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

Third Edition, Dated November 1, 2019

Summary of Topics

This third edition of ANSI/UL 60335-2-40 is an alignment with IEC 60335-2-40:2018 (6th edition), with national differences.

The new requirements are substantially in accordance with Proposal(s) on this subject dated December 7, 2018 and July 12, 2019.

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Third Edition

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

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

November 1, 2019

Approved American National Standard

ANSI/UL 60335-2-40-2019

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 any time. 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.

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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 inquires@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 Third Edition.

The most recent designation of ANSI/UL 60335-2-40 as an American National Standard (ANSI) occurred on November 1, 2019. 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 Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers. It is the third edition of CAN/CSA-C22.2 No. 60335-2-40, and the third edition of UL 60335-2-40. This edition of CAN/CSA-C22.2 No. 60335-2-40 supersedes the previous edition (s) published on September 15, 2017. This edition of UL 60335-2-40 supersedes the previous edition(s) published on September 15, 2017.

This harmonized standard is based on IEC Publication 60335-2-40: 6.0 edition 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.

At the time of this publication, IEC 60335-2-40, Edition 6.0 is available from IEC in English only. CSA Group will publish the French version when it becomes available from the IEC.

In Canada, for general requirements on the standards of the Canadian Electrical Code, Part II, see CAN/CSA-C22.2 No. 0.

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.

This CAN/CSA-C22.2 No. 60335-2-40, Standard for Safety for Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers is to be used in conjunction with the second edition of CAN/CSA-C22.2 No. 60335-1:16. The requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers are contained in this Part 2 Standard and CAN/CSA-C22.2 No. 60335-1:16. Requirements of this Part 2 Standard, where stated, amend the requirements of CAN/CSA-C22.2 No. 60335-1:16. Where a particular subclause of CAN/CSA-C22.2 No. 60335-1:16 is not mentioned in CAN/CSA-C22.2 No. 60335-2-40, the CAN/CSA-C22.2 No. 60335-1:16 subclause applies.

This UL Standard 60335-2-40 Standard for Safety for Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers, 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 and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows:

a) Technical national differences are allowed for national differences resulting from conflicts in 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.

b) Presentation is word for word except for editorial changes that do not alter the technical content of the standard. Examples of editorial changes include:

1) different font sizes, figure sizes, and table sizes;

2) minor variations in format, such as indentation and pagination;

3) font appearance (including the use of italic or bold text or uppercase or lowercase letters);

4) the use of a symbol (e.g., A or %) rather than the word (Ampere or percent), or the word rather than the symbol;

5) inclusion of inch-pound units for informational purposes;

6) corrections of misprints or typographical errors;

7) bilingual column headings or figure captions on a common table or figure in a bilingual edition;

8) change from first-angle to third-angle drawing;

9) addition of a statement: “This is a first-angle drawing”; and

10) substitution of a point (.) for a comma (,) as the decimal marker.

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.

These materials are subject to copyright claims of IEC and UL. No part of this publication may be reproduced in any form, including an electronic retrieval system, without the prior written permission of UL. All requests pertaining to the Household and Similar Electrical Appliances – Safety – Part 2-40: Particular Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers, UL 60335-2-40 Standard should be submitted to UL.

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NATIONAL DIFFERENCES

GENERAL

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.

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.

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5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

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

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

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

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

Subcommittee 61 D has prepared International Standard IEC 60335: 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/XX/FDIS	61D/XX/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 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.

A bilingual version of this publication may be issued at a later date.

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 ***Modification of the of the first sentence of the 7th paragraph after item 9 by replacing it with the following paragraph:***

This Part 2-40 is intended to be used in conjunction with CAN/CSA-C22.2 No. 60335-1:16 and the sixth edition of UL 60335-1. All references in this standard to IEC 60335-1 shall be replaced by CAN/CSA-C22.2 No. 60335-1:16 and the sixth edition of UL 60335-1.

102DV DE ***Modify the paragraph following NOTE 3 in the Part 2 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 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 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, dehumidifiers, 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 International Standard.

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

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

a) A1; and

b) B1 (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.1 DR *Modification of Clause 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 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/NFPA 70, *National Electrical Code*

ANSI/NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*

ANSI/NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*

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*

CAN/ULC-S102, ***Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies***

CSA B52, ***Mechanical Refrigeration Code***

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

CAN/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. 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. 100, ***Motors and generators***

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

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

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

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

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

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

CAN/CSA-C22.2 No. 198.1, ***Extruded insulating tubing***

CSA C22.2 No. 253, ***Medium-voltage ac contactors, controllers, and control centres***

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

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***

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

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

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

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

CSA Technical Information Letter No. M-07, ***Interim Certification Requirements for Photovoltaic (PV) Arc-Fault Protection (DC-AFP)***

IAPMO, ***Uniform Mechanical Code***

ICC, ***International Mechanical Code***

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

UL 67, ***Panelboards***

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

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

UL 224, ***Standard for Extruded Insulating Tubing***

UL 347, ***Standard for Medium-Voltage AC Contactors, Controllers, and Control Centers***

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

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

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

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

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

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

UL 1441, ***Standard for 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, ***Standard for Tests for Flammability of Small Polymeric Component Materials***

UL 1699B, ***Standard for 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 2043, ***Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces***

UL 2395, ***Standard for 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 9703, ***Outline of Investigation for Distributed Generation Wiring Harnesses***

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

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

IEC 60079-29-1, ***Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases***

IEC 60079-29-2, ***Explosive atmospheres – Part 29-2: Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen***

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

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

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***

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

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

3.101
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

3.115
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:***

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

3.121
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 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 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 metres.

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 metres.

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.

3.139
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

3.141
A2L REFRIGERANT
refrigerant classed as A2L according to ISO 817

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

3.143DV D1 ***Delete Clause 3.143 of the Part 2:***

This definition does not apply.

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 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 ($\lambda \approx 1$ nm) and the region of transition to radio waves ($\lambda \approx 1$ 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

3.151
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]

3.152
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 $\mu W/cm^2$

3.154
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 1DV 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 tapped control circuit is one 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
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 maximum quantity of refrigerant that can be released into a space

3.166DV
PRESSURE-RELIEF VALVE
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
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, which takes up 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
fitting made with a metal of a known low melting temperature. 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
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
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 field 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 installation for field installation of an accessory or option

3.177DV
LEAK DETECTION SYSTEM
a sensing system which 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 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)
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
part of the refrigerant sensor which is sensitive to the gas/vapour to be measured.

3.189DV
REFRIGERANT SENSOR
assembly in which the sensing element is housed and that can also contain associated circuit components

3.190DV
INTEGRAL REFRIGERANT SENSOR
a sensor that is within or directly mounted to the equipment housing.

Note 1DV to entry: Refrigerant sensors directly mounted in the appliance are integral refrigerant sensors.

3.191DV
LIMITED LIFE REFRIGERANT SENSOR
A REFRIGERANT SENSOR which is expected to fail within the life of the appliance.

4 General requirement

This clause of Part 1 is applicable.

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

All references to "sanitary hot water heat pumps" in this Part 2 shall be replaced with "hot water heat pumps and heat recovery units".

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.

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 a separate sample.

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.

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

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 5.101 of this Part 2 as follows:***

Replace "IEC 60335-2-34:2012" with "UL 60335-2-34:2017 and 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 5.102 of this Part 2 as follows:***

Replace "IEC 60335-2-34" with "UL 60335-2-34 and 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.

6.101 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.

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 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 (permanently connected equipment only)

– branch circuit selection current (BCSC) or if RLA exceeds 64% of maximum continuous current (MCC)

– 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".

Multiple motor load and combination-load equipment used in one- and two-family dwellings or cord and attachment plug connected equipment are not required to be marked with a short-circuit current rating (SCCR).

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

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 tenth paragraph of 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.

7.1DV.6 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 colour 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 colour mark shall extend at least 25 mm (1 inch) from the refrigerant servicing point and shall be replaced if removed.

7.1DV.7 D1 ***Modification of Clause 7.1 of the Part 2 to add the following at the end:***

If the refrigerant is flammable, symbol ISO 7010-W021, 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 colour.

7.1DV.8 D1 ***Modification of Clause 7.1 of this part 2 by addition of the following:***

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.9 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.10 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.11 D1 ***Modification of Clause 7.1 of the Part 2 by adding the following at the end of subclause 7.1:***

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.12 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.13 D1 ***Modification of subclause 7.1 of the Part 2 by addition of the following:***

Note 101 is applicable to the 6th dashed item after addition in Clause 7.1.

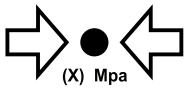
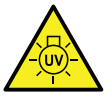
7.2DV D1 ***Modification of clause 7.2 of the Part 1 by replacing with:***

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.

7.6 *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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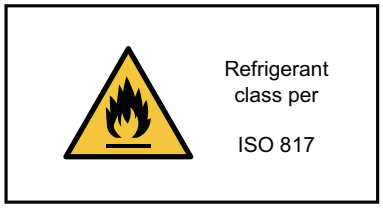
7.6DV D1 ***Modification of subclause 7.6 by addition by the following:***

Replace symbol ISO 7010-W021 with:



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

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.

7.15 *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.

7.102 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.

7.104 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).

7.105 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 adding the following:***

The marking shall be on the unit or units which must remain powered to activate the detection system and mitigation means. The marking shall be visible after installation without the removal of panels. An additional marking shall be provided in the form of a ship-with label with instructions to be applied on or adjacent to the nearest means of disconnection from the mains. This same information shall also be included in the instructions.

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.

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.

7.109 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 pressures 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 pressure as determined in Annex EE.

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

7.112DV.1 Cord-connected appliances shall be marked with the following: A statement requiring that a damaged cord be replaced with one supplied by the unit manufacture and not repaired.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

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.

10 Power input and current

This clause of Part 1 is applicable.

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:*

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.

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.

11.2.1 *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 to add a note as follows:*

NOTE 1DV – For horizontal ducted products, reference Figure 102b, rotated 90 degrees counter clockwise.

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 102a) or the minimum distance specified by the manufacturer, whichever is lower:

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

NOTE 2DV Appliancess, may be specified by the manufacturer for use in applications with limited space for the appliance and connected ducts. Examples:

– 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 this Part 2 by addition of 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 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. The unit shall then be operated continuously until temperatures and pressures 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 by addition of the following note.*

NOTE 2 For evaporating and condensing units, it may not be necessary to operate the refrigeration system during the test of Clause 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,

– the control box is externally loaded at not less than the marked compressor RLA or MRC and themarked 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 of Clause 11.3 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 by deleting the last sentence of Clause 11.4 of the Part 2.*

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

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

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:

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

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.

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*

Table 3 Continued on Next Page

Table 3 Continued

Parts	Temperature °C
– 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:	
• 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*

Table 3 Continued on Next Page

Table 3 Continued

Parts	Temperature °C
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.

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.

Table 3 Continued on Next Page

Table 3 Continued

Parts	Temperature °C
[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) 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"

b) Replace note a) of Table 3 with the following:

[a] Not required for motor-compressors that comply with Annex AA of UL 60335-2-34:2017 and CSA 60335-2-34-17.

c) Add the following note: "NOTE 103DV A maximum temperature for RTV silicon rubber is 130°C."

d) Add the following rows to the Table:

Parts	Temperature °C
Surfaces of product, discharge plenum, and duct at points of specified zero clearance to test enclosure	**92**
Surfaces of test enclosure where clearance more than zero to combustible material is specified	**92**
Appliance with a heat exchanger for the purpose of heating water, water 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.

13.1DV D2 *Modification of Clause 13.1 in the Part 1 by adding the following:*

For appliances with supplementary heat or provisions for supplementary heat tested in accordance with Clause 19.2, the leakage and dielectric test of Clause 13 of the Part 2 shall be conducted following completion of the tests of Clause 19.

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 D1 *Modification of Clause 13.2 of the Part 2 by replacing with the following:*

For permanently connected stationary class I appliances, the leakage current may exceed 3,5 mA, but 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.

13.2ADV D1 *Add Clause 13.2ADV.1 to Clause 13 of the Part 2:*

13.2ADV.1 For appliances rated greater than 600 V, leakage currents do not apply. The electrical strength test may be completed after testing as required by Clause 15. Electrical strength tests shall be conducted in accordance with Annex 101.DVH.

13.3DV D2 *Modification of Clause 13.3 of the Part 1 by adding of the following:*

A DC potential equivalent to 1,414 times the test voltage specified in Table 4 may 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 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.

15.3 *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 replacing with the following:*

For permanently connected stationary class I appliances, the leakage current may exceed 3,5 mA, but 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.

16.2ADV D1 *Add Clause 16.2ADV.1 to Clause 16 of the Part 2:*

16.2ADV.1 For appliances rated greater than 600 V, leakage currents do not apply. Electrical strength tests shall be conducted in accordance with Annex 101.DVH.

16.3DV D2 *Modification of Clause 16.3 of the Part 1 by adding the following:*

A DC potential equivalent to 1,414 times the test voltage specified in Table 7 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 NFPA 70 and clauses 26-252 or 26-254 of CSA C22.1; or

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.

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 replacing the last paragraph of Clause 19.1 of the Part 2 with the following:*

Appliances are additionally subjected to the tests specified in Clauses 19.104 and 19.105DV, as applicable.

19.1DV.2 D2 *Modification of Clause 19.1 of the Part 2 by adding the following:*

Appliances with supplementary heaters or provision for supplementary heaters shall be configured with inlet and outlet ducts and instrumented in accordance with the applicable clauses 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 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 *Modification of Clause 19.2 of the Part 2 by replacing it with Clauses 19.2DV.1 – 19.2DV.4:*

19.2DV.1 All appliances provided with SUPPLEMENTARY HEATERS shall be subjected to the following test under the conditions specified in Clause 11. Appliances shall be operated at RATED VOLTAGE or at the upper limit of the RATED VOLTAGE RANGE of the SUPPLEMENTARY HEATERS.

19.2DV.2 Limit cut-out: 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 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. After steady state conditions are reached, the restriction shall be resumed. The test shall continue until the last self-resetting thermal cut-out operates.

The outlet air temperature shall not exceed 93°C.

19.2DV.3 Heating operation: After the airflow conditions specified are established, the indoor airflow shall be 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 self-resetting thermal cut-out device operated for the first time as a result of slowly restricting the free area of the inlet.

The appliance shall operate until steady state conditions are established or for 1 h, whichever is longer. During the test, the temperatures shall be 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 as described in Clause 19.2DV.2 may be short-circuited, if necessary.

19.2DV.4 Restricted inlet: After the airflow conditions specified are established, the airflow shall be restricted at a rate of 1°K/min outlet air temperature rise until a self-resetting thermal cut-out device operates 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. After steady state conditions are reached the restriction shall be resumed. The test shall continue until the inlet is fully restricted.

The temperatures shall be monitored continuously. Temperatures shall not exceed the values shown in Table 3 + 30°C during the first hour, and as shown in Table 3 thereafter.

NOTE: The tests of Clause 19.2DV.4 may be conducted immediately after the tests of Clause 19.2DV.2.

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.

19.4 *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 a note to Clause 19.4 of the Part 2:*

NOTE 1DV For appliances with supplementary heat, the test of Clauses 19.2 (limit cut-out, heating operation and restricted inlet), 19.101 (fan failure), 19.101DV.1 (blocked outlet), 19.104 (curtain drape) and 19.105DV (back up protection) address the fault conditions as indicated in parenthesis. There can be other forms of operation or defects that could result in a hazardous condition that need to be addressed which are not be 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 CAN/CSA-22.2 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.1 D1 *Modification of Clause 19.7 of the Part 2:*

Replace "IEC 60335-2-34:2012" with "UL 60335-2-34:2017 and CSA 60335-2-34-17" in the second paragraph.

19.7DV.2 D1 *Modification of clause 19.7 of this Part 2 by addition of the following:*

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

– C22.2 No. 77 – Motors with Inherent Overheating Protection

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.

19.11.4 *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.

19.11.4.8 *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:*

Parts	Temperature Rise – °K
Surfaces of product, discharge plenum, and duct at points of specified zero clearance to test enclosure	100
Surfaces of test enclosure where clearance more than zero to combustible material is specified	100

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 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 by adding the following:***

Contacts tested for 100K cycles are considered to meet the intent of Clause 19.14, and only one set of contacts shall be required.

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.

19.101DV.1 D2 ***Modification of clause 19.101 of this part 2 by addition of the following:***

In appliances in which the compressor is enclosed by a non-metallic material, the following test shall apply.

The test shall be conducted under each of the following conditions:

– with 75% of the charge removed

– 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 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.

Component temperatures shall:

a) not exceed the temperature limits in Clause 11;

b) not exceed the relative thermal index of the material in accordance with UL 746B and CAN/CSA C22.2 No. 0.17 for polymeric materials.

Compliance is checked by inspection, and in case of doubt, the test shall be conducted.

19.101DV.2 D1 ***Modification of Clause 19.101 of the Part 2 by adding the following:***

Blocked outlet: The appliance shall be 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 appliance outlet air opening shall be 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 without a duct system (free air discharge) with any air discharge openings located more than 1,22 m above the floor level when the unit is installed as intended.

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.

19.103 *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 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.

19.105DV D1 *Add Clause 19.105DV.1 to Clause 19 of the Part 2:*

19.105DV.1 Backup Protection: For appliances with supplementary heaters, all self-resetting thermal cut-outs shall be by-passed and the tests of Clauses 19.2DV.4, 19.101, and 19.101DV.1 shall be repeated.

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.

The temperature limits and outlet air temperature limits of Clause 19.2DV.4 do not apply.

Clauses 19.13 of the Part 2 and of the Part 1 do not apply to this test.

19.106DV D1 *Modification by addition of new subclause to Clause 19 of this 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.1 D1 *Modification of Clause 21.1 of the Part 2 by replacing it with the following:*

Safety requirements specified in ANSI/ASHRAE 15 (USA) and CSA B52 (Canada) shall apply.

Safety requirements specified in Annex EE shall apply. The pressure test in Annex EE applies to parts other than pressure vessels.

Compliance shall be shown by test. The tests shall be conducted in accordance with the tests of Clause EE.5 of Annex EE.

21.1DV.2 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.3 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 this Part 2 by addition of the following:***

Alternatively, the appliance may be tested by a transport test by representative shipping mode(s) such as truck, rail, air, and/or ocean.

21.101DV D1 ***Add Clauses 21.101DV.1 – 21.101DV.9 to Clause 21 of the Part 1:***

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 above tests, the appliance shall comply with Clause 20.2 of the Part 1 even with any deflection or permanent deformation that might occur. The equipment shall comply with the requirements in this standard following these tests in the as-received condition.

21.101DV.7 If electrical enclosure seal gaskets are required to comply with the tests of Clause 15, then they shall comply with Annex 101.DVD.

21.101DV.8 Appliances intended to be suspended from the wall or ceiling shall withstand the test described in Clause 21.101DV.9 without falling from its intended mounting location.

21.101DV.9 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 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.

22.11DV.1 D1 ***Modification of Clause 22.11 of the Part 1 by adding the following sentence to the first paragraph:***

A door or cover of an enclosure giving access to a fuse shall be hinged, sliding type, pivoted, or equivalent and provided with an automatic latch, and secured in a manner that requires a tool for opening, for fuses other than:

a) fuses connected in Class 2 circuits;

b) extractor type fuses that have their own enclosures;

c) 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

d) 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.

22.11DV.2 D1 ***Modification of Clause 22.11 of the Part 1 by adding of the following paragraph:***

An interlock that is required to reduce the risk of electric shock shall open all supply conductors. An interlocking mechanism shall be:

– engaged before parts in a hazardous voltage circuit can be energized; and

– 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.

22.46 *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.

22.101 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.

22.102.2 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.

22.102.3 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.

22.104 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 shall meet the requirements of CSA 22.2 No. 110, 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 *Deletion: Clause 22.105DV 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 *Deletion: Clause 22.106DV 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 *Deletion: Clause 22.107DV 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 *Deletion: Clause 22.108DV 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 CUT-OUT, 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 of 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 *Add Clauses 22.112DV.1 - 22.112DV.20 to the Part 2:*

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.

22.112DV.3 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.4 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 pressure in case of fire.

22.112DV.5 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.6 A pressure vessel having an inside diameter greater than 76 mm but not exceeding 152 mm and having a gross internal volume not exceeding 0,085 m^3 shall be protected by a pressure-relief device(s) if it can contain liquid refrigerant. The minimum discharge capacity of such devices shall meet the requirements of the applicable mechanical refrigeration codes.

22.112DV.7 A pressure vessel having an inside diameter greater than 76 mm but not exceeding 152 mm and having a gross internal volume greater than 0,085 m^3 but less than 0,285 m^3 shall be protected by a pressure-relief device(s) if it can contain liquid refrigerant. Fusible plugs shall not be used.

22.112DV.8 A pressure vessel having an inside diameter greater than 152 mm mentioned in Clause 22.112DV.3 shall have pressure relief in accordance with the applicable mechanical refrigeration codes.

22.112DV.9 The requirements for the pressure relief indicated in Clauses 22.112DV.6 through 22.112DV.8 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. However, the pressure-relief device required in accordance with Clause 22.112DV.7 shall not be a fusible plug.

22.112DV.10 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.11 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.12 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.

22.112DV.13 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.14 Calculation of the discharge capacity of a rupture member or fusible plug shall be in accordance with the applicable refrigeration codes.

22.112DV.15 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.16 A pressure-limiting device shall be installed on all systems containing 10 kg or more of refrigerant.

22.112DV.17 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.

22.112DV.18 There shall be no stop valves between the pressure-limiting device and the compressor.

22.112DV.19 *Compliance with Clauses 22.112DV.1 to 22.112DV.18 is checked by inspection and, if necessary, by manual test.*

22.112DV.20 Self-resetting protective devices which cycle during the test of Clause 19.101 shall be rated for at least 100 000 cycles for line break devices and 5 000 cycles for non-line break.

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 by adding the following to Clause 22.113:*

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.

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 adding the following:***

Materials with a melting point (liquidus temperature) less than 427° C are considered low temperature solder alloys.

Fusible plugs, if vented to the outdoors, shall be accepted. Mechanical connectors shall be permanent joints and have a leak rate of not more than 3 g/year at 25% of the maximum allowable pressure.

NOTE 1DV Leak rates may be demonstrated following the test requirements of ISO 14903.

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 by adding the following:***

Charges greater than m_3 may be used if in compliance with the charge limits and mitigation methods of ANSI/ASHRAE 15 (USA) and/or CSA B52 (Canada). All other requirements of this standard still apply.

The refrigerant mass of each refrigerating system with A2 and A3 refrigerant shall not exceed m_1 as defined in Annex GG.

The refrigerant mass of each refrigerating system for non-fixed factory sealed single package units with A2L refrigerant shall not exceed m_1 as defined in Annex GG.

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 centimetres 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 the second bullet point in the seventh paragraph with the following:***

• 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 of a three phase load;

– $L_e = 2,5 \times (6,7/S_u)^4$ all others

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 AT 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 D1 ***Modification by deleting "but not higher than 700°C" in the third paragraph.***

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 airflow (QH_{min}) is not less than:

$$QH_{min} = 30 \times m_c/LFL$$

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.

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.

A 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.

22.119 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.

22.120 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.

22.121 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 location 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:***

For the installation condition where a refrigerant detection system is applied to fulfil the requirements of Annex GG, the sensor of the refrigerant detection system shall be located within the unit. For add on heat pumps the sensor of the refrigerant detection system shall be an integral part of the indoor coil cased assembly.

For installations with field applied joints which are exposed in the occupied space, the joints shall be:

a) joints in compliance with ISO 14903; or

b) joints in enclosures which vent to the unit where a leak would be detected or to the outside.

Compliance for REFRIGERANT SENSORS is checked by inspection and by testing in accordance with Annex MM. REFRIGERANT SENSORS for add on heat pumps are tested in the OFF state only.

Where mechanical ventilation is required in accordance with Annex GG or Annex 101.DVG, mechanical ventilation shall be initiated by a separate refrigerant detection system or shall utilize the refrigerant detection system provided by the appliance in accordance with this clause. For separate refrigerant detection system the sensors shall be located in the space, not more than 300 mm above the floor. If a remote detector sensor is used to activate mechanical ventilation, this is in addition to the required detection sensor in the unit.

22.122 REFRIGERANT DETECTION SYSTEMS that are required by this standard for A2L REFRIGERANTS shall comply with 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.

22.124 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.

22.125 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 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 °C 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. and UL 746B:

a) tensile strength,

b) flexural strength,

c) Izod impact,

d) tensile impact.

Compliance is checked by inspection.

22.125DV D1 *Delete Clause 22.125 of the Part 2:*

The requirements in Clause 22.125 do not apply. See Annex 101.DVG.

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.

22.127 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.

22.132DV D1 *Add Clauses 22.132DV.1 – 22.132DV.9 to the Part 1:*

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 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 There shall be adequate space or barriers to prevent accidental contact with live parts when performing routine service functions when power is applied to the unit.

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 D1 ***Modification of Clause 22 of this Part 2 by adding the following:***

For multi-split system appliances, see additional requirements in Annex 101.DVG.

22.134DV D1 ***Modification of Clause 22 of this Part 2 by adding the following:***

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.

22.135DV D1 ***Modification of Clause 22 of this Part 2 by adding the following:***

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:

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.

b) heat exchangers operating 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.

22.136DV D1 *Modification of Clause 22 of this Part 2 by adding the following:*

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.

22.137DV D1 *Add Clauses 22.137DV.1 – 22.137DV.4 to the Part 1 which cover requirements for service receptacles:*

22.137DV.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.

22.137DV.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 No. 70; or

c) the receptacle is intended for use only with specific accessories.

22.137DV.3 Receptacles connected to the line side of a unit disconnect shall have a separate disconnect.

22.137DV.4 When installed on appliances for outdoor use the receptacle shall comply with the following:

a) Installation shall comply with the requirements in CSA C22.1 and ANSI/NFPA No. 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 C22.2 No. 144.1, and UL 943.

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.

23 Internal wiring

This clause of Part 1 is applicable except as follows.

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.

23.102DV D1 *Modification of clause 23 of the Part 1 by addition of the following:*

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 1 by adding the following:*

The conductors of hazardous voltage circuits and extra-low-voltage safety circuits shall be 22 AWG or larger.

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 *Delete Clauses 24.1DV.2 – 24.1DV.4 of the Part 1:*

The requirements in Clauses 24.1DV.2 – 24.1DV.4 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*

• *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 D2 *Modification of Clause 24.1.4 of the Part 2 by replacing the first and second bullet items with the following:*

• ***SELF-RESETTING THERMAL CUT-OUTS***	***100 000***
• ***NON-SELF-RESETTING THERMAL CUT-OUTS***	***6 000***

24.1.4DV.3 D2 *Modification of Clause 24.1.4 of the Part 2 by adding four bullet items and a note at end of the list:*

• ***contactors which control the motor-compressor or other motor loads***	***100 000***
• ***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***

NOTE 1DV – 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.4 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.

24.101 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.

24.1DV DR *Modification of Clauses 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 percent 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 if the free end of the lead can not be used in every installation.

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) 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 0.9 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 appliances for outdoor use shall be between 1,5 and 3 m long and shall be either an EXTRA HARD USAGE or a HARD USAGE CORD.

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 may have a power supply cord of up to 4,5 m in length.

25.101DV DR *Add Clauses 25.101DV.1 and 25.101DV.2 to Clause 25 of the Part 1:*

25.101DV.1 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.

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.

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 (a.c. or d.c.) 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 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.

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 clause to Clause 29.101DV.1 to Clause 29 of the Part 1:*

29.101DV.1 For appliances rated greater than 600 V, Annex 101.DVH shall apply for creepage and clearances.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

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.

30.2.2 Not applicable.

30.101DV DC *Add Clause 30.101DV.1 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.

30.102DV D1 ***Add Clause 30.102DV.1 to Clause 30 of the Part 1:***

30.102DV.1 Appliances shall comply with the additional requirements of Annex 101.DVI.

30.103DV DC ***Add Clause 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) moulded 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 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 Clause 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 1st paragraph of the addition to Clause 31 of this Part 1 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.

32.101.3 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
	$\mu W/cm^2$	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 $\mu W/cm^2$ effective irradiance is exempt per IEC 62471. This is 0,2 $\mu W/cm^2$ 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:*

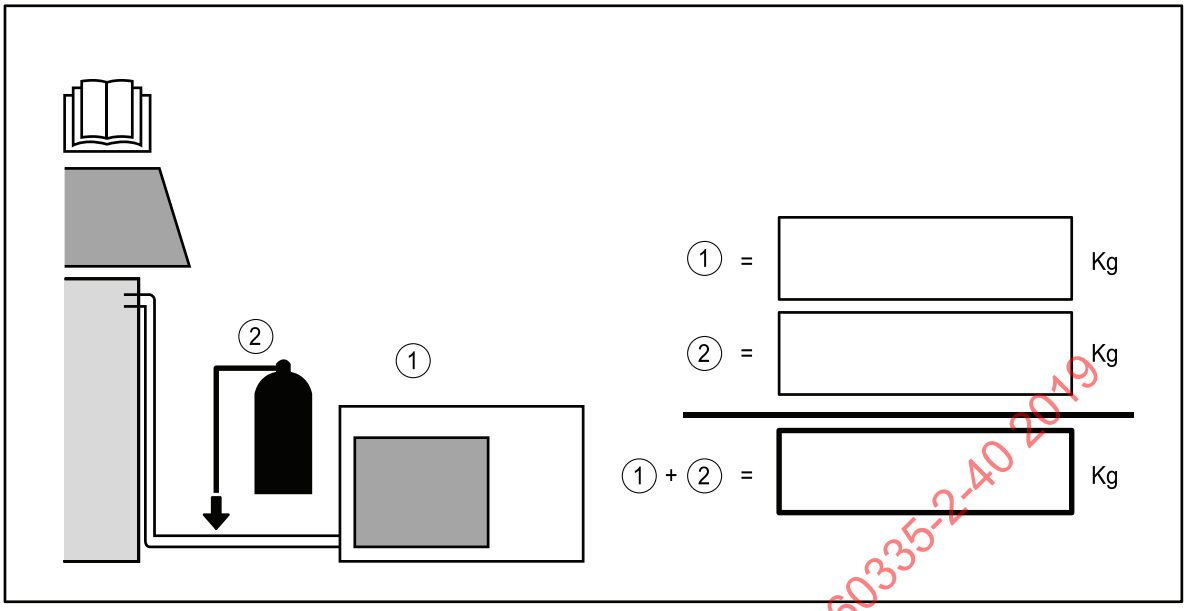
– the UV-C IRRADIANCE measurements shall be conducted with a scanning spectroradiometer, or a narrow band range radiometer;

– 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.



IEC

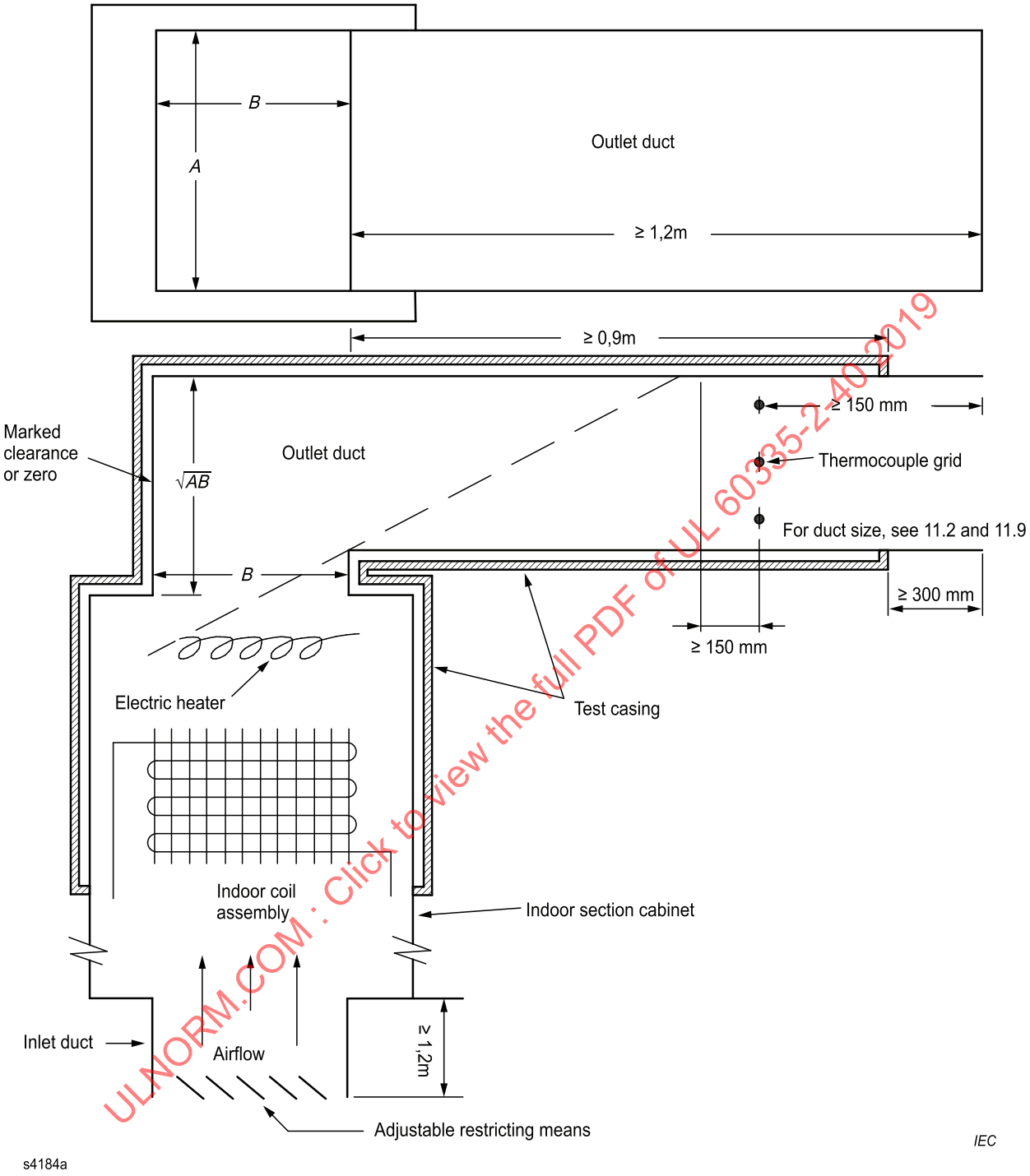
su3098

Key

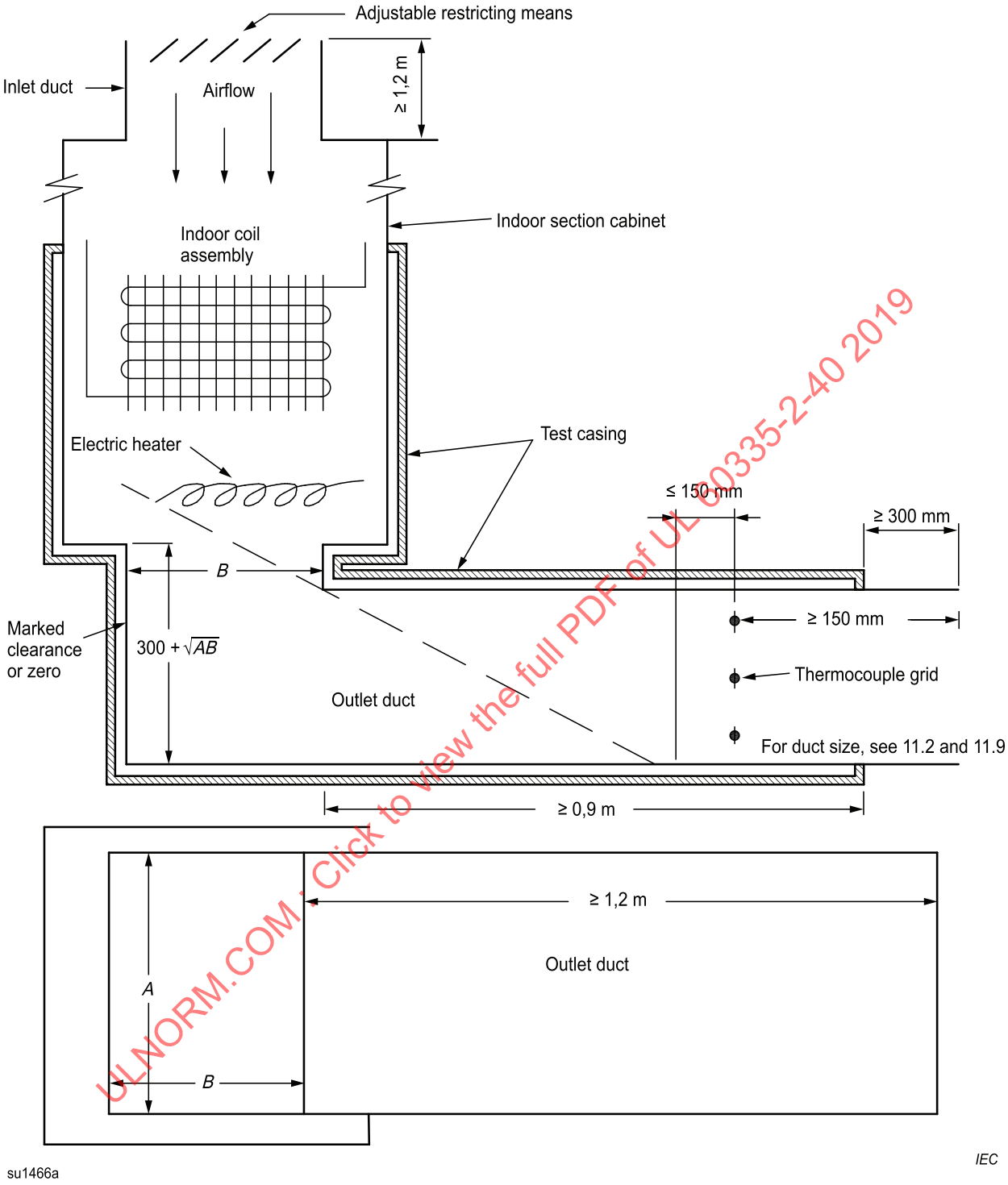
Example 1 REFRIGERANT CHARGE of the precharged part of the appliance

Example 2 REFRIGERANT CHARGE added during installation

Figure 101
Example of label for field charged units

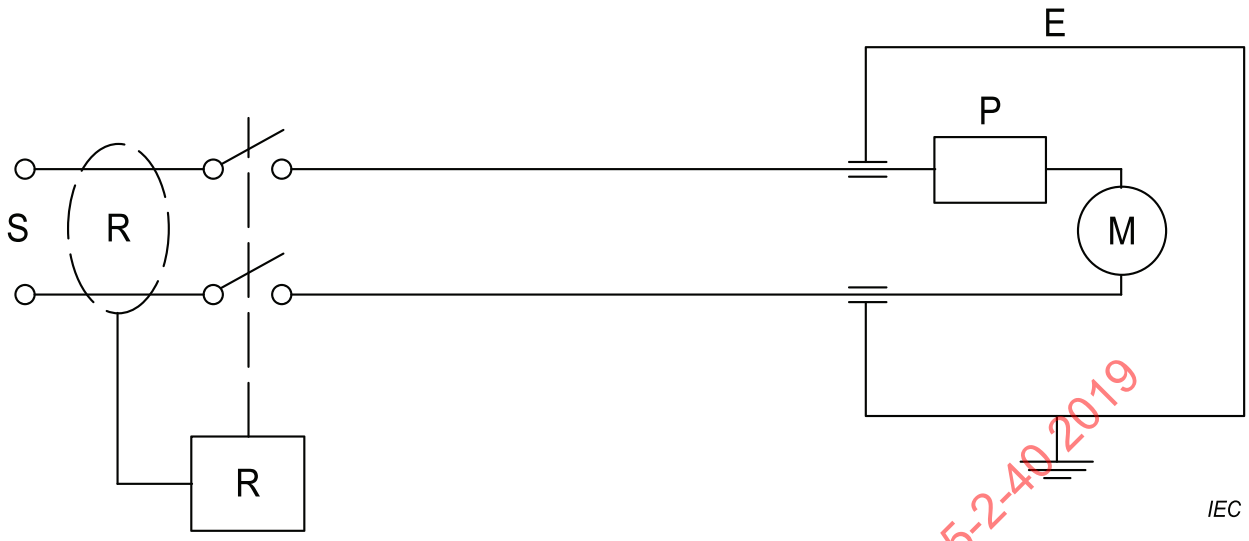


a) Upflow application



b) Downflow application

Figure 102
Arrangement for heating test of appliances with supplementary heater



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

Annexes

The annexes of Part 1 are applicable except as follows.

Annex ADV
(informative)

Routine Tests

Annex ADV.1 D1 ***Modification of Annex A in the Part 1:***

Following the title, replace "(informative)" with "(normative)."

ADV.2 D1 ***Modification of Clause A.2 in Annex A of the Part 1 by adding 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 s. 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.

ADV.101 D1 ***Add Clauses ADV.101.1 – ADV.101.7 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 Annex EE.2 on the high pressure side and Annex EE.4 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 Annex EE.4 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.5 of Annex EE 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 Annex 101.DVG, compliance with Clause EE.5 of Annex EE indoor coil assemblies shall be demonstrated periodically by testing of indoor coil assemblies randomly sampled from production at least 3 times per year.

ADV.101.10 For the periodic tests of 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.

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	–	–	–	–
Dehumidifi-cation	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	Lower flammable limit [b,d] at nominal composition [h]	Lower flammability limit [b,d] at worst case formulation
				°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_3CClF_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

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
				°C	°C (A2L only)	°C	kg/m^3	kg/kmol	kg/kmol	kg/m^3	kg/m^3
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.

[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 BBDV.1 D2 ***Modification of Table BB.1 of Annex BB of the Part 2 as follows:***

In note (g) to Table BB.1, delete “, but not higher than 700°C”.

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 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 – Mandatory clauses in each manual. Different manuals can be combined into one manual.

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	
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.1DV 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 DD.9, DD.10, or DD.13.

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;

– the appliance 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.1 D1 ***Modification of Clause DD.3.1 of the Part 2 by addition of the following:***

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;

DD.3.1DV.2 D1 ***Modification of Clause DD.3.1 of the Part 2 by replacing the first dashed item with the following:***

– information for spaces where refrigerant pipes are allowed, including statements

• that 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, 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 the installation of pipe-work shall be kept to a minimum.

• that pipe-work 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 Clause 22.116. In case of field charge, the effect on refrigerant charge caused by the different pipe length shall be quantified.

• that mechanical connections made in accordance with Clause 22.118 shall be accessible for maintenance purposes;

• that provision shall be made for expansion and contraction of long runs of piping;

• that 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;

• that piping in refrigeration systems shall be so designed and installed to minimize the likelihood of hydraulic shock damaging the system;

• that steel pipes and components shall be protected against corrosion with a rustproof coating before applying any insulation;

• that flexible pipe elements shall be protected against mechanical damage, excessive stress by torsion, or other forces, and that they should be checked for mechanical damage annually;

• that precautions shall be taken to avoid excessive vibration or pulsation;

• 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;

• 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.

The test pressure after removal of pressure source shall be maintained for at least 1 h with no decrease of pressure indicated by the test gauge, with test gauge resolution not exceeding 5% of the test pressure.

During the evacuation test, after achieving a vacuum level specified in the manual or less, the refrigeration system shall be isolated from the vacuum pump and the pressure shall not rise above 1500 microns within 10 min. The vacuum pressure level shall be specified in the manual, and shall be the lessor of 500 microns or the value required for compliance with national and local codes and standards, which may vary between residential, commercial, and industrial buildings.

• that field-made refrigerant joints indoors shall be tightness tested according to the following requirements: 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.

DD.3.1DV.3 D1 ***Modification of Clause DD.3.1 of the Part 2 as follows:***

Delete the second dashed item.

DD.3.1DV.4 D1 ***Modification of Clause DD.3.1 of this Part 2 by adding the following to the fifth dashed item:***

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 the altitude adjustment factor (AF) factor in Table DD.3.1DV based on for building site ground level altitude (H_{alt}) in meters.

Table DD.3.1DV
Altitude Adjustment Factor

H_{alt}	0	200	400	600	800	1000	1200	1400	1600
AF	1.00	1.00	1.00	1.00	1.02	1.05	1.07	1.10	1.12
H_{alt}	1600	1800	2000	2200	2400	2600	2800	3000	3200
AF	1.12	1.15	1.18	1.21	1.25	1.28	1.32	1.36	1.40

DD.3.1DV.5 D1 ***Modification of Clause DD.3.1 of the Part 2 as follows:***

Adding "All dimensional data shall be provided in both SI and IP units" at end of the sixth dashed item.

DD.3.1DV.6 D1 ***Modification of Clause DD.3.1 of the Part 2 as follows:***

Deleting the 15th dashed item.

DD.3.1DV.7 D1 ***Modification of Clause DD.3.1 of the Part 2 by replacing the last dashed item with the following;***

– 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.

DD.3.1DV.8 D1 ***Modification of Clause DD.3.1 of the Part 2 by addition of the following:***

For add on heatpumps 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 22.116.

– Detection of a leak shall turn on the indoor fan at the highest available speed or turn it on to not less Q_{min} as determined in Annex GG. (Consult furnace manufacturer.)

DD.3.1DV.9 D1 ***Modification of Clause DD.3.1 of the Part 2 by addition of the following:***

The following additional information shall be specified in the manual for multi-split system using safety shut off valves in installation of appliances using A2L refrigerants where the information is needed for the function of the manual and as applicable to the appliance:

– Safety shut off valves installation shall avoid hydraulic shock.

– Safety shut off valves shall not block in liquid refrigerant unless adequate relief is provided to the refrigerant system low pressure side.

– 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 Clause 101.DVG.7.

– 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 Clause 101.DVG.6.2.

DD.3.1DV.10 D1 ***Modification of Clause DD.3.1 of the Part 2 by addition of the following:***

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 instructions for replacement.

– REFRIGERANT SENSORS for REFRIGERANT DETECTION SYSTEMS shall only be replaced with sensors specified by the appliance manufacture.

DD.3.1DV.11 D1 ***Modification of Clause DD.3.1 of the Part 2 by addition of the following dashed item:***

– Instruction to verify actuation of mitigation actions per Annex GG.

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 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, 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 detection is provided in both the appliance and any external connections are also provided with a sensor immediately below the joint.

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.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.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:

a) safely remove refrigerant following local and national regulations;

b) purge the circuit with inert gas;

c) evacuate (optional for A2L);

d) purge with inert gas (optional for A2L);

e) open the circuit by cutting or brazing.

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.

Ensure that the outlet for the vacuum pump is not close to any potential ignition sources and that ventilation is 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.

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.4.1DV.1 D1 ***Modification by replacing the first paragraph of Clause EE.4.1 of the Part 2 with the following:***

In order to determine the maximum standstill pressure, the appliance shall be charged in accordance with the instructions and then soaked in the highest operating temperature specified by the manufacturer with power off until the refrigerating system pressure has stabilized within ± 1% of the mean system pressure for a period of not less than 30 min.

EE.4.1DV.2 D1 ***Modification of Clause EE.4.1 in the Part 2 by adding the following at the end:***

For multi-split appliances, using flammable refrigerants and applied in compliance with Annex 101.DVG, the pressure test value for indoor coils shall be at least five times the maximum pressure developed during standstill.

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 Clauses 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.5.1DV D1 ***Modification Clause EE.5.1 by adding the following at the end:***

For multi-split appliances using flammable refrigerants and applied in compliance with Annex 101.DVG, the test shall be conducted at 100% of the test pressure determined in Clauses EE.2, EE.3, or EE.4.

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.5.6DV D1 ***Modification of Clause EE.5.6 by replacing the first sentence with the following:***

The total number of cycles shall be 500 000.

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.

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.2.1DV D1 *Modification of Clause FF.2.1 of the Part 2 by adding the following:*

The leak rate shall not exceed 600 g/s.

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.2.2DV D1 *Modification of Clause FF.2.2 of the Part 2 by adding the following:*

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.2.3 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:

$$V = \frac{(15 \times m_c)}{LFL} \quad \text{(FF.1)}$$

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.2.4DV D2 ***Modification of Clause FF.2.4 in the Part 2 by replacing the first sentence with the following:***

The test shall be conducted in a room that is draft free (less than 0.5 m/s airflow velocity) and of sufficient size to conduct the test.

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.

FF.2.5DV D2 ***Modification of Clause FF.2.5 of this Part 2 by adding the following:***

For appliances using A2L refrigerants, these requirements apply, after replacing "25% of the *LFL*" with "75% of the *LFL*" in two places and replacing "15% of the *LFL*" with "50% of the *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 at sea level.

NOTE 1 Table GG.1 is provided as guidance when applying Annex GG.

NOTE 2 The factors in the formulas are in cubic metres 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	GG.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 replacing the second paragraph with the following:*

Symbol m_c denotes the refrigerant charge of a single refrigerating system. For appliances with multiple refrigerating systems, each refrigerating system shall be evaluated independently.

GG.1.1DV.2 D2 *Modification of Clause GG.1.1 of the Part 2 by adding of the following as the last paragraph.*

Toxicity charge limits shall be determined in accordance with ANSI/ASHRAE 15 (USA) and CSA B52 (Canada). If the toxicity-based charge limits are lower than the flammability-based charge limits, the toxicity charge limits shall take precedence.

GG.1.1DV.3 D2 *Modification of Clause GG.1.1 as follows:*

Delete the last sentence in NOTE 3.

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:

$$m_1 = 4 \times LFL \quad \text{(GG.1)}$$

(GG.2)

$$m_2 = 26 \times LFL$$

(GG.3)

$$m_3 = 130 \times LFL$$

where *LFL* is the LOWER FLAMMABLE LIMIT in kg/m^3 for the refrigerant used.

For A2L REFRIGERANTS, m_1, m_2, m_3 is defined as follows:

(GG.4)

$$m_1 = 6 \times LFL$$

(GG.5)

$$m_2 = 52 \times LFL$$

(GG.6)

$$m_3 = 260 \times LFL$$

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 by replacing equation (GG.1) with:*

(GG.1)

$$" m_1 = 3 \times LFL"$$

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) a portable appliance;

b) a non-fixed factory sealed single package; or

c) a cord connected appliance which may be periodically or seasonally relocated (excluding servicing) by the end user

the equation GG.4 shall be replaced with:

(GG.4)

$$" m_1 = 3 \times LFL"$$

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 GG.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:

(GG.7)

$$Anv_{min} = \frac{m_c - m_{max}}{LFL \times 104} \times \sqrt{\frac{A}{g \times m_{max}} \times \frac{M}{M - 29}}$$

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.1.3DV1 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 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 4th paragraph of Clause GG.1.3 of the Part 2 by the first "1.6 m" with "1.8 m".***

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.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:

(GG.8)

$$m_{max} = 2,5 \times (LFL)^{(5/4)} \times h_0 \times (A)^{1/2}, \text{ not to exceed } m_{max} = SF \times LFL \times h_0 \times A$$

or the required minimum floor area A_{min} to install an appliance with REFRIGERANT CHARGE m_c (kg) shall be in accordance with following:

(GG.9)

$$A_{min} = (m_c / (2,5 \times (LFL)^{(5/4)} \times h_0))^2, \text{ not less than } A_{min} = m_c / (SF \times LFL \times h_0)$$

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 metres 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 metres 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 metres 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

For appliances with a refrigerant charge of $m_c \leq m_1$, no mitigation is required.

For appliance where leaked refrigerant cannot enter the space or the air-stream connected to the space, no mitigation is required.

For 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 serving a single room using A2L refrigerant with a refrigerant charge of $m_1 \leq m_c \leq m_2$, the requirements of Clause GG.2.2.1 apply. If the space has room area more than A_{min}, no further measure is required. If room area is less than A_{min}, Clause GG.8 or GG.9 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 Clause 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 multi-split 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 101.DVG.1 the requirements of Clause 101.DVG.3 shall apply if applicable.

For appliances with a refrigerant charge of $m_c > m_3$, the requirements of ANSI/ASHRAE 15 (USA) or CSA B52 (Canada) shall apply. All other requirements of this standard shall apply.

For appliance installed in machinery rooms as defined in ANSI/ASHRAE 15 (USA) or CSA B52 (Canada) the subsequent Clauses GG.2.1.1 through GG.13 of Annex GG and Clause 101.DVG shall not apply.

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:

(GG.8)

$$m_{max} = 2,5 \times (LFL)^{(5/4)} \times h_0 \times (A)^{1/2}, \text{ not to exceed } m_{max} = SF \times LFL \times h_0 \times A$$

or the required minimum floor area A_{min} to install an appliance with refrigerant charge m_c (kg) shall be in accordance with following:

(GG.9)

$$A_{min} = (m_c / (2,5 \times (LFL)^{(5/4)} \times h_0))^2, \text{ not less than } A_{min} = m_c / (SF \times LFL \times h_0)$$

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 0,25;**

h_0 is the release height, the vertical distance in metres 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 metres 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 metres of the unit (see Figure GG.5).

Reference installed heights are given below:

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.

NOTE 1DV This formula is not applicable for refrigerants lighter than 42 kg/kmol.

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. 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 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.

GG.2.2 Appliances using A2L refrigerants with incorporated circulation airflow

GG.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:

(GG.10)

$$m_{\max} = 0,75 \times LFL \times h_{ra} \times A$$

or the required minimum room area A_{min} of installed appliance with REFRIGERANT CHARGE m_c (kg) shall be in accordance with following;

(GG.11)

$$A_{\min} = m_c / (0,75 \times LFL \times h_{ra})$$

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 t he outlet. The grill area shall not be deducted. [b] h_{ra} shall not exceed 2,2 m. [c] See Figure GG.6 for examples.				

(GG.12)

$$h_d = \left(1 + \frac{2,35}{LFL\left(1 - \frac{1,2}{\rho}\right) + 0,05}\right) \times (0,0183 \times v^2 \times \sin^2\varphi$$

where

v is the CIRCULATION AIRFLOW velocity in m/s;

φ is the CIRCULATION AIRFLOW elevation angle from horizontal in degrees ($0° \le \varphi \le 90°$);

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:*

Incorporated circulation airflow applies to fixed appliances only.

When the fan incorporated in an appliance is continuously operated, or operation is initiated by a refrigerant detection system with a sufficient circulation airflow rate, the maximum refrigerant charge can be increased or minimum room area can be reduced according to following.

The minimum circulation airflow velocity shall be 2 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;

(GG.1DV)

$$Q_{\min} = 60 \times m_c / LFL$$

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:

(GG.10)

$$m_{\max} = SF \times LFL \times h_a \times A$$

or the required minimum room area A_{min} of installed appliance with refrigerant charge m_c (kg) shall be in accordance with following;

(GG.11)

$$A_{\min} = m_c / (SF \times LFL \times h_a)$$

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_a is the air delivery height in upper side in m;

***A* is the room area in m^2;**

***SF* is a safety factor with a value of 0,25;**

***LFL* is the lower flammability limit in kg/m^3.**

GG.2.2.2 Permanent 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.2.2.3 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.1 D2 *Modification of the 1st bullet of Clause GG.2.2.3 of the part 2 by replacing with the following.*

• Energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Q_{min}. The minimum airflow Q_{min} shall be attained within 15 s following the input signal to turn on the fan.

GG.2.2.3DV.2 D2 *Modification of Clause GG.2.2.3 of the Part 2 by deleting the second paragraph:*

This paragraph does not apply.

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 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}.

$$Q_{\min} = S \times 15\,(24,5 \times m_c / M) \text{ (with a minimum of } 2m^3 / h)$$

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.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:*

GG.5 Requirements for mechanical ventilation for machinery rooms.

The following requirements for machinery rooms in ANSI/ASHRAE 15 shall apply: Clauses 7.4 and 8.11 and, when applicable, either Clauses 8.12 or 8.13 (USA.)

The requirements for machinery rooms in Clauses 6.2 and 6.3 of CSA B52 shall apply (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 deleting the last sentence.*

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:

(GG.14)

$$m_{max} = 0,25 \times A \times LFL \times 2,2$$

or the required minimum floor area, A_{min}, to install an appliance with REFRIGERANT CHARGE m_c shall be in accordance with the following:

(GG.15)

$$A_{min} = m_c / (0,25 \times LFL \times 2,2)$$

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.7.2 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 1DV 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.8.2DV D1 ***Delete Clause GG.8.2 and all its subclauses in the Part 2:***

The requirements in GG.8.2 do not apply.

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:

(GG.16)

$$Anv_{\min} = \frac{m_c - m_{\max}}{LFL \times 104} \times \sqrt{\frac{A}{g \times m_{\max}} \times \frac{M}{M - 29}}$$

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:

(GG.17)

$$m_{max} = \frac{\left(\frac{Anv_{min}}{0,14}\right)^2}{\frac{0,04}{LFL}}$$

(GG.18)

$$Anv_{min} = 0,14 \times \sqrt{m_c \times \frac{0,04}{LFL}}$$

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.8.3 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.8.3.1.1 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.8.3.1.2 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.8.3.2 Required airflow

The airflow shall be calculated using of the formula below. Losses caused by ducts or other components in the air stream have to be considered.

(GG.19)

$$Q = (m_c - m_{\max}) / (4 \times LFL) \times 2 \times 60$$

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:

(GG.20)

$$V = 4 \times m_c / LFL$$

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 adding the following:*

For all appliances without air circulation fans, m_{max} in equation (GG.19) shall be set to m_1.

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, 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.

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:

(GG.21)

$$Q_{\min} = 60 \times m_c / LFL$$

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:

(GG.22)

$$m_{\max} = SF \times LFL \times H \times TA$$

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:

(GG.23)

$$TA_{\min} = m_c / (SF \times LFL \times H)$$

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.9.1DV2 D2 ***Modification of Clause GG.9.1 of the Part 2 as follows:***

In equations (GG.22) and (GG.23), replace "SF" with "0.25".

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.9.3 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 the 1st paragraph with the following:***

When a refrigerant detection system according to Annex LL operates the following shall be initiated:

a) Energize the fan(s) of the appliance to deliver indoor airflow at or above the minimum airflow Q_{min}. The minimum airflow Q_{min} shall be attained within 15 s following the input signal to turn on the fan.

b) Disable the compressor operation unless the compressor operation reduces the leak rate or the total amount of charge released to the indoor space.

c) Fully open all zoning damper(s) of the appliance and energize control signals to open any external zoning dampers, if applicable. If the smallest conditioned space meets the minimum room area requirement, only one zoning damper is required to be fully opened.

d) Activate additional mechanical ventilation, if required.

e) Deenergize supplementary heat.

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

(GG.24)

$$V_{min} = (-4,0 \times 10^{-5} \times M^2 + 0,0108 \times M + 1m42) / \sin \varphi$$

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:

(GG.25)

$$m_{max} = 0,25 \times LFL \times H \times A$$

(GG.26)

$$A_{min} = m_c / (0,25 \times LFL \times H)$$

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:

(GG.27)

$$m_{max} = 0,50 \times LFL \times H \times A$$

(GG.28)

$$A_{min} = m_c / (0,50 \times LFL \times H)$$

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 *Delete Clause GG.10 of the Part 2:*

The requirements in Clauses GG.10.1 to GG.10.5 do not apply.

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.11.2 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):

(GG.29)

$$Anv_{min} = \frac{1}{720 \times LFL} \times \sqrt{\frac{M}{LFL \times (M - 29)}}$$

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.11.3 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.11.3.2 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:

(GG.30)

$$m_c = -\frac{10 \times V}{Q} ln\left(1 - \frac{Q \times 0,25 \times LFL}{10}\right)$$

For (Q × 0,25**LFL*)/10 ≥ 1, the airflow shall be determined according the following formula:

(GG.31)

$$Q = \frac{10}{0,25 \times LFL}$$

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.11.3.4 Operation of mechanical ventilation

Mechanical ventilation shall be operated continuously or shall be switched on by a REFRIGERANT DETECTION SYSTEM.

G.11DV D1 *Delete Clause GG.11 of the Part 2:*

The requirements in Clauses GG.11.1 to GG.11.3 do not apply.

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.12.2 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.12DV D1 *Delete Clause GG.12 of the Part 2:*

The requirements in Clauses GG.12.1 and GG.12.2 do not apply.

GG.13 Safety alarms for enhanced tightness refrigerating systems using A2L refrigerants

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.

GG.13DV D1 *Delete Clause GG.13 of the Part 2:*

The requirements in Clauses GG.13.1 and GG.13.2 do not apply.

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

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
	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
	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.

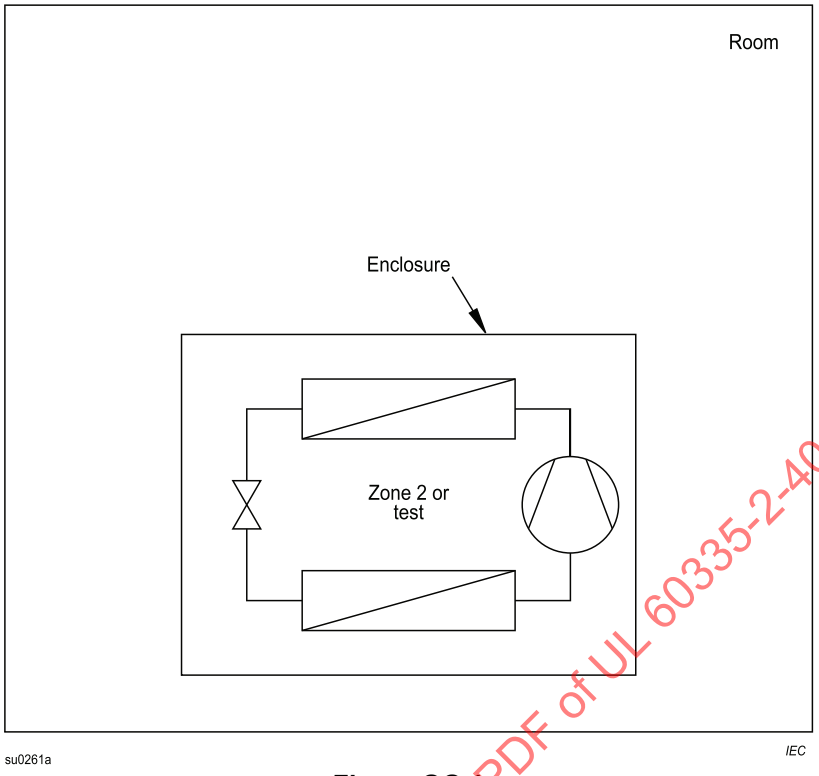


Figure GG.1
Unventilated area

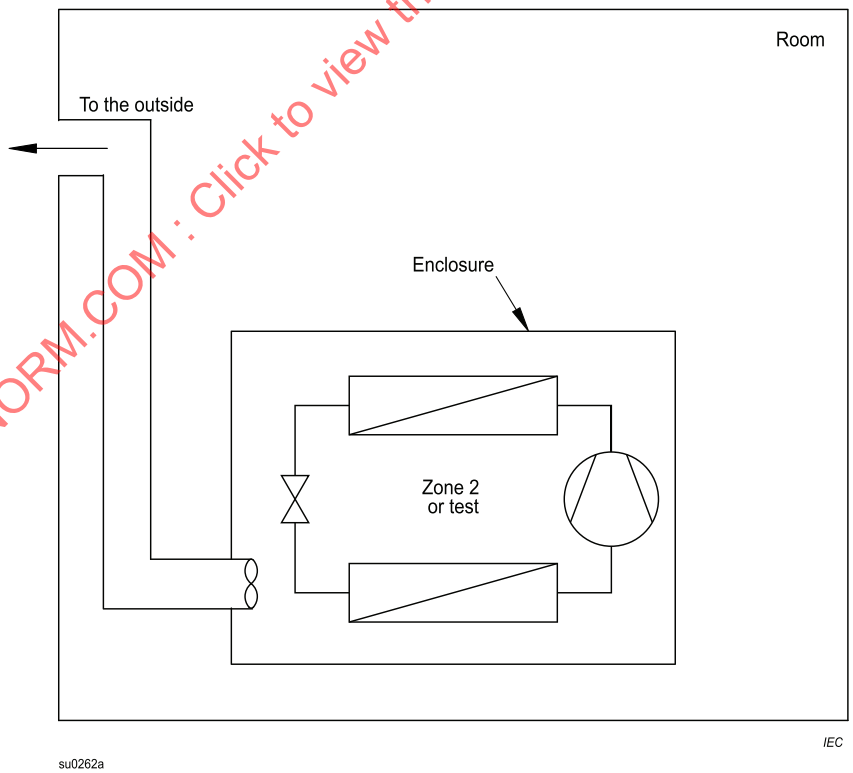
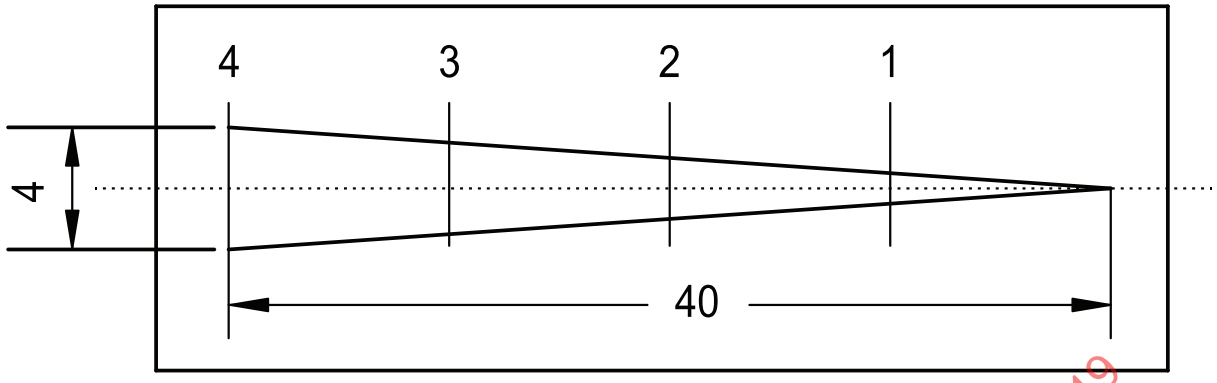


Figure GG.2
Mechanical ventilation



su0874a

Figure GG.3
Isosceles triangle arrow test gauge

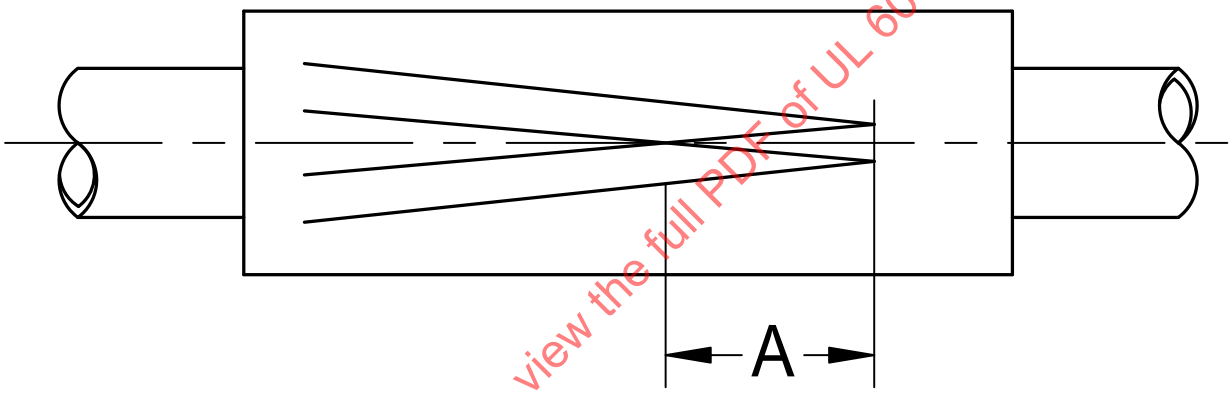


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Figure GG.4
Measurement of vibration amplitude

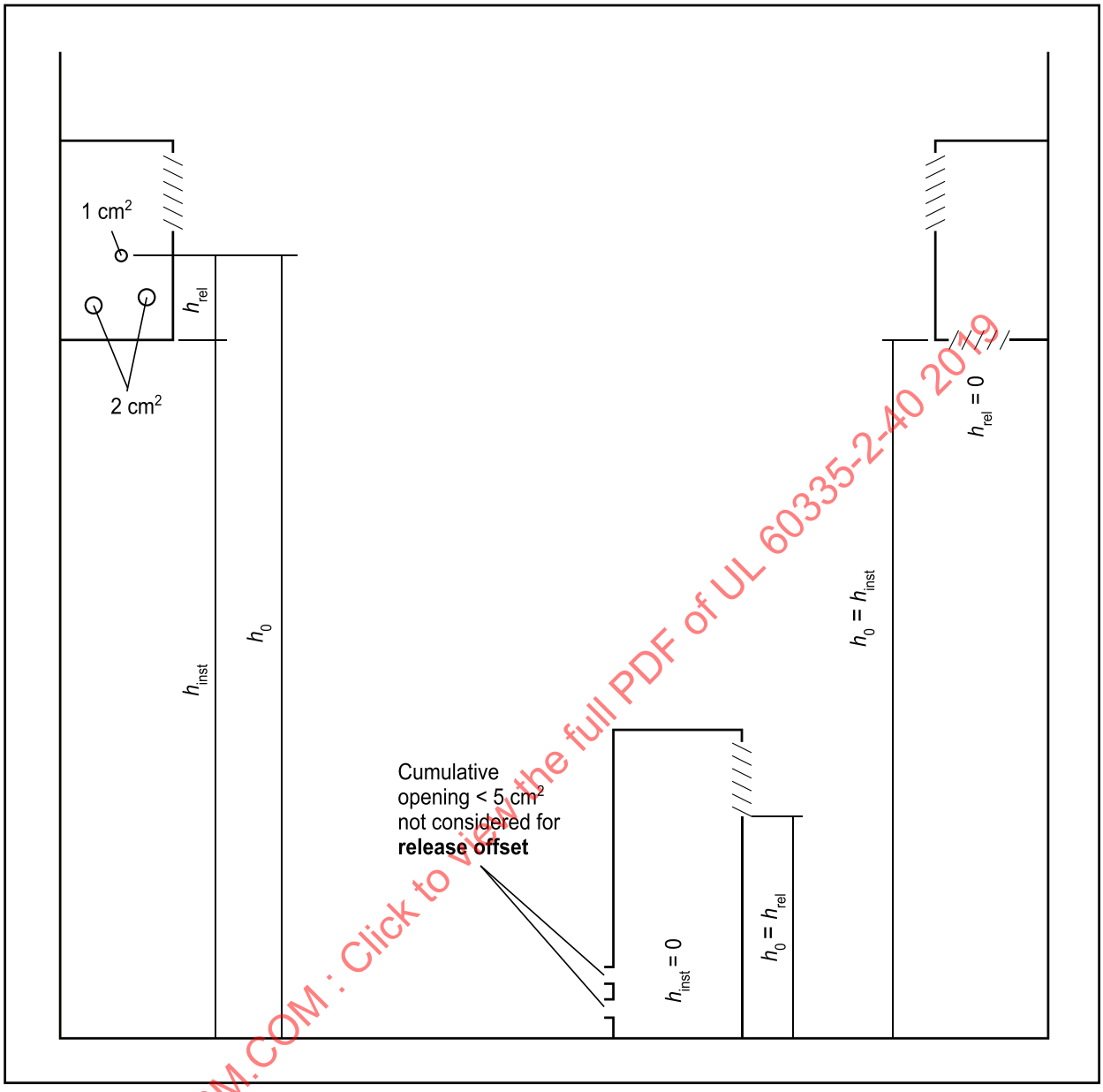
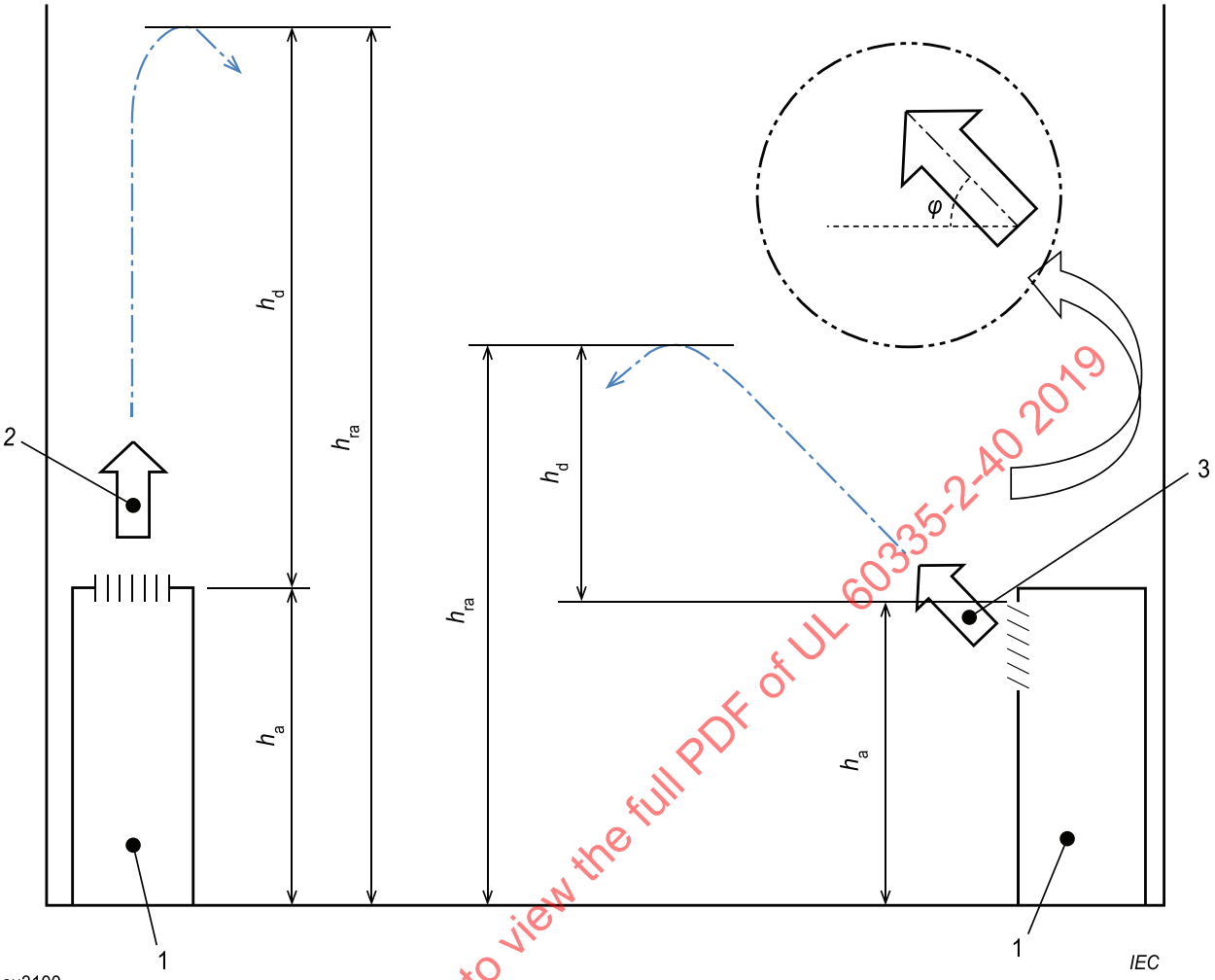


Figure GG.5
Relevant heights h_{inst}, h_0 and h_{rel} for calculation of A_{min} and m_{max}



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,

a) Evacuate the refrigerant circuit.

b) Purge the refrigerant circuit with oxygen free nitrogen.

c) Evacuate again. (not required for A2L refrigerants)

d) 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.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:

(JJ.1)

$$d_{eff} = 4 \times \frac{A}{S}$$

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.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:

(JJ.2)

$$d_{eff} < 22,3 \times S_u^{\ -1,09} (\text{in mm}) \leq 7\ \text{mm}$$

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 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 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)

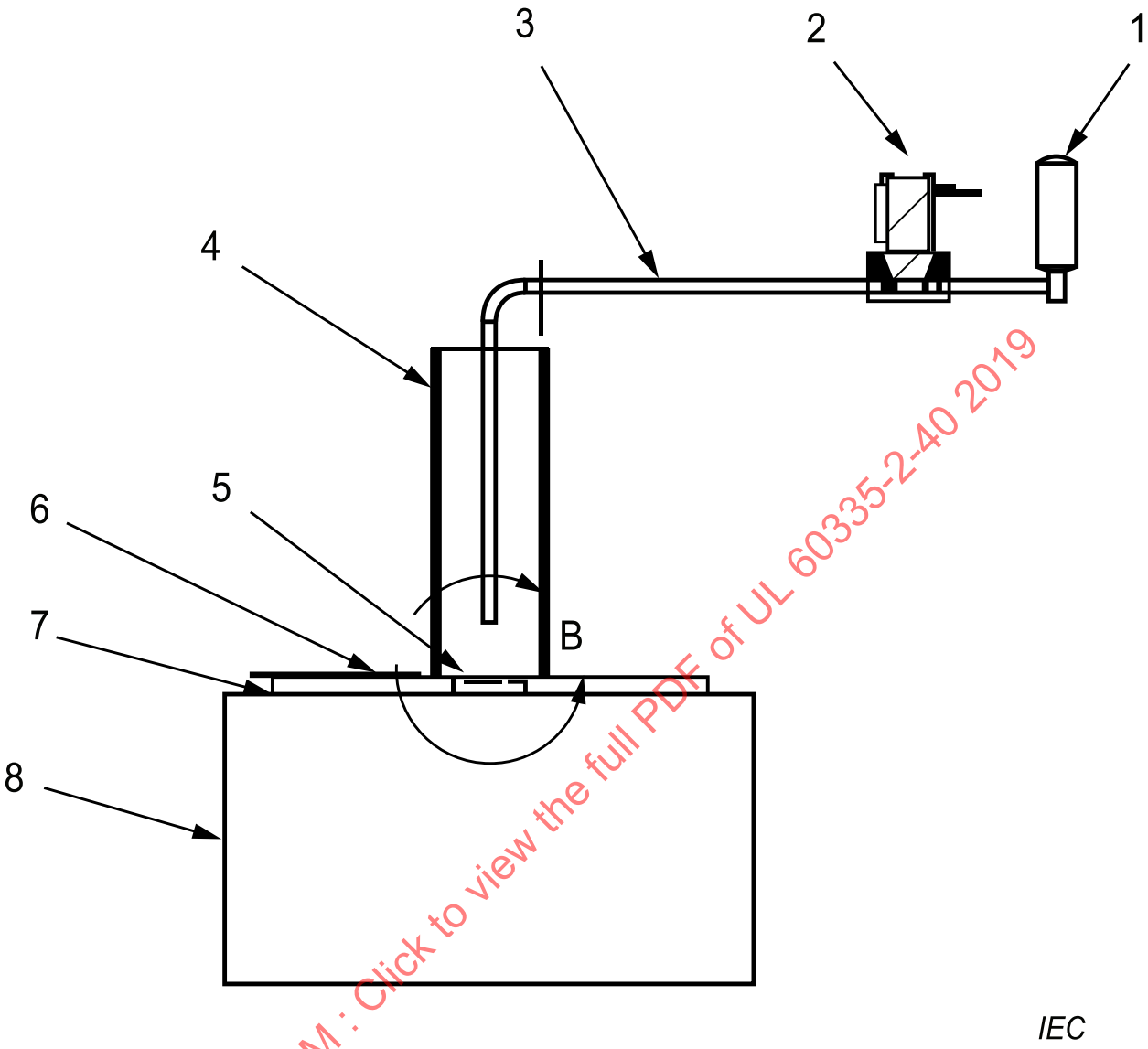
Test method for hot surface ignition temperature for A2L

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.

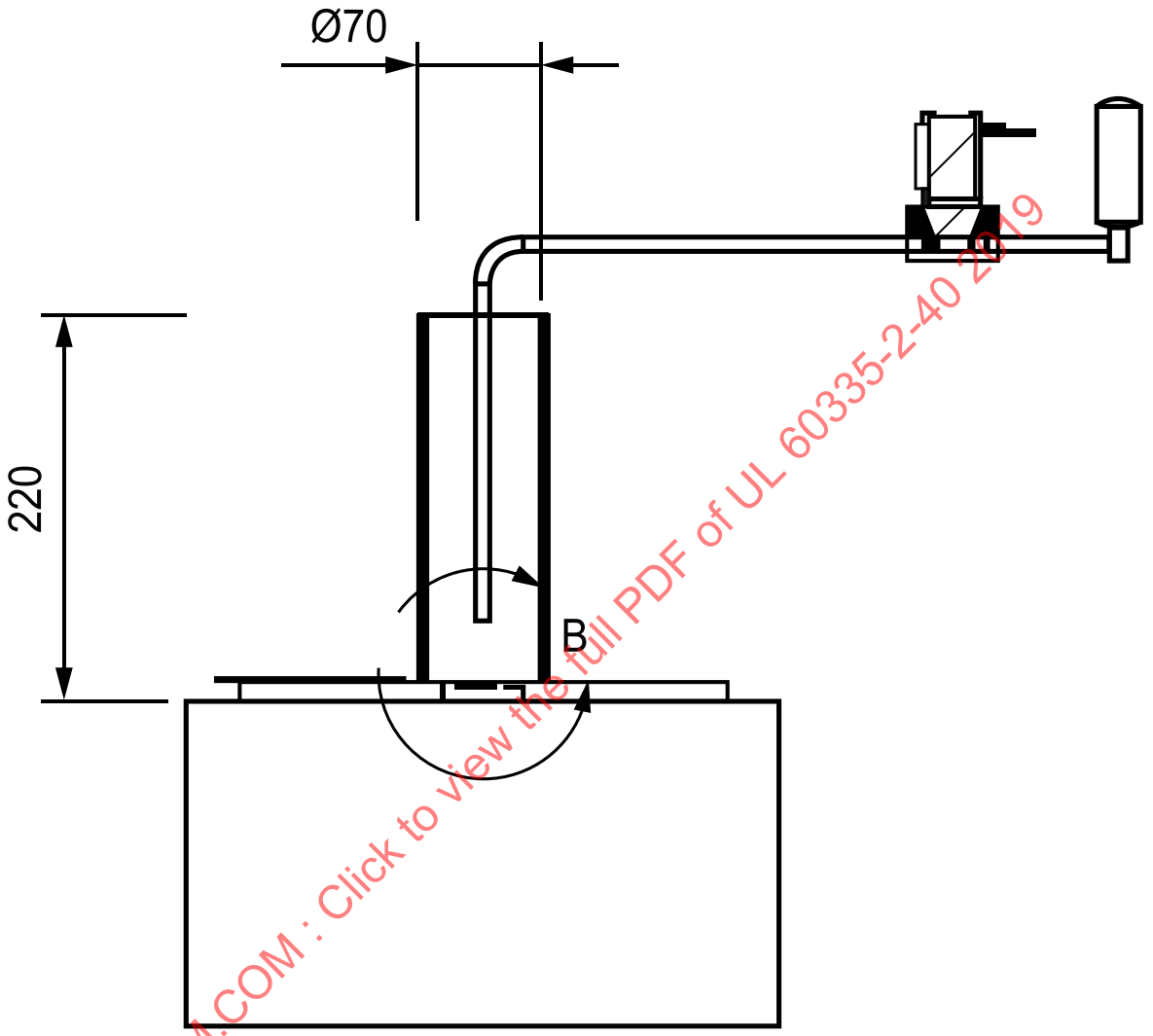


Key

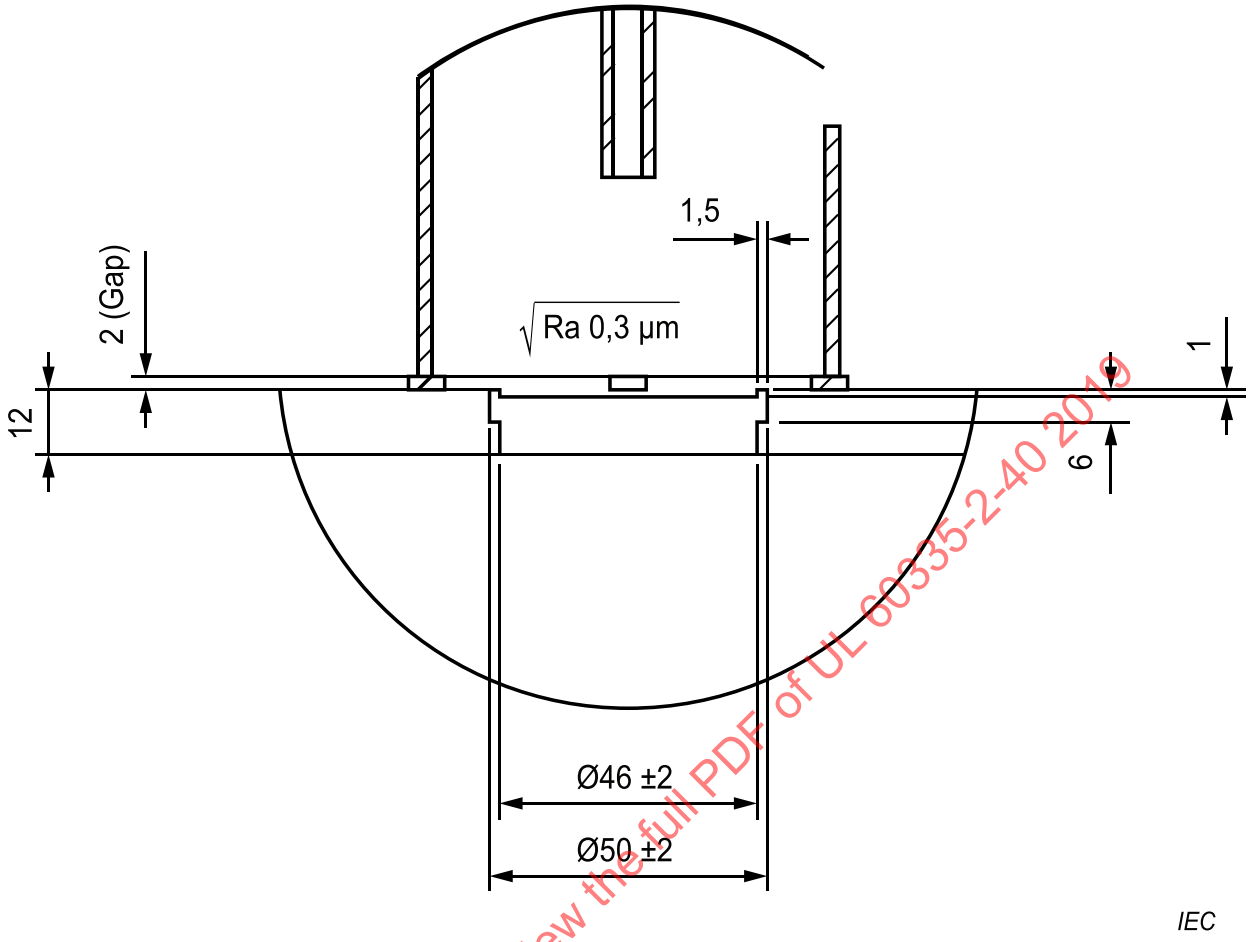
1 refrigerant cylinder with valve
2 valve
3 spray tube
4 glass cylinder
5 planchet
6 thermocouple
7 insulation
8 hot plate

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

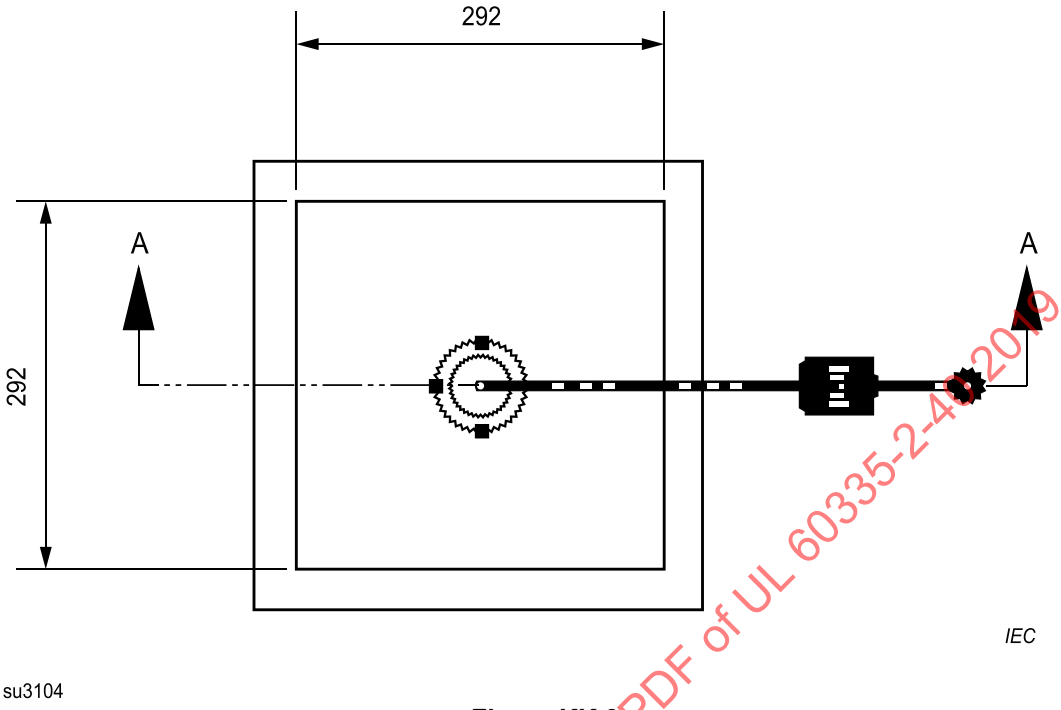


Figure KK.3
Top view of test apparatus

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 C 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 B and valve C. 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 860 °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 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.

LL.DV D1 *Modification of Clauses LL.1 – LL.8 of the Part 2 by replacing with the following:*

LL.1DV General

This annex applies to REFRIGERANT DETECTION SYSTEMS for use with appliances using A2L refrigerant only.

REFRIGERANT DETECTION SYSTEMS shall be set to be activated at a predetermined set point in response to leaked refrigerant. Where *LFL* is referenced in this annex, the *LFL* shall be taken at WCF as specified in ISO 817.

Refrigerant detection systems may respond directly to the refrigerant concentration or may respond to a representative surrogate gas, such as oxygen for example.

REFRIGERANT SENSORS for REFRIGERANT DETECTION SYSTEMS for flammable refrigerant shall comply with the requirements IEC 60079-29-1 for group II equipment and this annex for indicating type fixed INTEGRAL REFRIGERANT SENSORS with the following modifications:

– IEC 60079-29-1 shall be applied regardless of its scope statement;

– For INTEGRAL REFRIGERANT SENSORS indicators are not required;

– Alarm signals shall be non-latching type;

– A fault signal in the event of failure of the REFRIGERANT SENSOR is not required;

– A signal to indicate that the sensor is energized or is in alarm state is not required;

– Instructions shall be available to the appliance manufacture, but need not be available to the appliance user;

– Where *LFL* is referenced, the *LFL* shall be taken at WCF as specified in ISO 817;

– Requirements for calibration tolerance in IEC 60079-29-1 are replaced by ± 15% of the pre-set value;

– Requirements for marking in IEC 60079-29-1 are replace by LL.10DV; and

– Requirements for response time in IEC 60079-29-1 do not apply.

Compliance is only required when tested with the refrigerant marked on the appliance nameplate.

If there is a conflict between this annex and IEC 60079-29-1, this annex shall take precedence.

SENSORS shall not be subject to poisoning as determined in LL.5DV.

Note: IEC 60079-29-2 provides guidance on which technologies may be subject to poisoning.

REFRIGERANT SENSORS in compliance with clauses 22.116 and/or 22.117 of this Part 2 are not considered ignition sources.

LL.2DV Function of refrigerant detection systems

REFRIGERANT DETECTION SYSTEMS shall be capable of detecting a pre-set concentration level of the refrigerant marked on the appliance nameplate and initiating the operation as defined in Annex GG.

LL.3DV Refrigerant detection system range, accuracy and response time

Including the worst case combined effects of declared manufacturing tolerances and drift, the pre-set level shall be selected such that the REFRIGERANT DETECTION SYSTEM shall provide an output according to applicable clauses of Annex GG of this standard within 10 s or less when the sensor is put into refrigerant concentration of 100 % of *LFL* or lower. These requirements shall apply after the REFRIGERANT DETECTION SYSTEM power is turned on and the warm-up time period has elapsed.

The REFRIGERANT DETECTION SYSTEM, including REFRIGERANT 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.

The test shall be conducted after the warm-up time for the refrigerant sensor has elapsed.

The refrigerant sensor head shall be placed into a gas that consists of air and has a refrigerant concentration of 100% of LFL or lower.

The duration shall start at the same time as the refrigerant hits the refrigerant sensor head and stopped when the refrigerant detection system gives an output signal.

NOTE 1DV The test of Clause LL.3DV may be run after the test of Clause LL.7DV.

LL.4DV Refrigerant detection system calibration

REFRIGERANT DETECTION SYSTEMs shall be pre-set and calibrated from the factory for the refrigerant used. The pre-set level shall not be adjustable. Recalibration other than zero point self-recalibration shall not be allowed.

The requirements for long term stability Group II for indicating fixed SENSOR in IEC 60079-29-1 shall apply. The test gas shall be 100% refrigerant.

LL.5DV Selectivity test and poisoning test

LL.5DV.1 REFRIGERANT SENSORS shall not have false or nuisance trips, and not subject to poisoning.

Compliance is checked by the following test.

LL.5DV.2 The output shall not indicate presence of refrigerant concentration above the setpoint when the REFRIGERANT SENSOR is exposed sequentially as described in LL.5DV.4 – LL.5DV.8, to the concentrations of gases and vapours shown in Table LL.5DV.1. These substances are intended to represent air contaminants found in the vicinity of an installed appliance.

Table LL.5DV.1
Gas and vapour concentrations

Substance	Concentration, ppm
Methane	500
n-Butane	300
n-Heptane	500
Ethyl acetate	200
Isopropyl alcohol	200
Carbon dioxide	5000
Ammonia	100
Ethanol	200
Toulene	200
Trichloroethane	200
Acetone	200
Silicone	100

LL.5DV.3 Calculate the interior volume of the test chamber used in LL.5DV.1. From this volume, calculate the amount of each test substance necessary to supply the concentrations given in Table LL.5DV.1.

LL.5DV.4 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 minutes. Close and seal the chamber to prevent air infiltration.

LL.5DV.5 Using a syringe or equivalent device, add the calculated amount of the first 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.5DV.6 Allow the REFRIGERANT SENSOR to remain in the chamber for 2 hours. During this time the output shall not indicate the presence of refrigerant concentration above the setpoint.

LL.5DV.7 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. Reseal the chamber and repeat the test using another substance from Table LL.5DV.1 until the REFRIGERANT SENSOR has been exposed to all substances. It is not required that exposure to the substances be in any particular order.

LL.5DV.8 At the end of the test the REFRIGERANT SENSOR shall be tested in compliance with LL.3DV.

LL.6DV Electrical outputs for refrigerant detection system

The device shall have an output to indicate the presence of a refrigerant concentration exceeding the set point.

The REFRIGERANT SENSORS and controls shall be configured such that a failure of the controls or sensor turns on the indoor fan to deliver Q_{min} or greater as defined in Annex GG and 101.DVG. For ADD-ON HEATPUMPS a failure of the REFRIGERANT SENSOR or controls shall turn on the indoor fan at the highest available speed or to not less than Q_{min} as determined in Annex GG.

LL.7DV Vibration requirements

Vibration requirements of IEC 60079-29-1 for fixed gas detection sensors need not apply to the entire appliance.

LL.8DV Refrigerant detection system self-test routine

The refrigerant detection system shall include a means for self-testing to determine if a REFRIGERANT SENSOR or sensing element malfunction has occurred. The self-test shall include missing REFRIGERANT SENSOR (open circuit), by-passed REFRIGERANT SENSOR (shorted circuit), and REFRIGERANT SENSOR output out of range.

The test shall be run at least every hour, and if a failure is detected, the device shall take the actions in accordance with Clause LL.6DV.

If the REFRIGERANT SENSOR is a LIMITED LIFE REFRIGERANT SENSOR and requires replacement after a given period, then the device shall take the actions prescribed in LL.6DV at the end of the specified life and shall provide indication that replacement is required.

Compliance is checked by inspection.

LL.9DV Serviceability

REFRIGERANT SENSORS shall be accessible for inspection, and replacement. REFRIGERANT SENSORS for replacement shall be specified by the appliance manufacturer.

LL.10DV REFRIGERANT SENSOR identification

The REFRIGERANT SENSORS shall be marked or tagged with

a) name, trade mark or identification mark of the manufacturer or responsible vendor;

b) reference number or other means for identifying the refrigerant sensor; and

c) "This refrigerant sensor shall only be replaced with manufacturer approved sensor". If the SENSOR is only replaceable as part of an assembly of parts, then the assembly shall be marked.

The markings shall comply with 7.14 of the Part 1.