heating mode, m_{REL-H}, shall be calculated per the following:

$$m_{REL-H} = L_{VAP} \times TD_{VAP} \times \rho_{VAP-H} + L_{LIQ} \times TD_{LIQ} \times \rho_{LIQ-H} + IV_{UNIT} \times \rho_{MIX-H} + [6.8\,g/s \times T_{RESP}] / 1000$$

where

L_{VAP} is total length of vapor interconnecting tubing from SAFETY SHUT-OFF VALVES to each indoor section, m

TD_{VAP} is tube volume per length for tube diameter L_{VAP} from Table GG.6DV in m^3/m

ρ_{VAP-H} is the density of superheated vapor refrigerant at 40.6 °C (105 °F) saturation temperature with a degree of superheat equal to 33.3 K (60 °R) in kg/m^3

L_{LIQ} is the total length of liquid interconnecting tubing from SAFETY SHUT-OFF VALVES to each indoor section in m

TD_{LIQ} is the tube volume per length for tube diameter L_{LIQ} from Table GG.6DV in m^3/m

ρ_{LIQ-H} is density of saturated liquid refrigerant at 40.6 °C (105 °F) in kg/m^3

IV_{UNIT} is the total internal volume of all indoor sections including coil, headers, tubing and all refrigerant containing parts of the units that are downstream of the SAFETY SHUT-OFF VALVE as determined by the manufacturer in m^3

ρ_{MIX-H} is the refrigerant density assuming 40 % liquid and 60 % vapor by volume (= 0.40 × ρ_{LIQ-H} + 0.60 × ρ_{VAP-H}) , kg/m^3

T_{RESP} is response time for REFRIGERATION DETECTION SYSTEM in sec, which shall be 30 sec

GG.12.7.3DV RELEASABLE CHARGE in Cooling Mode

The RELEASABLE CHARGE in the cooling mode, m_{REL-C}, shall be calculated per the following:

$$m_{REL-C} = L_{VAP} \times TD_{VAP} \times \rho_{VAP-C,LP} + L_{LIQ} \times TD_{LIQ} \times \rho_{LIQ-C,HP} + IV_{UNIT} \times \rho_{MIX-C} + [6.8\,g/s \times T_{RESP}] / 1000$$

where:

L_{VAP} is total length of vapor interconnecting tubing from SAFETY SHUT-OFF VALVES to each indoor section, m

TD_{VAP} is tube volume per length for tube diameter L_{VAP} from Table GG.6DV in m^3/m

$\rho_{VAP-C,LP}$ is the density of saturated vapor refrigerant at 10 °C (50 °F) in kg/m^3

L_{LIQ} is the total length of liquid interconnecting tubing from SAFETY SHUT-OFF VALVES to each indoor section in m

TD_{LIQ} is the tube volume per length for tube diameter L_{LIQ} from Table GG.6DV in m^3/m

$\rho_{LIQ-C,HP}$ is the density of saturated liquid refrigerant at 43.3 °C (110 °F) in kg/m^3

$\rho_{LIQ-C,LP}$ is the density of saturated liquid refrigerant at 10 °C (50 °F) in kg/m^3

IV_{UNIT} is the total internal volume of all indoor sections including coil, headers, tubing and all refrigerant containing parts of the units that are downstream of the SAFETY SHUT-OFF VALVE as determined by the manufacturer in m^3

ρ_{MIX-C} is the refrigerant density assuming 20 % liquid and 80 % vapor by volume (= 0.20 × $\rho_{LIQ-C,LP}$ + 0.80 × $\rho_{VAP-C,LP}$), kg/m^3

T_{RESP} is response time for REFRIGERATION DETECTION SYSTEM in sec, which shall be 30 sec

GG12.7.4DV RELEASABLE CHARGE in Off/Standby Mode

The RELEASABLE CHARGE in the off/standby mode, m_{REL-S}, shall be calculated per the following:

$$m_{\text{REL-S}} = L_{\text{VAP}} \times TD_{\text{VAP}} \times \rho_{\text{OFF}} + L_{\text{LIQ}} \times TD_{\text{LIQ}} \times \rho_{\text{OFF}} + IV_{\text{UNIT}} \times \rho_{\text{OFF}} + [6.8\,g/s \times T_{\text{RESP}}] / 1000$$

where

L_{VAP} is total length of vapor interconnecting tubing from SAFETY SHUT-OFF VALVES to each indoor section, m

TD_{VAP} is tube volume per length for tube diameter L_{VAP} from Table GG.6DV in m^3/m

$\rho_{VAP-OFF}$ is the density of saturated vapor refrigerant at 23.9 °C (75 °F), kg/m^3

L_{LIQ} is the total length of liquid interconnecting tubing from SAFETY SHUT-OFF VALVES to each indoor section in m

TD_{LIQ} is the tube volume per length for tube diameter L_{LIQ} from Table GG.6DV in m^3/m

$\rho_{LIQ-OFF}$ is the density of saturated liquid refrigerant at 23.9 °C (75 °F), kg/m^3

IV_{UNIT} is the total internal volume of all indoor sections including coil, headers, tubing and all refrigerant containing parts of the units that are downstream of the SAFETY SHUT-OFF VALVE as determined by the manufacturer in m^3

ρ_{OFF} is the refrigerant density assuming 20 % liquid and 80 % vapor by volume at 23.9 °C (75 °F) saturation conditions (= 0.20 × $\rho_{LIQ-OFF}$ + 0.80 × $\rho_{VAP-OFF}$), kg/m^3

TR_{ESP} is response time for REFRIGERATION DETECTION SYSTEM in sec, which shall be 30 sec

Table GG.6DV
Tube volume per unit length

Tube OD		Tube internal volume per unit length	
mm	in	m^3 / m	ft^3 / ft
6.35	0.250	1.77E−05	2.05E−04
7.94	0.313	3.10E−05	3.59E−04
9.53	0.375	4.80E−05	5.55E−04
12.7	0.500	9.29E−05	1.08E−03
15.9	0.625	1.49E−04	1.73E−03

Table GG.6DV Continued on Next Page

Table GG.6DV Continued

Tube OD		Tube internal volume per unit length	
mm	in	m^3 / m	ft^3 / ft
19.1	0.750	2.14E−04	2.48E−03
22.2	0.875	2.96E−04	3.43E−03
25.4	1.000	3.89E−04	4.50E−03
28.6	1.125	5.03E−04	5.85E−03
31.8	1.250	6.23E−04	7.21E−03
38.1	1.500	9.10E−04	1.05E−02
41.3	1.625	1.08E−03	1.25E−02
54.0	2.125	1.88−03	2.18E−02
66.7	2.625	2.89E−03	3.35E−02
Note: Values in IP are for reference only.			

GG.13 Safety alarms for enhanced tightness refrigerating systems using A2L refrigerants

GG.13DV D1 ***Delete Clause GG.13 of the Part 2.***

The requirements of Clause GG.13 do not apply.

GG.13.1 General

If an alarm is employed to warn of a leak in the occupied space, the alarm shall warn of a refrigerant leak in accordance with GG.13.2. The alarm shall be turned on by the signal from the REFRIGERANT DETECTION SYSTEM. The alarm shall also alert an authorized person to take appropriate action.

GG.13.2 Alarm system warning

GG.13.2.1 General

The alarm system shall warn both audibly and visibly, such as both a loud (15 dBA above the background level) buzzer and a flashing light.

GG.13.2.2 Alarm for general occupancy

At least one alarm inside the occupied space shall be installed. For the occupancy listed below, the alarm system shall also warn at a supervised location, such as the night porter's location, as well as the occupied space.

Rooms, parts of buildings, building where

• sleeping facilities are provided,

• people are restricted in their movement

• an uncontrolled number of people are present, or

• to which any person has access without being personally acquainted with the necessary safety precautions.

Table GG.5
Minimum airflow

Minimum airflow V_{min} (m/s)							
h_a (m)	M	Airflow angle above horizontal φ (degrees)					
		15	30	45	60	75	90
< 0,3	50	7,08	3,67	2,59	2,12	1,90	1,83
	60	7,40	3,83	2,71	2,21	1,98	1,92
	70	7,62	3,94	2,79	2,28	2,04	1,97
	80	7,78	4,03	2,85	2,32	2,08	2,01
	90	7,90	4,09	2,89	2,36	2,12	2,04
	100	8,00	4,14	2,93	2,39	2,14	2,07
	110	8,07	4,18	2,96	2,41	2,16	2,09
	120	8,14	4,21	2,98	2,43	2,18	2,11
< 0,60	50	6,47	3,35	2,37	1,93	1,73	1,67
	60	6,76	3,50	2,47	2,02	1,81	1,75
	70	6,96	3,60	2,55	2,08	1,86	1,80
	80	7,10	3,68	2,60	2,12	1,90	1,84
	90	7,21	3,73	2,64	2,16	1,93	1,87
	100	7,30	3,78	2,67	2,18	1,96	1,89
	110	7,37	3,82	2,70	2,20	1,97	1,91
	120	7,43	3,85	2,72	2,22	1,99	1,92
< 0,90	50	5,78	2,99	2,12	1,73	1,55	1,50
	60	6,04	3,13	2,21	1,81	1,62	1,56
	70	6,22	3,22	2,28	1,86	1,67	1,61
	80	6,35	3,29	2,32	1,90	1,70	1,64
	90	6,45	3,34	2,36	1,93	1,73	1,67
	100	6,53	3,38	2,39	1,95	1,75	1,69
	110	6,59	3,41	2,41	1,97	1,77	1,71
	120	6,64	3,44	2,43	1,99	1,78	1,72
< 1,20	50	5,01	2,59	1,83	1,50	1,34	1,30
	60	5,23	2,71	1,92	1,56	1,40	1,35
	70	5,39	2,79	1,97	1,61	1,44	1,39
	80	5,50	2,85	2,01	1,64	1,47	1,42
	90	5,59	2,89	2,04	1,67	1,50	1,45
	100	5,65	2,93	2,07	1,69	1,52	1,46
	110	5,71	2,96	2,09	1,71	1,53	1,48
	120	5,75	2,98	2,11	1,72	1,54	1,49
< 1,50	50	4,09	2,12	1,50	1,22	1,10	1,06
	60	4,27	2,21	1,56	1,28	1,15	1,11
	70	4,40	2,28	1,61	1,31	1,18	1,14
	80	4,49	2,32	1,64	1,34	1,20	1,16
	90	4,56	2,36	1,67	1,36	1,22	1,18
	100	4,62	2,39	1,69	1,38	1,24	1,19

Table GG.5 Continued on Next Page

Table GG.5 Continued

Minimum airflow V_{min} (m/s)							
h_a (m)	M	Airflow angle above horizontal φ (degrees)					
		15	30	45	60	75	90
	110	4,66	2,41	1,71	1,39	1,25	1,21
	120	4,70	2,43	1,72	1,40	1,26	1,22
< 1,80	50	2,89	1,50	1,06	0,86	0,77	0,75
	60	3,02	1,56	1,11	0,90	0,81	0,78
	70	3,11	1,61	1,14	0,93	0,83	0,81
	80	3,18	1,64	1,16	0,95	0,85	0,82
	90	3,23	1,67	1,18	0,96	0,86	0,83
	100	3,26	1,69	1,19	0,98	0,87	0,84
	110	3,30	1,71	1,21	0,99	0,88	0,85
	120	3,32	1,72	1,22	0,99	0,89	0,86
h_a is the air delivery height in upper side in m.							

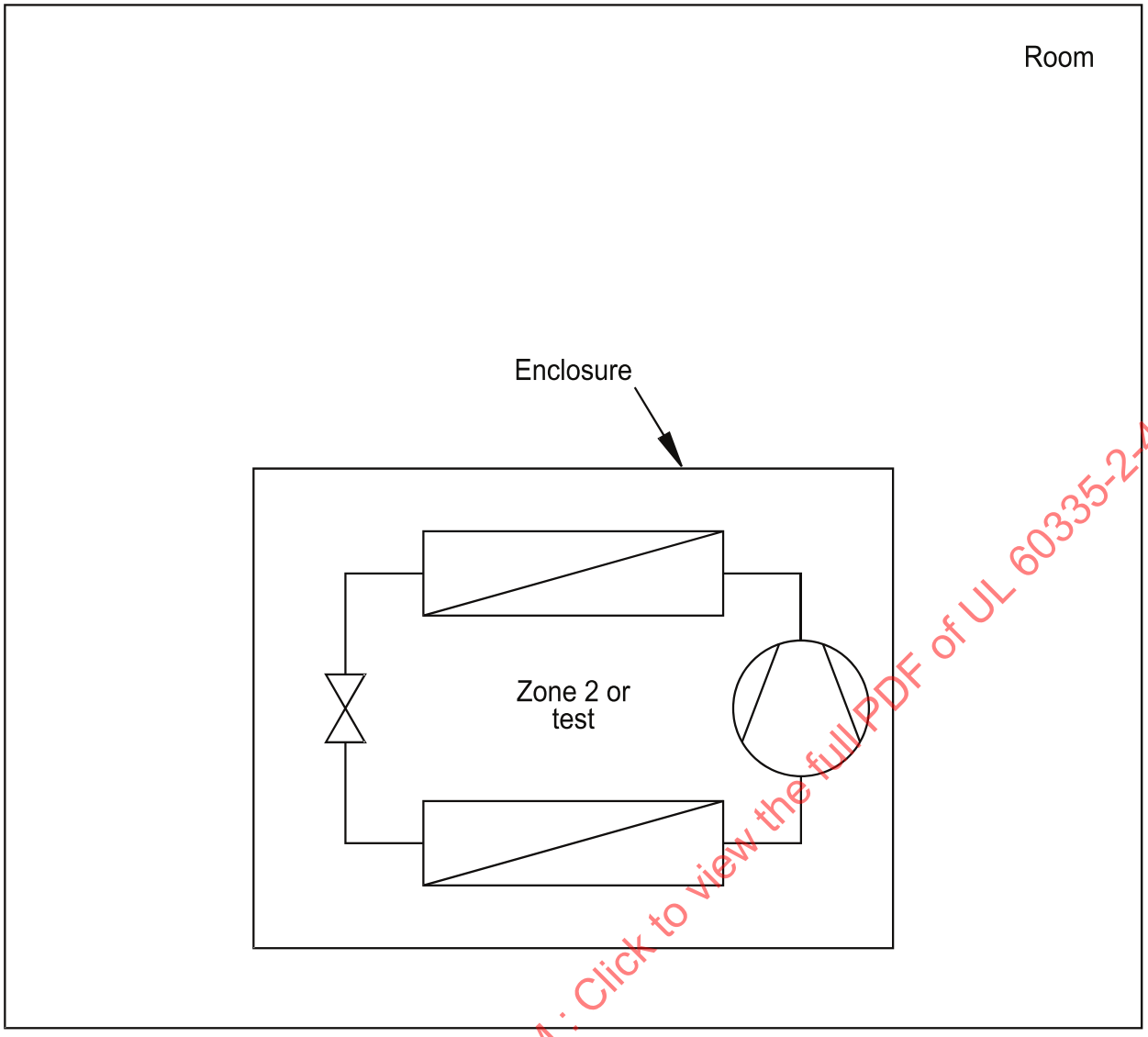


Figure GG.1

Unventilated area

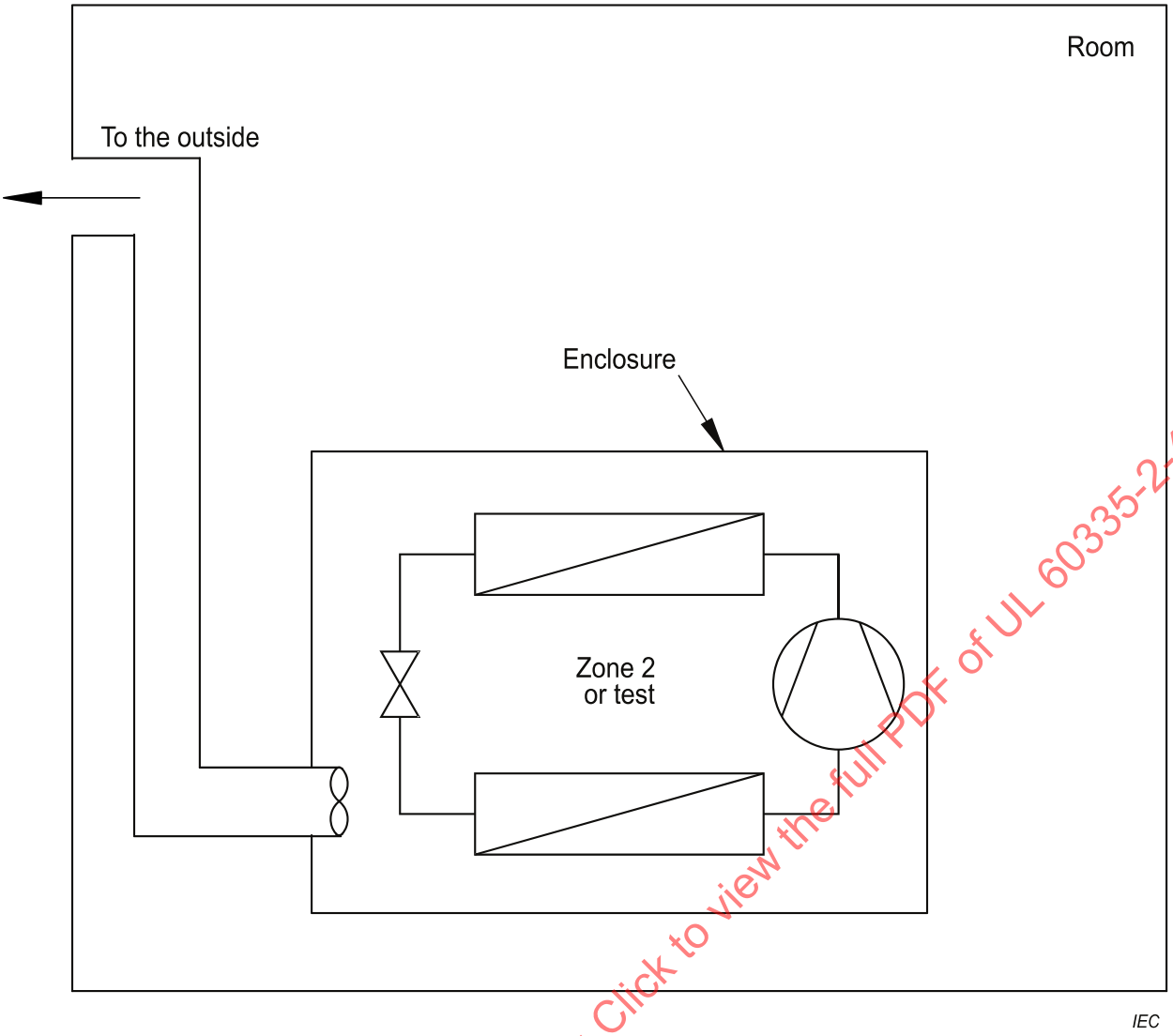
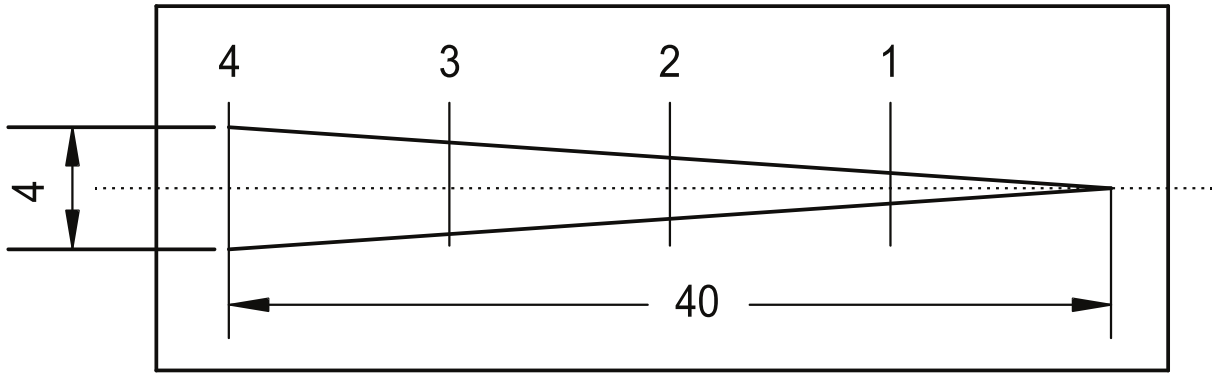


Figure GG.2

Mechanical ventilation



su0874a

Figure GG.3

Isosceles triangle arrow test gauge

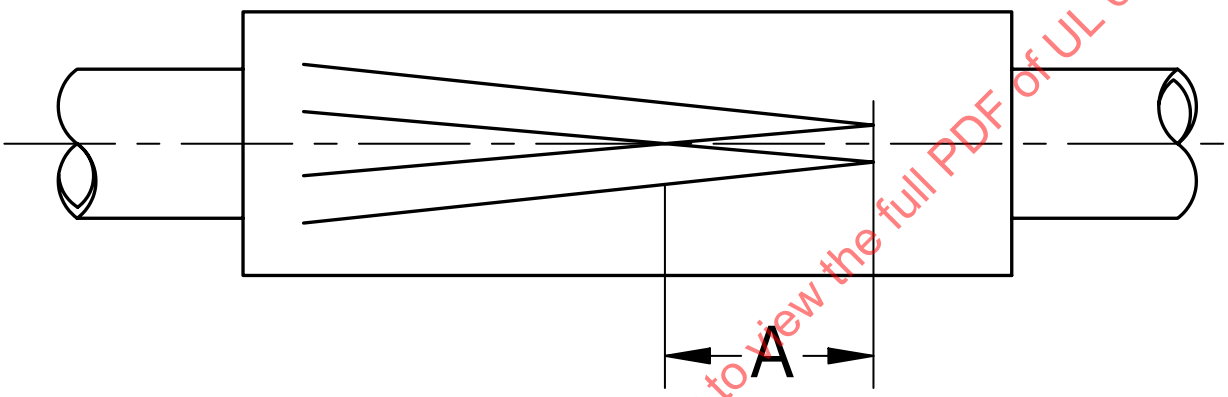


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Figure GG.4

Measurement of vibration amplitude

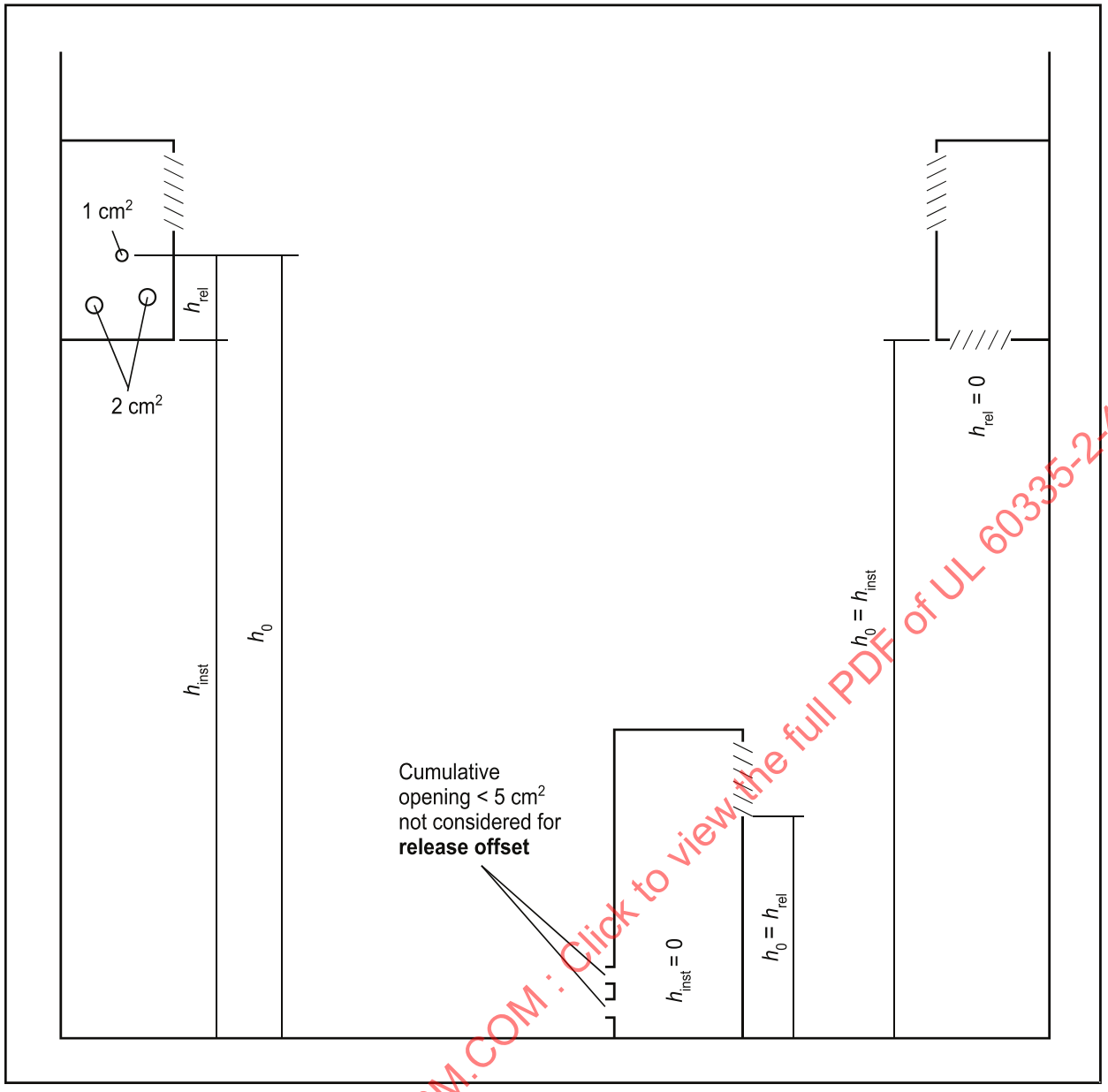
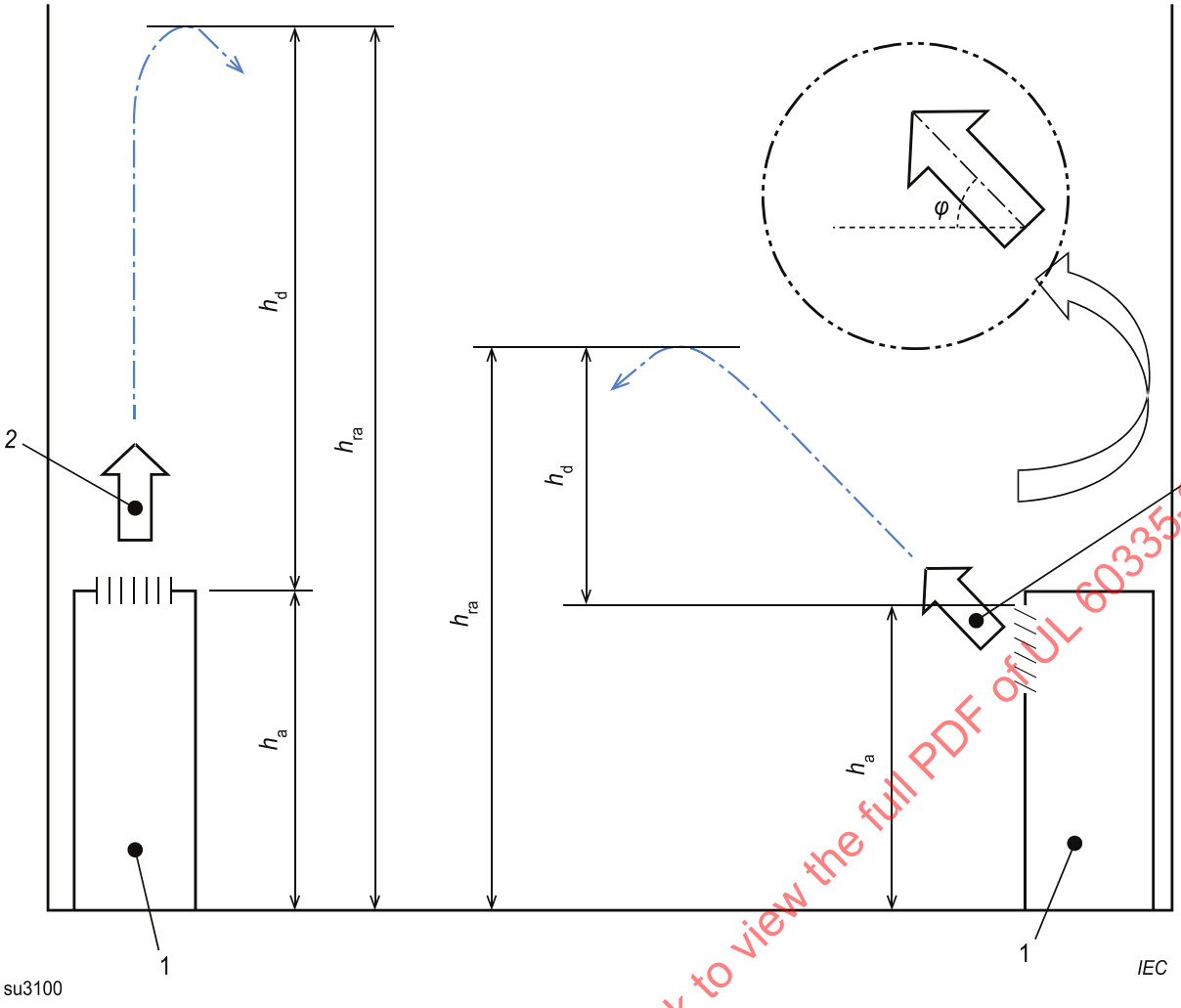


Figure GG.5

Relevant heights h_{inst}, h_0 and h_{rel} for calculation of A_{min} and m_{max}



Key

1 appliance

2 airflow direction: Upwards (vertical φ = 90°)

3 airflow direction: Upwards

Figure GG.6

Airflow direction

Annex HH
(informative)

Competence of service personnel

HH.1 General

Information of procedures additional to usual information for refrigerating appliance installation, repair, maintenance and decommission procedures is required when an appliance with FLAMMABLE REFRIGERANTS is affected.

The training of these procedures is carried out by national training organisations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation.

The achieved competence should be documented by a certificate.

HH.2 Information and training

HH.2.1 The training should include the substance of the following:

HH.2.2 Information about the explosion potential of FLAMMABLE REFRIGERANTS to show that flammables may be dangerous when handled without care.

HH.2.3 Information about POTENTIAL IGNITION SOURCES, especially those that are not obvious, such as lighters, light switches, vacuum cleaners, electric heaters.

HH.2.4 Information about the different safety concepts:

Unventilated – (see Clause GG.2) Safety of the appliance does not depend on ventilation of the housing. Switching off the appliance or opening of the housing has no significant effect on the safety. Nevertheless, it is possible that leaking refrigerant may accumulate inside the enclosure and flammable atmosphere will be released when the enclosure is opened.

Ventilated enclosure – (see Clause GG.4) Safety of the appliance depends on ventilation of the housing. Switching off the appliance or opening of the enclosure has a significant effect on the safety. Care should be taken to ensure sufficient ventilation before.

Ventilated room – (see Clause GG.5) Safety of the appliance depends on the ventilation of the room. Switching off the appliance or opening of the housing has no significant effect on the safety. The ventilation of the room shall not be switched off during repair procedures.

HH.2.5 Information about refrigerant detectors:

• Principle of function, including influences on the operation.

• Procedures, how to repair, check or replace a refrigerant detector or parts of it in a safe way.

• Procedures, how to disable a refrigerant detector in case of repair work on the refrigerant carrying parts.

HH.2.6 Information about the concept of sealed components and sealed enclosures according to IEC 60079-15:2010.

HH.2.7 Information about the correct working procedures:

a) Commissioning

• Ensure that the floor area is sufficient for the REFRIGERANT CHARGE or that the ventilation duct is assembled in a correct manner.

• Connect the pipes and carry out a leak test before charging with refrigerant.

• Check safety equipment before putting into service.

b) Maintenance

• Portable equipment shall be repaired outside or in a workshop specially equipped for servicing units with FLAMMABLE REFRIGERANTS.

• Ensure sufficient ventilation at the repair place.

• Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.

• Discharge capacitors in a way that won't cause any spark. The standard procedure to short circuit the capacitor terminals usually creates sparks.

• Reassemble sealed enclosures accurately. If seals are worn, replace them.

• Check safety equipment before putting into service.

c) Repair

• Portable equipment shall be repaired outside or in a workshop specially equipped for servicing units with FLAMMABLE REFRIGERANTS.

• Ensure sufficient ventilation at the repair place.

• Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.

• Discharge capacitors in a way that won't cause any spark.

• When brazing is required, the following procedures shall be carried out in the right order:

– Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.

– Evacuate the refrigerant circuit.

– Purge the refrigerant circuit with nitrogen for 5 min (not required for A2L REFRIGERANTS).

– Evacuate again (not required for A2L REFRIGERANTS).

– Remove parts to be replaced by cutting, not by flame.

– Purge the braze point with nitrogen during the brazing procedure.

– Carry out a leak test before charging with refrigerant.

• Reassemble sealed enclosures accurately. If seals are worn, replace them.

• Check safety equipment before putting into service.

d) Decommissioning

• If the safety is affected when the equipment is putted out of service, the REFRIGERANT CHARGE shall be removed before decommissioning.

• Ensure sufficient ventilation at the equipment location.

• Be aware that malfunction of the equipment may be caused by refrigerant loss and a refrigerant leak is possible.

• Discharge capacitors in a way that won't cause any spark.

• Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.

• When FLAMMABLE REFRIGERANTS except A2L REFRIGERANTS are used,

– Evacuate the refrigerant circuit.

– Purge the refrigerant circuit with nitrogen for 5 min.

– Evacuate again.

– Fill with nitrogen up to atmospheric pressure.

– Put a label on the equipment that the refrigerant is removed.

e) Disposal

• Ensure sufficient ventilation at the working place.

• Remove the refrigerant. If the recovery is not required by national regulations, drain the refrigerant to the outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building.

• When FLAMMABLE REFRIGERANTS except A2L REFRIGERANTS are used,

– Evacuate the refrigerant circuit.

– Purge the refrigerant circuit with nitrogen for 5 min.

– Evacuate again.

– Cut out the compressor and drain the oil.

• Evacuate the refrigerant circuit.

• Purge the refrigerant circuit with nitrogen for 5 min.

• Evacuate again.

• Cut out the compressor and drain the oil.

HH.2.7DV.1 D1 ***Modification of Clause HH.2.7 of the Part 2 by replacing the text in the fifth bullet under "c) Repair" with the following:***

• When brazing is required, the following procedures shall be carried out in the following order:

– Safely remove the refrigerant following local and national regulations. If the recovery is not required by national regulations, drain the refrigerant to the

outside. Take care that the drained refrigerant will not cause any danger. In doubt, one person should guard the outlet. Take special care that drained refrigerant will not float back into the building;

– Purge the refrigerant circuit with oxygen free nitrogen;

– Evacuate the refrigerant circuit;

– Purge the refrigerant circuit with nitrogen for 5 min (not required for A2L refrigerants).

– Evacuate again (not required for A2L refrigerants).

– Remove parts to be replaced by cutting or brazing.

– Purge the braze point with nitrogen during the brazing procedure required for repair.

– Carry out a leak test before charging with refrigerant.

HH.2.7DV.2 D1 ***Modification of Clause HH.2.7 of the Part 2 by replacing the text in the third bullet under "e) Disposal" with the following, and deleting the fourth, fifth, and sixth bullet items:***

When flammable refrigerants are used,

– evacuate the refrigerant circuit.

– purge the refrigerant circuit with oxygen free nitrogen.

– evacuate again. (not required for A2L refrigerants); and

– cut out the compressor and drain the oil.

Annex II
(Void)

Annex JJ
(normative)

Allowable opening of relays and similar components to prevent ignition of A2L refrigerants

JJ.1 General

Annex JJ is applicable to electric components or devices of appliances using A2L REFRIGERANTS.

Annex JJ defines the maximum size of openings in relays and similar components that prevents flame propagation to outside. A relay and similar components that comply with the requirements of this annex are not considered as a POTENTIAL IGNITION SOURCE for A2L REFRIGERANTS.

JJ.1DV DE *Modification of Clause JJ.1 of the Part 2 by replacing the first paragraph with the following:*

Annex JJ is applicable to electrical components or devices of appliances using A2L REFRIGERANTS.

Annex JJ defines the maximum size of openings in relays and similar components that prevents flame propagation to the outside. A relay and similar components that comply with the requirements of this annex are not considered as a POTENTIAL IGNITION SOURCE for A2L REFRIGERANTS.

JJ.2 Definition of the opening

The effective diameter is the equivalent diameter of a circular opening that has the same quenching effect to an opening of any shape. The effective diameter of the opening of relays and similar components is defined as follows:

$$d_{\text{eff}} = 4 \times \frac{A}{S} \qquad \text{(JJ.1)}$$

where

d_{eff} is the effective diameter in mm;

A is the cross sectional area of opening in mm^2;

S is the length of perimeter of opening in mm.

JJ.2DV DE *Modification of Clause JJ.2 of the Part 2 by replacing with the following:*

The effective diameter is the equivalent diameter of a circular opening that has the same quenching effect to an opening of any shape. For conical openings the largest cross-sectional area shall be considered. The effective diameter of the openings of relays and similar components is defined as follows:

$$d_{eff} = 4 \times \frac{A}{S} \qquad \textbf{(JJ.1DV)}$$

where

d_{eff} is the effective diameter of each opening in mm

A is the cross sectional area of each opening in mm^2

L is the length of perimeter of each opening in mm

JJ.3 Determination of maximum allowable opening

Relays and similar components shall not be considered as a POTENTIAL IGNITION SOURCE if the effective diameter of all holes complies with the following equation:

$$d_{\text{eff}} < 22{,}3 \times S_{\text{u}}^{-1{,}09}\ (\text{in mm}) \leq 7\ \text{mm} \qquad \text{(JJ.2)}$$

where

d_{eff} is the effective diameter in mm;

S_u is the burning velocity in cm/s.

Alternatively, a type test can be used to determine if relays and similar components are not a POTENTIAL IGNITION SOURCE. This type test shall show that there is no propagation of a flame from any contact inside of the relay to the outside, for the concentration of the refrigerant as used for determining the maximum burning velocity. Where the type test is used, the effective diameter limit is 12 mm.

Compliance is checked by inspection or by the following test: At the position of the contact, the refrigerant shall be ignited. It shall be observed if any propagation to the outside of the relay or similar component enclosure occurs. The test shall be repeated five times on the same sample and no propagation shall occur outside the relay or similar component. The test condition should be at the highest burning velocity as specified in 22.116.

NOTE A type test conducted with a refrigerant with a higher burning velocity can be used as evidence to show compliance for a refrigerant with a lower burning velocity.

JJ.3DV DE *Modification of Clause JJ.3 of the Part 2 by replacing with the following:*

Relays and similar components shall not be considered as a potential ignition source if the effective diameter, d_{eff} , of each hole is less than or equal to 7 mm and complies with the following equation:

$$d_{\text{eff}} < 22{,}3 \times S_{\text{u}}^{-1{,}09}\ (\text{in mm}) \leq 7\ \text{mm} \qquad \textbf{(JJ.2DV)}$$

where

d_{eff} is the effective diameter in mm

S_u is maximum laminar burning velocity in cm/s as determined by Clause 22.116DV.6

Alternatively, a type test can be used to determine if relays and similar components are not a POTENTIAL IGNITION SOURCE. This type test shall show that there is no propagation of a flame from any contact inside of the relay to the outside, for the concentration of the

refrigerant as used for determining the maximum burning velocity. Where the type test is used, the effective diameter limit is less than or equal to 12 mm.

Compliance is shown by inspection or by the following test: At the position of the contact , the refrigerant shall be ignited. It shall be observed if any propagation to the outside of the relay or similar component enclosure occurs. The test shall be repeated five times on the same sample and no propagation shall occur outside the relay or similar component. The test condition should be at the highest burning velocity as specified in Clause 22.116.

NOTE A type test conducted with a refrigerant with a higher burning velocity can be used as evidence to show compliance for a refrigerant with a lower burning velocity.

Annex KK
(normative)

Test method for hot surface ignition temperature for A2L

KK.1 General

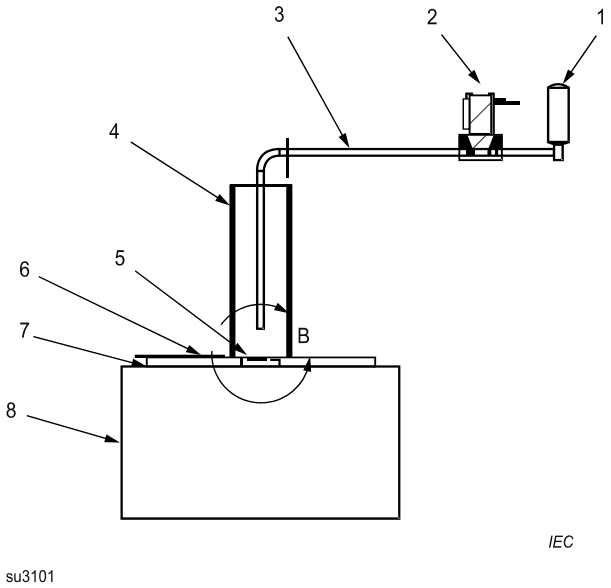
The HOT SURFACE IGNITION TEMPERATURE of A2L REFRIGERANTS shall be determined according to Annex KK. The refrigerants shall be sprayed onto a horizontal flat plate surface which is set at the test temperature.

The test system consists of a hot plate, a spray tube and a chimney. Figure KK.1, Figure KK.2 and Figure KK.3 display the set-up of the test apparatus.

NOTE This method is a modification of the ASTM D6668 "*Standard Test Method for Discrimination Between Flammability Ratings of F = 0 and F = 1*". The ASTM test is designed for automotive fluids as a pass fail test at 815 °C. We are interested in liquefied refrigerants and defining the maximum no ignition temperature.

KK.1DV D1 ***Modification of Clause KK.1 of the Part 2 by replacing the NOTE with the following:***

NOTE This method is a modification of the ASTM D8211 Standard Test Method for Hot Surface Ignition Temperatures of Gases on Flat Surface.



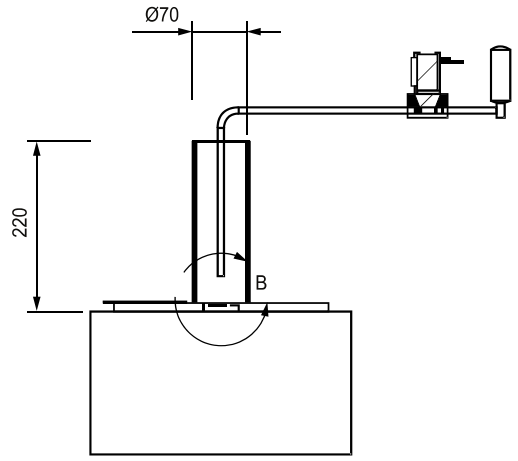
Key

1 refrigerant cylinder with valve
2 valve
3 spray tube
4 glass cylinder
5 planchet
6 thermocouple
7 insulation
8 hot plate

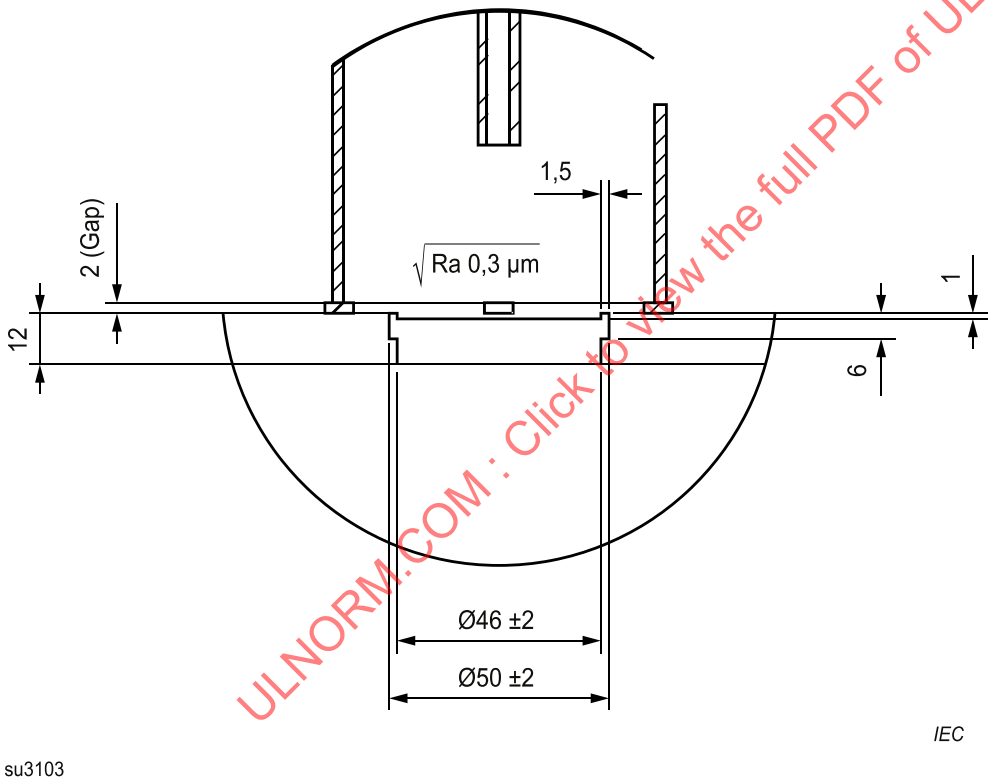
Figure KK.1

Front view of test apparatus labels

Dimensions in millimetres



a) Front view with dimensions



b) Detail of section B

Figure KK.2

Test apparatus with dimensions

Dimensions in millimetres

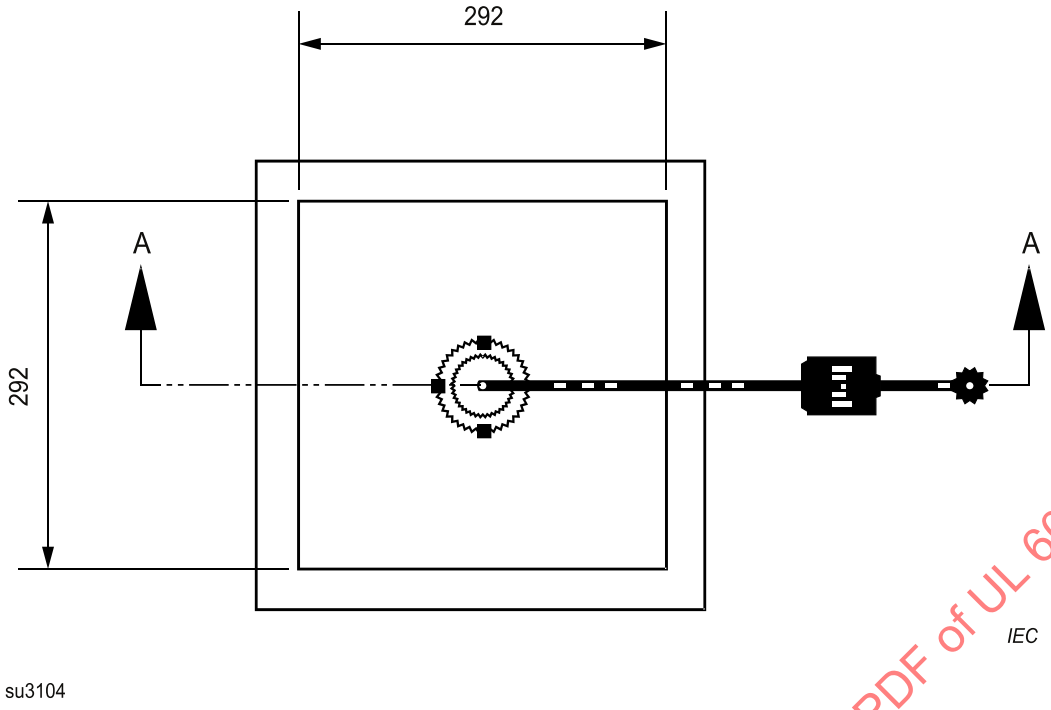


Figure KK.3

Top view of test apparatus

KK.2 Test equipment requirements

The hot plate shall have the following characteristics. The hot plate shall consist of a flat stainless steel plate with the dimensions:

Diameter: 50 mm ± 2,0 mm

Thickness: 6 mm –0/+2,0 mm

Surface texture: ISO 1302

The hot plate shall be positioned horizontally. The heaters shall provide uniform heating of the plate. All surfaces other than the test surface should be thermally insulated using ceramic fibre board capable to withstand 815 °C. This insulation shall be such that vapours cannot be ignited by other than the hot plate top surface.

Spray system shall consist of a liquid supply, two valves (trap liquid volume of 1,0 cm^3 ± 0,2 cm^3), tubing for directing the spray. The spray tube from valve to the end shall have the following dimensions:

Length: 250 mm ± 5,0 mm

Outer diameter: ≤ 4 mm

Inner diameter: 1,6 mm ± 0,1 mm

Use a type K thermal couple with the individual wires spot welded on opposite sides of the centre of the upper surface of the hot plate.

A borosilicate or quartz glass chimney shall be 230 mm ± 10 mm long and 70 mm ± 10 mm inner diameter . The chimney shall be supported so that it is vertically mounted and has a gap of 2,5 mm ± 0,2 mm between its bottom edge and the top on the insulation.

KK.3 Procedure

The ambient conditions of the test shall be set at 23 °C ± 3 °C and 50 % RH ± 5 % RH. The chimney and hot plate establishes a constant air velocity during the test. This airflow dilutes the vapours so that an optimum (near stoichiometric) concentration for ignition develops over the hot surface.

The test shall be performed in a laboratory fume hood. The test apparatus including the chimney top shall be located in the laminar flow region of the laboratory fume hood so the chimney flow is not disturbed.

The end of the spray refrigerant line shall be placed 40 mm ± 10 mm above the hot plate and shall point at the centre of the hot plate. The tube shall be perpendicular to the horizontal plate.

Operating steps:

1) The hot plate shall be heated until a steady test temperature is maintained for 5 min. The plate temperature shall be kept within ± 15 °C of the set-point during the test.

2) Refrigerant used for the test shall be the nominal composition (NC) per ISO 817. Refrigerant from the liquid phase shall be trapped between valve 1 and valve 2. Open valve C to spray the liquid refrigerant onto the centre of the hot plate.

3) Observe and record if ignition (flames) occurs or does not occur within 3 min after release.

NOTE Ignition is considered as being within the chimney above the plate.

Care shall be given to avoid vapours getting under the insulation, any ignition outside of the chimney is due to ignition on surfaces hotter than the test surface.

4) A minimum of 5 min of ventilation shall be allowed between runs to clear out reaction products and residual refrigerant.

5) Perform a minimum of 5 repetitions trials at each temperature being tested.

6) The temperature of the hot plate shall be set at 800 °C, if ignition occurs, then the plate temperature is to be reduced in increments of 20 °C until no ignition occurs in five trials. This temperature is to be recorded as the HOT SURFACE IGNITION TEMPERATURE (HSIT).

KK.3DV D2 *Modification of step 6) of clause KK.3 by replacing 800 °C with 1000 °C.*

KK.4 Test report

The results shall be recorded in a test report. The report shall include all the information necessary for the interpretation of the test and all information required by the method used. The report shall include:

• documentation with the sample identity and composition,

• temperature where ignition did not occur and where ignition did occur if applicable.

The reported HOT SURFACE IGNITION TEMPERATURE shall be highest temperature with no ignition in five trials.

Annex LL
(normative)

Refrigerant detection systems for A2L refrigerants

LL.1 General

REFRIGERANT DETECTION SYSTEMS shall be set to be activated before the refrigerant concentration reaches 25 % of the *LFL*. Where *LFL* is referenced in this annex, the *LFL* shall be taken at WCF – Worst Case Formulation as specified in ISO 817.

LL.2 Function of the refrigerant detection systems

The REFRIGERANT DETECTION SYSTEMS shall be capable of detecting a pre-set level of the refrigerant concentration of the refrigerant that the sensor is designated to be used with and initiate the operation as defined in Annex GG.

LL.3 Refrigerant detection system range, accuracy and response time

REFRIGERANT DETECTION SYSTEM shall make output according to the applicable clauses of Annex GG of this standard within 30 s when the sensor is put into refrigerant concentration of 25 % of *LFL* or lower.

The REFRIGERANT DETECTION SYSTEM, including the sensors, shall comply with the above requirements over the full range of operating temperature and humidity as specified by the appliance manufacturer.

Compliance is checked by test.

LL.4 Refrigerant detection system calibration

The REFRIGERANT DETECTION SYSTEMS shall be pre-set and calibrated (with an accuracy of ± 20 %) from the factory for the refrigerant used.

LL.5 Electrical outputs for refrigerant detection system

The device shall have an output in accordance with the applicable clauses of Annex GG of this standard.

LL.6 Vibration requirements

A sensor shall withstand vibration without breakage or damage of parts and shall continue to function. The vibration parameters shall be defined based on the intended application and expected transportation. If vibration operating parameters are not established by the manufacturer, then a sample of the sensor shall be subject to the requirements defined below.

To comply with the vibration requirements, two samples shall be secured to the intended mounting and in turn securely fastened to a variable speed vibration test machine having an amplitude and frequency as follows:

- *10 Hz to 31,5 Hz, with 1,0 mm total excursion, and*

- *31,5 Hz to 150 Hz, with 2 g acceleration peak.*

The samples shall be vibrated over the specified frequency range, displacement and acceleration for a period of 1 h in each of the three mutually perpendicular planes. The change rate shall not exceed 10 Hz/min. After the samples are vibrated, they shall be tested to verify they still sense refrigerant at 25 % of LFL or lower.

LL.7 Refrigerant detection system self-test routine

The detection system shall include a means for self-testing the sensor to determine the output is at proper range. The test shall be run at least every hour and if a failure is detected, an alarm shall be activated.

If the sensor has a defined life and requires replacement after a given period, then the detection system shall initiate an alarm or indication that replacement is required. If sensor becomes more sensitive with aging to generate false alarm, the end of life alarm can be omitted.

Compliance is checked by inspection.

LL.8 Sensor identification

The sensors shall be marked with

• name, trade mark or identification mark of the manufacturer or responsible vendor;

• model or type reference.

Compliance is checked by inspection.

Annex LL.DV D1 *Modification of Annex LL of the Part 2 by replacing the title with the following and by replacing Clauses LL.1 to LL.8 with the following:*

Refrigerant detection systems for flammable refrigerants

LL.1DV General

This annex applies to REFRIGERANT DETECTION SYSTEM for use in appliances using FLAMMABLE REFRIGERANTS.

LL.1.1DV Responses

When the sensed refrigerant gas concentration is above the DETECTION THRESHOLD LIMIT VALUE, the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE as defined in Clause 22 and Annex GG. When the REFRIGERANT DETECTION SYSTEM incorporates a GROUP CONTROLLER it shall additionally comply with the requirements of Annex 101.DVN for ITE COOLING APPLIANCES.

The REFRIGERANT DETECTION SYSTEM, including the REFRIGERANT SENSOR(S), shall comply with the above mentioned requirements over the full range of standby and operating atmospheric conditions for the intended mounting location(s), as specified by the appliance manufacturer, considering dry bulb temperature, dew point temperature, relative humidity, and pressure.

Note 1: The REFRIGERANT DETECTION SYSTEM may respond to the refrigerant gas concentration or to gases being displaced by the refrigerant, such as oxygen.

Note 2: In this Annex, refrigerant gas concentration refers to the dimensionless volume fraction expressed

a) percentage (e.g. 1 %);

b) parts per million (e.g. 10000 ppm); or

c) relative to a reference value of concentration such as *LFL* (e.g. 25 % of *LFL*),

except when it is specifically stated that the concentration is expressed as a mass density (e.g. kg/m^3).

LL.1.2DV In this Annex, where *LFL* is referenced it refers to the *LFL* value in ISO 817 for the refrigerant specified on the appliance nameplate. The refrigerant used for all tests shall be within the composition tolerances from the nominal composition as specified in ISO 817.

Note: In ISO 817 the *LFL* for refrigerant blends is typically measured at the WCF composition.

LL.1.3DV The tests of Clauses LL.5DV, LL.6DV, and LL.13DVare carried out on three separate samples for each clause; the tests of Clause LL.7DV are carried out on 15 samples; the samples from these tests may be used again for other tests when specifically requested by the manufacturer. The tests in other clauses of Annex LL shall be done with three samples and the tests are sequentially carried out in the following order: Clauses LL.4DV, LL.8DV, LL.9DV, LL.10DV, LL.11DV, LL.12DV and LL.13DV.

LL.1.4DV REFRIGERANT SENSOR or SENSING ELEMENT manufacturers evaluating components used within a REFRIGERANT DETECTION SYSTEM provided by another manufacturer shall declare maximum and minimum DETECTION THRESHOLD LIMIT VALUES for compliance with this Annex, corresponding to the output of the REFRIGERANT SENSOR or SENSING ELEMENT. In such cases, the REFRIGERANT SENSOR or SENSING ELEMENT manufacturer shall provide information about how the output correlates to the test gas concentrations in Table LL.1DV to allow determination of when a REFRIGERANT DETECTION SYSTEM would have initiated the required SYSTEM RESPONSE.

LL.2DV Test gases and default test conditions

LL.2.1DV Unless otherwise specified, the tests of Annex LL are carried out using air and test gases

- **of constant temperature ± 2 °C within the range 15 °C to 25 °C throughout the duration of each test;**
- **of constant relative humidity ± 10 % RH within the range 30 % RH to 70 % RH throughout the duration of each test; and**
- **of constant pressure ± 1 kPa within the range of 86 kPa to 108 kPa throughout the duration of each test.**

Note: Air and refrigerant mixtures for test gases prepared in advance should consider the expected relative humidity.

LL.2.2DV Test gas concentrations for the tests of Annex LL shall be in accordance with Table LL.1DV. Test gas concentration shall be within the applicable tolerance interval.

LL.2.3DV Table LL.1DV illustrates the relationship between DETECTION THRESHOLD LIMIT VALUE, tolerances, and test gas concentrations.

LL.2.4DV Prior to each test, the REFRIGERANT SENSOR and/or REFRIGERANT DETECTION SYSTEM shall be placed within the test chamber in clean air at the environmental conditions specified in Clause LL.2DV (clean air), and energized from a rated source of supply for the manufacturer's declared WARM-UP TIME.

Table LL.1DV
Test gas concentrations

Clause reference	Test description	Test gas concentration % of LFL (unless otherwise indicated)	Low ratio test gas concentration % of LFL	High ratio test gas concentration % of LFL
LL.3.2DV	Response time	25,0 [+0,0/−1,0]	Not applicable	Not applicable
LL.4.3DV	Calibration and short term stability	Not applicable	*DTLV* – [3,0 ± 0,3] but shall not be lower than [1,1 ± 0,1]	*DTLV* + [3,0 ± 0,3] but shall not be higher than [24,7 ± 0,3]
LL.5.9DV	Selectivity test and poisoning test	Not applicable	*DTLV* – [6,0 ± 0,6] but shall not be lower than [1,1 ± 0,1]	*DTLV* + [6,0 ± 0,6] but shall not be higher than [24,7 ± 0,3]
LL.6.4DV a)	Refrigerant poisoning and oil spray test	Not applicable		
LL.6.4DV b)				
LL.6.4DV c)		25,0 [+0,0/−1,0]	Not applicable	Not applicable
LL.7DV	Long-term stability	Not applicable	*DTLV* – [6,0 ± 0,6] but shall not be lower than [1,1 ± 0,1]	*DTLV* + [6,0 ± 0,6] but shall not be higher than [24,7 ± 0,3]
LL.8DV	Humidity test	Not applicable		
LL.9DV	Temperature test	Not applicable		
LL.10DV	Pressure test	Not applicable		
LL.11.3DV	Vibration test	Not applicable		
LL.12DV	Calibration and short term stability during EMI	Not applicable		
LL.13DV	Ignition test	[110 ± 0,5] % of stoichiometric concentration	Not applicable	Not applicable

Table LL.2DV
Relationship among DTLV, tolerance and test gas (informative)

DETECTION THRESHOLD LIMIT VALUE (*DTLV*)	Clause: LL.4DV						Clauses: LL.5.9DV, LL.6.4DV, LL.7DV, LL.8DV, LL.9DV, LL.10DV, LL.11.3DV, LL.12DV					
	Tolerance of REFRIGERANT DETECTION SYSTEM: ± 2,5 % of *LFL*		Low ratio test gas: [3,0 ± 0,3] % of *LFL* below the *DTLV*, but no lower than [1,1 ± 0,1] % of *LFL*		High ratio test gas: [3,0 ± 0,3] % of *LFL* above the *DTLV*, but no higher than [24,7 ± 0,3] % of *LFL*		Tolerance of REFRIGERANT DETECTION SYSTEM: ± 5,0 % of LFL		Low ratio test gas: [6,0 ± 0,3] % of *LFL* below the *DTLV*, but no lower than [1,1 ± 0,1] % of *LFL*		High ratio test gas: [6,0 ± 0,3] % of *LFL* above the *DTLV*, but no higher than [24,7 ± 0,3] % of *LFL*	
	Lower limit	Upper limit	Low ratio test gas, min.	Low ratio test gas, max.	High ratio test gas, min.	High ratio test gas, max.	Lower limit	Upper limit	Low ratio test gas, min.	Low ratio test gas, max.	High ratio test gas, min.	High ratio test gas, max.
% LFL	% LFL	% LFL	% LFL	% LFL	% LFL	% LFL	% LFL	% LFL	% LFL	% LFL	% LFL	% LFL
1,0	1,0	3,5	1,0	1,2	3,7	4,3	1,0	6,0	1,0	1,2	6,7	7,3
2,0	1,0	4,5	1,0	1,2	4,7	5,3	1,0	7,0	1,0	1,2	7,7	8,3
3,0	1,0	5,5	1,0	1,2	5,7	6,3	1,0	8,0	1,0	1,2	8,7	9,3
4,0	1,5	6,5	1,0	1,3	6,7	7,3	1,0	9,0	1,0	1,2	9,7	10,3
5,0	2,5	7,5	1,7	2,3	7,7	8,3	1,0	10,0	1,0	1,2	10,7	11,3
6,0	3,5	8,5	2,7	3,3	8,7	9,3	1,0	11,0	1,0	1,2	11,7	12,3
7,0	4,5	9,5	3,7	4,3	9,7	10,3	2,0	12,0	1,0	1,3	12,7	13,3
8,0	5,5	10,5	4,7	5,3	10,7	11,3	3,0	13,0	1,7	2,3	13,7	14,3
9,0	6,5	11,5	5,7	6,3	11,7	12,3	4,0	14,0	2,7	3,3	14,7	15,3
10,0	7,5	12,5	6,7	7,3	12,7	13,3	5,0	15,0	3,7	4,3	15,7	16,3
11,0	8,5	13,5	7,7	8,3	13,7	14,3	6,0	16,0	4,7	5,3	16,7	17,3
12,0	9,5	14,5	8,7	9,3	14,7	15,3	7,0	17,0	5,7	6,3	17,7	18,3
13,0	10,5	15,5	9,7	10,3	15,7	16,3	8,0	18,0	6,7	7,3	18,7	19,3
14,0	11,5	16,5	10,7	11,3	16,7	17,3	9,0	19,0	7,7	8,3	19,7	20,3
15,0	12,5	17,5	11,7	12,3	17,7	18,3	10,0	20,0	8,7	9,3	20,7	21,3
16,0	13,5	18,5	12,7	13,3	18,7	19,3	11,0	21,0	9,7	10,3	21,7	22,3
17,0	14,5	19,5	13,7	14,3	19,7	20,3	12,0	22,0	10,7	11,3	22,7	23,3
18,0	15,5	20,5	14,7	15,3	20,7	21,3	13,0	23,0	11,7	12,3	23,7	24,3
19,0	16,5	21,5	15,7	16,3	21,7	22,3	14,0	24,0	12,7	13,3	24,4	25,0
20,0	17,5	22,5	16,7	17,3	22,7	23,3	15,0	25,0	13,7	14,3	24,4	25,0
21,0	18,5	23,5	17,7	18,3	23,7	24,3	16,0	25,0	14,7	15,3	24,4	25,0
22,0	19,5	24,5	18,7	19,3	24,4	25,0	17,0	25,0	15,7	16,3	24,4	25,0
23,0	20,5	25,0	19,7	20,3	24,4	25,0	18,0	25,0	16,7	17,3	24,4	25,0
24,0	21,5	25,0	20,7	21,3	24,4	25,0	19,0	25,0	17,7	18,3	24,4	25,0
25,0	22,5	25,0	21,7	22,3	24,4	25,0	20,0	25,0	18,7	19,3	24,4	25,0

LL.3DV Response time of the refrigerant detection system

LL.3.1DV The DETECTION THRESHOLD LIMIT VALUE of the REFRIGERANT DETECTION SYSTEM shall be declared by the appliance manufacturer. Worst case combined effects of shift and drift shall be considered over the condition ranges of the appliance as declared per Clause LL.1.1DV.

The DETECTION THRESHOLD LIMIT VALUE shall not be less than 1,0 % of *LFL* and not greater than 25,0 % of *LFL*. The declaration should include consideration of all tests with the associated low and high ratio test gases.

The REFRIGERANT DETECTION SYSTEM shall not be damaged or deteriorated by release of the refrigerant(s) marked on the appliance, except as follows. If such damage or deterioration of a REFRIGERANT DETECTION SYSTEM occurs, the REFRIGERANT DETECTION SYSTEM or the control of the appliance shall indefinitely latch the SYSTEM RESPONSE until the damaged component has been replaced and shall provide a notification that replacement is required. The REFRIGERANT DETECTION SYSTEM shall be considered subject to damage, if the test of Clause LL.3.2DV is terminated by the REFRIGERANT DETECTION SYSTEM after providing a notification or corresponding signal that replacement is required.

LL.3.2DV The REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within 30 s when the REFRIGERANT SENSOR is directly exposed to a refrigerant gas concentration of 25 % of *LFL*.

Compliance is checked by test.

The test shall be conducted after the REFRIGERANT DETECTION SYSTEM power is switched on in clean air and the WARM-UP TIME has elapsed.

The REFRIGERANT SENSOR shall be exposed to a step change in the gas volume ratio from clean air to the test gas specified in Table LL.1DV within 3,0 s. Velocity of the test gas relative to the REFRIGERANT SENSOR shall not exceed 1.5 m/s.

Exposure shall occur by direct aspiration of a homogenous mixture into an apparatus containing the REFRIGERANT SENSOR within a confined volume, or by injection of refrigerant into a closed chamber containing the REFRIGERANT SENSOR in a manner that mixes with chamber air prior to the mixture arriving at the SENSING ELEMENT, or by inserting the sensor into a chamber containing a homogenous mixture at the target refrigerant gas concentration. If inserting the REFRIGERANT SENSOR into a closed chamber via an external movable door or barrier, the SENSING ELEMENT shall either be entirely inside the chamber with the door closed or be sealed by a push through barrier. If inserting the REFRIGERANT SENSOR into an open chamber the SENSING ELEMENT shall be submerged no less than 50 mm below the interface between the test gas and ambient room air.

The REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within 30 s after the step change is completed.

The measurement of the time of response shall start with the completion of switching from clean air to the test gas.

If the REFRIGERANT DETECTION SYSTEM initiates a SYSTEM RESPONSE within the required time, then the REFRIGERANT SENSOR shall be exposed to clean air.

If the REFRIGERANT DETECTION SYSTEM initiates a SYSTEM RESPONSE indicating a refrigerant leak after 5 h of exposure to clean air, then the REFRIGERANT DETECTION SYSTEM or the appliance shall provide notification to the user that replacement of the REFRIGERANT SENSOR is required (see also Clause 22.122).

If the REFRIGERANT DETECTION SYSTEM provides notification that replacement is required, then it shall be verified for at least 90 min in clean air that the REFRIGERANT DETECTION SYSTEM continues to provide a SYSTEM RESPONSE indicating a refrigerant leak.

LL.3.3DV REFRIGERANT SENSOR or SENSING ELEMENT manufacturers evaluating components used within a REFRIGERANT DETECTION SYSTEM shall declare a response time when tested in accordance with requirements of Clause LL.3.2DV for the maximum DETECTION THRESHOLD LIMIT VALUE declared per Clause LL.1.4DV.

LL.4DV Refrigerant detection system calibration and short-term stability

LL.4.1DV The REFRIGERANT DETECTION SYSTEM shall be calibrated from the manufacturer for the refrigerant marked on the appliance.

Note: The applicable manufacturer may be the REFRIGERANT SENSOR manufacturer, the REFRIGERANT DETECTION SYSTEM manufacturer, or the appliance manufacturer.

LL.4.2DV The DETECTION THRESHOLD LIMIT VALUE shall not be adjustable in the field. Recalibration other than self-recalibration shall not be allowed.

LL.4.3DV The REFRIGERANT DETECTION SYSTEM shall consistently initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 2,5 % of *LFL*, but not lower than 1,0% of *LFL*.

Compliance is checked by inspection and test.

The test shall be conducted after the REFRIGERANT DETECTION SYSTEM power is switched on in clean air and the WARM-UP TIME has elapsed.

Confirm the DETECTION THRESHOLD LIMIT VALUE the REFRIGERANT DETECTION SYSTEM shall respond as intended when tested as follows:

- *The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.*

- *The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.*

Repeat twice after the initial test with a 15 min interval between tests.

LL.5DV Selectivity test and poisoning test

LL.5.1DV REFRIGERANT DETECTION SYSTEMS shall not have false or nuisance trips, or poisoning damage under typical environmental conditions. After being exposed to the gases in Table LL.3DV, the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 5,0 % of *LFL*, but not lower than 1,0 % of *LFL*.

Compliance is checked by the following test.

LL.5.2DV *The REFRIGERANT SENSOR shall be exposed in any sequence to each substance individually, as described in Clauses LL.5.4DV to LL.5.8DV, to the concentrations of gases and vapors shown in Table LL.3DV.*

Table LL.3DV
Gas and vapor concentrations

Substance	Concentration, ppm	CAS RN®
Methane	500	74-82-8
n-Butane	300	106-97-8
n-Heptane	500	142-82-5
Ethyl acetate	200	141-78-6
Isopropyl alcohol	200	67-63-0
Carbon dioxide	5000	124-38-9
Ammonia	100	7664-41-7
Ethanol	200	64-17-5
Toluene	200	108-88-3
Acetone	200	67-64-1
Hexamethyldisloxane	110	107-46-0
Note: CAS RN® stands for Chemical Abstracts Service Registry Number.		

LL.5.3DV *Based on the interior volume of the test chamber used in Clauses LL.5.2DV, calculate the amount of each test substance necessary to supply the concentrations given in Table LL.3DV.*

LL.5.4DV *Ensure that the chamber has been well ventilated with fresh air. Place the REFRIGERANT SENSOR in operation inside the chamber and allow it to run for [15 ± 5] min. Close and seal the chamber to prevent air infiltration.*

LL.5.5DV *Using a syringe or equivalent device, add the calculated amount of a test substance into the chamber at a rate and in a location such that it is well mixed with the air and does not cause localized high concentrations.*

LL.5.6DV *The REFRIGERANT SENSOR shall remain in the chamber for [2 ± 0.02] h. During this time there shall not be a SYSTEM RESPONSE indicating the presence of refrigerant gas concentration above the DETECTION THRESHOLD LIMIT VALUE or indicating a sensor fault.*

LL.5.7DV *Purge the chamber with clean air to remove all of the test atmosphere. Maintain clean air in the chamber for a recovery time of 16 h or as specified by the manufacturer. In no case shall recovery time exceed 16 h.*

LL.5.8DV *Open the chamber and repeat the test from Clauses LL.5.4DV through LL.5.8DV using another substance from Table LL.3DV until the REFRIGERANT SENSOR has been exposed to all substances.*

LL.5.9DV *At the end of the test, following conditions shall be met:*

- *The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.*

- *The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.*

LL.6DV Refrigerant poisoning and oil spray test

LL.6.1DV General

The REFRIGERANT DETECTION SYSTEM shall not be damaged or deteriorated by release of the refrigerant(s) marked on the appliance and oil (if any) contained within the appliance, except as follows. If such damage or deterioration of a REFRIGERANT DETECTION SYSTEM occurs, the REFRIGERANT DETECTION SYSTEM or the control of the appliance shall indefinitely latch after any SYSTEM RESPONSE until the damaged component has been replaced and shall provide a notification that replacement is required. The REFRIGERANT DETECTION SYSTEM shall be considered subject to damage, if the test of Clause LL.6.3DV is terminated by the REFRIGERANT DETECTION SYSTEM after providing a notification or corresponding signal that replacement is required.

After being exposed to the refrigerant(s) marked on the appliance, the REFRIGERANT DETECTION SYSTEM shall either:

- **consistently initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 5,0 % of *LFL*, but not lower than 1,0 % of *LFL*, and initiate a SYSTEM RESPONSE within 60 s when the REFRIGERANT SENSOR is put into refrigerant concentration of 25 % of *LFL*; or**

- **initiate a SYSTEM RESPONSE indicating a refrigerant leak that continues until the REFRIGERANT SENSOR has been replaced.**

Compliance is checked by the following test.

LL.6.2DV *Test set-up*

a) The test is conducted using a cylindrical test chamber constructed per Figure LL.1DV. The test chamber volume shall be no less than 15 L and not more than 50 L, with height to diameter ratio in the range of 1,2 to 2,0.

b) The test chamber shall be located in a test environment with ambient conditions controlled throughout the duration of the test to the default test conditions of Clause LL.2DV. The test chamber shall have a known volume $V_{chamber}$ and height $h_{chamber}$ with provisions to mount the REFRIGERANT SENSOR at a height of 5 % ~ 10 % × $h_{chamber}$ on or above a false floor allowing liquid to drain to the bottom of the chamber, and for the spray orifice at a height of 50 % ~ 55 % × $h_{chamber}$ directed in a horizontal direction (± 5°).

c) The REFRIGERANT SENSOR shall be installed in the most unfavourable of any orientation permissible when installed within the appliance. Permissible installation orientation(s) shall be as declared by the manufacturer or as stated in the installation manual. The top of the test chamber shall include inlet and outlet openings of area A_{in} ± 5 % and A_{out} ± 5 % and a fan with an airflow rate of Q_{fan} ± 5 % when operating at zero static pressure difference.

d) The inlet and outlet openings shall be configured to avoid recirculation of the exhaust. The spray orifice shall be a square edge cylindrical hole with a length to diameter ratio in the range of 1,0 to 2,0, with the diameter selected to achieve the required liquid mass flow rate. Liquid spray mass flow rate shall be measured. The average measured rate shall be within ± 20 % of the required value.

$$m_r = 0{,}075 \times V_{chamber} \quad \textbf{(LL.1DV)}$$

$$m_{liquid} = \frac{m_r}{(1 - w_{oil})} \quad \textbf{(LL.2DV)}$$

$$Q_{fan} = \frac{0{,}0015 \times m_r \times w_{oil}}{LFL} \quad \textbf{(LL.3DV)}$$

$$A_{in} = \frac{Q_{fan}}{1,5} \quad \text{(LL.4DV)}$$

$$A_{out} = \frac{Q_{fan} + \frac{m_r}{1000 \times \rho_{vap}}}{1,0} \quad \text{(LL.5DV)}$$

Where

m_r *[g/s]* is the refrigerant mass flow rate

$V_{chamber}$ *[L]* is the internal free volume of the test chamber

m_{liquid} *[g/s]* is the total liquid mass flow rate

w_{oil} *[-]* is the mass fraction of oil mixed in the refrigerant

Q_{fan} *[m^3/s]* is the volumetric airflow rate of the fan with zero static pressure

***LFL [kg/m^3]* is the LOWER FLAMMABILITY LIMIT expressed as density**

w_{vapor} *[-]* is the mass fraction (two-phase vapor quality) of refrigerant vapor when pressure is reduced at constant enthalpy from saturated liquid at ambient temperature to atmospheric pressure of the test environment

ρ_{vap} *[kg/m^3]* is the density of saturated refrigerant vapor (at dew point) at the ambient atmospheric pressure of the test environment

A_{in} *[m^2]* is the cross sectional area of the fan supply opening

A_{out} *[m^2]* is the cross sectional area of the exhaust opening

Note 1: The following values are constants:

0,075 [g·s^{-1}·L^{-1}]

0,0015 [kg/g]

1,5 [m/s]

1000 [g/kg] and

1,0 [m/s]

Note 2: w_{vapor} ≈ 0,3 to 0,4 for many refrigerants depending on ambient conditions, calculate the actual value using refrigerant properties for the refrigerant marked on the appliance nameplate.

e) The REFRIGERANT SENSOR shall be exposed either to a mixture of refrigerant and oil if the appliance contains oil in the refrigerant circuit, or to refrigerant only if the appliance refrigerant circuit is oil-free. The refrigerant shall be as marked on the appliance, repeating the test with new sensor samples for each refrigerant if multiple refrigerants are marked. The oil shall be either the same used in the appliance or an oil with similar miscibility

characteristics in a temperature range of 10 °C to 30 °C, and the oil concentration as mass fraction shall be either w_{oil} = 0,020 ± 0.001 or a value determined to be representative of the appliance during NORMAL OPERATION. The refrigerant shall be taken from the liquid phase of the refrigerant cylinder. The tubing or piping between the refrigerant cylinder and the spray orifice shall be sized, and the height of the refrigerant cylinder above the spray orifice shall be selected, to avoid flashing in a sight glass upstream of the orifice during the liquid refrigerant release.

LL.6.3DV *Test procedure*

A setup according to Clause LL.6.2DV shall be provided as follows:

a) Place the REFRIGERANT SENSOR in the test chamber and after the WARM-UP TIME has elapsed operate it for [15 ± 5] min in clean air.

b) The refrigerant and oil mixture shall be sprayed for 4 min (or until test is terminated).

c) The REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within 30 s, otherwise the test is terminated.

d) Fan shall be activated [15 ± 1,0] s after the REFRIGERANT DETECTION SYSTEM initiates a SYSTEM RESPONSE.

e) Fan shall be deactivated no less than 5 min after the REFRIGERANT DETECTION SYSTEM resets, but not before the liquid temperature sensor at the bottom of the test chamber returns to within 2 K of the test environment temperature.

f) If the REFRIGERANT DETECTION SYSTEM or the appliance provides notification to the user that replacement of the REFRIGERANT SENSOR is required then the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE indicating a refrigerant leak until the REFRIGERANT SENSOR has been replaced and the test shall be terminated. (See Clause 22.122)

g) Test according to Clause LL.6.4DV.

h) Repeat Items b) to f) (total of two spray cycles) unless test is terminated.

Operate the REFRIGERANT DETECTION SYSTEM in clean air for either 24 h or the manufacturer's declared recovery time period, whichever value is less. If the test was terminated by stage c) without the notification of stage d) then the REFRIGERANT DETECTION SYSTEM cannot be tested in accordance with Clause LL.6.4DV and is considered not compliant.

LL.6.4DV *Compliance criteria*

After the recovery time period, to confirm the DETECTION THRESHOLD LIMIT VALUE and response time the REFRIGERANT DETECTION SYSTEM shall respond as intended when tested as follows:

a) The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.

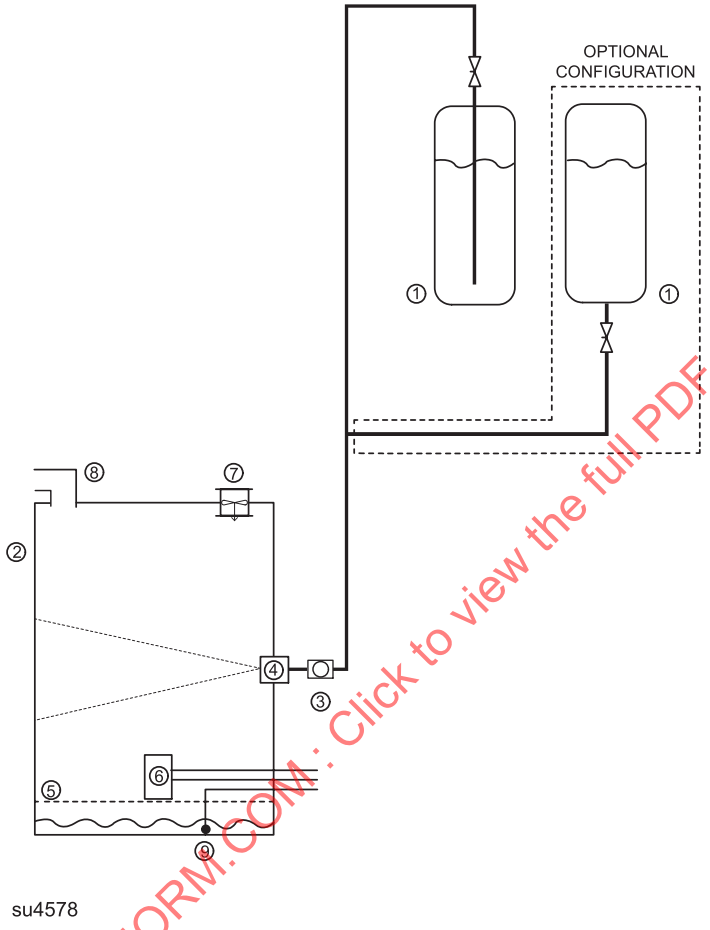
b) Operate in clean air for [15 ± 5] min. The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.

c) Operate in clean air for [15 ± 5] min. The REFRIGERANT SENSOR shall be exposed to the test gas specified in Table LL.1DV and the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM

RESPONSE within 60 s. The exposure shall be a step change meeting the exposure requirements for the test of Clause LL.3.2DV.

If the REFRIGERANT DETECTION SYSTEM provides notification that replacement is required, then verify for at least 90 min that the REFRIGERANT DETECTION SYSTEM continues to provide a SYSTEM RESPONSE indicating a refrigerant leak.

The number of samples in the test chamber may vary from 1 to 3, provided that each sample is located not more than 20 % of the test chamber diameter from the center; if testing more than one sample at the same time the first sensor to respond triggers the timer for the fan operation.



1 – Refrigerant cylinder with liquid connection
2 – Cylindrical test chamber
3 – Sight glass
4 – Spray orifice
5 – False floor with liquid drains
6 – Device under test (Refrigerant sensor)
7 – Supply fan
8 – Exhaust opening
9 – Liquid temperature sensor

Figure LL.1DV

Test Chamber for Refrigerant Poisoning and Oil Spray Test

Table LL.4DV
Example of the test chamber design
(informative)

Test chamber volume	$V_{chamber}$	20 L
Local Atmospheric Ambient Pressure		100,0 kPa
Ambient Temperature		20 °C
Refrigerant		R-32
	LFL	0,306 kg/m^3
saturated vapor density at ambient conditions	ρ_{vap}	2,95 kg/m^3
refrigerant mass flow rate	m_r	1,500 g/s
mass fraction of oil	w_{oil}	0,0200 [-]
total liquid mass flow rate	m_{liquid}	1,531 g/s
mass fraction (vapor quality) flashed refrigerant at ambient conditions	w_{vapor}	0,319 [-]
airflow rate	Q_{fan}	0,00235 m^3/s
		140,8 L/min
fan supply opening area	A_{in}	0,001564 m^2
diameter (if circular opening)		44,6 mm
fan exhaust opening area	A_{out}	0,00285 m^2
diameter (if circular opening)		60,3 mm
orifice size: as required to achieve (1,531 g/s) ± 20 % when measuring the average flow rate (e.g. weight change of refrigerant cylinder divided by 240 s)		

LL.7DV Long-term stability

LL.7.1DV Over a period of 90 days the REFRIGERANT DETECTION SYSTEM shall consistently initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 5,0 % of *LFL*, but not lower than 1,0 % of *LFL*.

Compliance is checked by the following test:

The REFRIGERANT SENSOR shall be exposed to clean air and energized continuously for a period of 90 days. The constant pressure requirement of Clause LL.2.1DV shall not apply to this test. Every 15 days, the following shall occur:

- ***The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.***

- ***The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.***

LL.7.2DV The manufacturer shall provide data or evidence concerning the life of the REFRIGERANT SENSOR relative to the life of the appliance. If the REFRIGERANT SENSOR life is less than the appliance life then the sensor shall be designated as a LIMITED LIFE REFRIGERANT SENSOR.

LL.8DV Humidity test

Over the humidity range of the appliance, the REFRIGERANT DETECTION SYSTEM shall consistently initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 5,0 % of *LFL*, but not lower than 1,0 % of *LFL*.

NOTE Condensation can occur on REFRIGERANT SENSORS. This is not considered by Annex LL.

Compliance is checked by the following test:

The REFRIGERANT SENSOR shall be exposed for 60 min to clean air humidified to the lesser of [10 ± 3] % RH at [22 ± 2] °C or the minimum absolute humidity declared per Clause LL.1.1DV at [22 ± 2] °C.

To confirm the DETECTION THRESHOLD LIMIT VALUE, the REFRIGERANT DETECTION SYSTEM shall respond as intended when tested as follows with the test gas conditioned to the same humidity and temperature:

- *The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.*

- *The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.*

The procedure shall be repeated at the greater of [90 ± 5] % RH at [40 ± 2] °C or the maximum absolute humidity declared per Clause LL.1.1DV. The test temperature shall be adjusted as necessary to achieve the worst case declared maximum absolute humidity range per Clause LL.1.1DV while simultaneously maintaining the relative humidity to the greater of [90 ± 5] % RH or the maximum relative humidity declared per Clause LL.1.1DV. The test condition shall be at a non-condensing humidity state.

LL.9DV Temperature test

Over the temperature range of the appliance, the REFRIGERANT DETECTION SYSTEM shall consistently initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 5,0 % of *LFL*, but not lower than 1,0 % of *LFL*.

Compliance is checked by the following test:

Place the REFRIGERANT SENSOR in operation inside a chamber having the capability of holding the REFRIGERANT SENSOR at the specified temperatures within ± 2 K. The REFRIGERANT SENSOR shall be acclimated at each of the following temperatures for at least 3 h or until acclimated within ± 2 K for a minimum of 1 h:

- *The minimum temperature that the REFRIGERANT SENSOR can be exposed to in the application as declared by the manufacturer per Clause LL.1.1DV, or lower*

- *The maximum temperature that the REFRIGERANT SENSOR can be exposed to in the application as declared by the manufacturer per Clause LL.1.1DV, or higher*

To confirm the DETECTION THRESHOLD LIMIT VALUE at each of the above mentioned temperatures, the REFRIGERANT DETECTION SYSTEM shall respond as intended when tested as follows with the test gas at the same temperature:

- *The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.*

- *The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.*

Note: Humidity prior to the start of the test will be per Clause LL.2.1DV, however humidity is not controlled during the temperature test.

LL.10DV Pressure test

Over the air pressure range of the appliance, the REFRIGERANT DETECTION SYSTEM shall consistently initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 5,0 % of *LFL*, but not lower than 1,0 % of *LFL*.

Compliance is checked by the following test:

Place the REFRIGERANT SENSOR in operation inside a chamber having the capability of holding the REFRIGERANT SENSOR at the specified pressures within ± 1.0 kPa. The REFRIGERANT SENSOR shall be acclimated at each of the following pressures for at least 1 h:

- ***The lower of either 80 kPa or the minimum pressure that the REFRIGERANT SENSOR can be exposed to in the application as declared by the manufacturer per Clause LL.1.1DV***

- ***The higher of either 110 kPa or the maximum pressure that the REFRIGERANT SENSOR can be exposed to in the application as declared by the manufacturer per Clause LL.1.1DV***

To confirm the DETECTION THRESHOLD LIMIT VALUE at each of the above mentioned pressures, the REFRIGERANT DETECTION SYSTEM shall respond as intended when tested as follows with the test gas at the same pressure:

- ***The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.***

- ***The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min and the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.***

NOTE: The test pressure can be adjusted by use of a variable volume test chamber, for example by expanding or contracting a bladder within the test chamber to adjust the test pressure without changing the test gas volume ratio.

LL.11DV Vibration test

LL.11.1DV Vibration requirements apply to the REFRIGERANT DETECTION SYSTEM. Vibration requirements for the REFRIGERANT DETECTION SYSTEM shall be tested as installed as follows, when declared by the manufacturer.

The REFRIGERANT DETECTION SYSTEM shall withstand vibration without breakage or damage of parts and shall continue to function.

After the vibration test, the REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE at the DETECTION THRESHOLD LIMIT VALUE within a tolerance of ± 5,0 % of *LFL*, but not lower than 1,0 % of *LFL*.

Compliance is checked by the following test:

To comply with the vibration requirements, the REFRIGERANT DETECTION SYSTEM shall be secured using the intended mounting means, and in turn securely fastened to a variable speed vibration test machine having an amplitude and frequency as follows:

- ***10 Hz to 31,5 Hz, with 1,0 mm total displacement;***

- ***31,5 Hz to 150 Hz, with 2 g_{rms} acceleration peak; or***

- ***higher values of displacement or acceleration as declared by the manufacturer.***

NOTE: The REFRIGERANT SENSOR may be tested independently from the other components of the REFRIGERANT DETECTION SYSTEM as long as the REFRIGERANT DETECTION SYSTEM is tested as a complete system where the SYSTEM RESPONSE is evaluated.

LL.11.2DV *The REFRIGERANT DETECTION SYSTEM shall be vibrated over the specified frequency range, displacement and acceleration for a period of 1 h in each of the three mutually perpendicular planes. The change rate shall not exceed 10 Hz/min.*

Alternatively the REFRIGERANT DETECTION SYSTEM may be tested using the vibration test of Clause 21.101DV.1.

LL.11.3DV *After the vibration test the REFRIGERANT DETECTION SYSTEM shall respond as intended when tested as follows:*

- *The REFRIGERANT SENSOR shall be exposed to the low ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall not initiate a SYSTEM RESPONSE within this time.*

- *The REFRIGERANT SENSOR shall be exposed to the high ratio test gas specified in Table LL.1DV for 5 min. The REFRIGERANT DETECTION SYSTEM shall initiate a SYSTEM RESPONSE within this time.*

- *A visual observation shall confirm that the REFRIGERANT SENSOR has not become detached from its mounting means.*

LL.12DV Electromagnetic compatibility test

The REFRIGERANT DETECTION SYSTEM shall be immune or otherwise fault tolerant to surrounding radiated radio-frequency electromagnetic energy.

Compliance is checked by test.

The REFRIGERANT DETECTION SYSTEM is subjected to radiated fields in accordance with IEC 61000-4-3.

The frequency ranges tested shall be:

– *80 MHz to 1 000 MHz, test level 3;*

– *1,4 GHz to 2,0 GHz, test level 3;*

– *2,0 GHz to 2,7 GHz, test level 2.*

The dwell time for each frequency is to be sufficient to observe a possible malfunction of the REFRIGERANT DETECTION SYSTEM.

NOTE: See Clause 19.11 of the Part 1, and Clause 19 of the Part 2.

After subjected to radiated fields, the REFRIGERANT DETECTION SYSTEM shall pass the tests of Clause LL.4.3DV, when using modified acceptance criteria of DTLV within a tolerance of ± 5,0 % of *LFL* but not lower than 1,0 % of *LFL*.

LL.13DV Ignition test

REFRIGERANT SENSORS shall not be a source of ignition for leaked refrigerant.

Compliance is checked by inspection or test.