UL 60950-22

STANDARD FOR SAFETY

Information Technology Equipment – Safety – Part 22: Equipment to be Installed Outdoors

UL Standard for Safety of Information Technology Equipment – Safety – Part 22: Equipment to be Installed Outdoors, UL 60950-22

Second Edition, Dated March 31, 2017

Summary of Topics

This new edition of ANSI/UL 60950-22 is being issued to update requirements to those published in IEC 60950-22, second edition. Technical changes to the IEC Standard have been incorporated into the new edition of the UL Standard. National Differences from the First Edition of UL 60950-22 were reviewed and updated in the new edition.

UL 60950-22 is an adoption of IEC 60950-22, Information Technology Equipment – Safety – Part 22: Equipment to be Installed Outdoors (Second Edition, issued January 2016). Please note that the National Difference document incorporates all of the U.S. national differences for UL 60950-22.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated September 30, 2016.

No Text on This Page

CSA Group
CAN/CSA-C22.2 No. 60950-22:17
Second Edition
(IEC 60950-22:2017, MOD)

Underwriters Laboratories Inc.
UL 60950-22
Second Edition

Information Technology Equipment – Safety – Part 22: Equipment to be Installed Outdoors

March 31, 2017

This national standard is based on publication IEC 60950-22, Second Edition (2016).

Approved by

Standards Council of Canada
Conseil canadien des normes

Approved American National Standard
ANSI

ANSI/UL 60950-22-2017

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.

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. 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.

To purchase CSA Group Standards and related publications, visit CSA Group's Online Store at shop.csa.ca or call toll-free 1-800-463-6727 or 416-747-4044.

This ANSI/UL Standard for Safety consists of the Second Edition. The most recent designation of ANSI/UL 60950-22 as an American National Standard (ANSI) occurred on March 31, 2017. 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.

To purchase UL Standards, visit Comm 2000 at http://www.comm-2000.com/HowToOrder.aspx or call toll-free 1-888-853-3503.

ISBN 978-1-4883-0706-5

CONTENTS

PREFACE .....5 DE

FOREWORD 8

INTRODUCTION 11

1 Scope 12
1.1 Equipment covered 12
1.2 Additional requirements 12
2 Normative references 12
3 Terms and definitions 14
4 Conditions for outdoor equipment 14
4.1 Ambient air temperature 14
4.2 Mains supply 15
4.3 Rise of earth potential 16
5 Marking and instructions 16
6 Protection from electrical shock in an outdoor location 17
6.1 Voltage limits of user-accessible parts in outdoor locations 17
6.2 Limited current circuits in outdoor locations 17
6.3 Protection for socket-outlet in outdoor locations 17
7 Wiring terminals for connection of external conductors 18
8 Construction requirements for outdoor enclosures 18
8.1 General 18
8.2 Resistance to ultra-violet radiation 19
8.3 Resistance to corrosion 20
8.4 Bottoms of fire enclosures 21
8.5 Gaskets 21
9 Protection of equipment within an outdoor enclosure 22
9.1 Protection from moisture 22
9.2 Protection from plants and vermin 23
9.3 Protection from excessive dust 24
10 Mechanical strength of enclosures 25
10.1 General 25
10.2 Impact test 25
11 Outdoor equipment containing valve regulated or vented batteries 26
11.1 Risk of explosion from lead acid, NiCd and NiMH batteries 26
11.2 Ventilation preventing an explosive gas concentration 27
11.3 Ventilation test 28

Annex A (normative) Water-saturated sulphur dioxide atmosphere (see 8.3.2 and 8.3.3)

Annex B (normative) Water spray test (see 9.1)

Annex C (normative) Ultraviolet light conditioning test (see 8.2)

C.1 Test apparatus 33
C.2 Mounting of test samples 33

C.3 Carbon-arc light-exposure apparatus 33
C.4 Xenon-arc light-exposure apparatus 33

Annex D (normative) Gasket tests (see 8.5)

D.1 Gasket tests 34
D.2 Tensile strength and elongation tests 34
D.3 Compression test 34
D.4 Oil immersion test 35

Annex E (informative) Rationale

E.1 General 37
E.2 Electric shock 37
E.3 Energy related hazards 38
E.4 Fire 38
E.5 Mechanical hazards 38
E.6 Heat related hazards 38
E.7 Radiation 39
E.8 Chemical hazards 39
E.9 Biological hazards 39
E.10 Explosion hazards 39

Annex NAE (informative) U.S. and Canadian regulatory requirements D1

Bibliography

PREFACE

DE

This is the harmonized CSA and UL Standard for Information Technology Equipment – Safety – Part 22: Equipment to be Installed Outdoors. It is the second edition of CAN/CSA-C22.2 No. 60950-22 and the second edition of UL 60950-22. This edition of CAN/CSA-C22.2 No. 60950-22 supersedes the previous edition published on April 23, 2007. This edition of UL 60950-22 supersedes the previous edition published on April 23, 2007.

This harmonized standard is based on IEC Publication 60950-22: second edition, Information Technology Equipment – Safety – Part 22: Equipment to be Installed Outdoors, issued January 2016. IEC 60950-22 is copyrighted by the IEC.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of representatives of leading industry companies and organizations 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 Safety of Electronic Equipment within the Field of Audio/Video, Information, and Communication Technology, 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 has been approved as a National Standard of Canada by the Standards Council of Canada (SCC).

This Standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

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.

Level of harmonization

This standard adopts the IEC text with national differences.

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

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

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

Reasons for differences from IEC DE

The national differences in this binational Part 22 Standard are included to reference the binational version of IEC 60950-1, which is designated as CAN/CSA-C22.2 No. 60950-1/UL 60950-1, to address issues related to references to the first and second editions of CSA/UL 60950-1, and to address additional requirements for lightning strikes (Clauses 1 and 2), components used to reduce the overvoltage category (Clause 4), markings (Clause 5), national codes related to wiring (Clause 7), additional requirements for resistance to UV radiation, corrosion, and testing of gasket materials (Clause 8), protection from excessive dust (Clause 9), and U.S. and Canadian regulatory requirements (Annex NAE). DE

Interpretations DE

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. DE

IEC Copyright DE

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 60950-22, Information Technology Equipment – Safety – Part 22: Equipment to be Installed Outdoors, copyright 2016, 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. DE

General DE

National differences from the text of the International Electrotechnical Commission (IEC) Publication 60950-22, Information Technology Equipment – Safety – Part 22: Equipment to be installed outdoors, Copyright 2016, are indicated by the following margin notations: DE

There are six types of national differences, as noted below. The national difference type is noted in the margin next to the affected text. The standard may not include all types of these national differences. DE

D1 – national differences based on national regulatory requirements which result in equivalent or more stringent requirements than in IEC 60950-22. DE

D2 – national differences based on other than national regulatory requirements which result in equivalent or more stringent requirements than in IEC 60950-22. DE

DI – national differences based on IEC final draft international standards (FDIS). DI national differences may be less stringent than, equivalent to, or more stringent than requirements in IEC 60950-22. DE DE DE

DC – national differences based on UL and CSA component requirements. DC national differences may be less stringent than, equivalent to, or more stringent than component requirements in IEC 60950-22. DE DE DE

D3 – national differences based on binational requirements which result in less stringent requirements than in IEC 60950-22. DE DE

DE – editorial national differences that correct typographical errors in IEC 60950-22 or revise the terminology, but do not alter the technical intent of the requirements. This notation is also used for informative statements such as the Preface. DE DE DE

National differences have been incorporated into the body of the standard. If national differences necessitate the deletion of IEC 60950-22 text, the IEC 60950-22 text has been retained but has been ~~lined out~~. Text added as a result of national differences has been underlined. Text added as the Preface and Annex NAE is not underlined. DE DE DE DE

Annex NAE has been included at the back of the standard. Pointers to this annex are provided in the right-hand margin of the body of the standard to direct the user to this informative annex. The pointer text is provided in ***BOLD ITALICS***. An examples of such a pointer is shown here in the right-hand margin. DE DE DE DE ***NAE***

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INFORMATION TECHNOLOGY EQUIPMENT – SAFETY – Part 22: Equipment to be installed outdoors

FOREWORD

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

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

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

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

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.

International Standard IEC 60950-22 has been prepared by IEC TC 108: Safety of electronic equipment within the field of audio/video, information technology and communication technology.

This second edition cancels and replaces the first edition published in 2005. It constitutes a technical revision.

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

– more extensive requirements for battery ventilation.

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

FDIS	Report on voting
108/615/FDIS	108/634/RVD

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

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

This Part 22 of IEC 60950 is intended to be used with IEC 60950-1:2005, hereafter referred to as "Part 1". The subclauses of IEC 60950-1 apply as far as reasonable. Where safety aspects are similar to those of Part 1 the relevant Part 1 clause or subclause is shown for reference in parentheses after the clause or subclause title in Part 22. Where a requirement in Part 22 refers to a requirement or criterion of Part 1, a specific reference to IEC 60950-1, is made. All references to clauses and subclauses in IEC 60950-1 are to the second edition. If the relevant clause or subclause has been renumbered in IEC 60950-1, second edition, the first edition reference is identified in parentheses directly after the second edition reference. DE DE DE DE DE DE

A list of all parts in the IEC 60950 series, published under the general title *Information technology equipment – Safety*, can be found on the IEC website.

In this standard, the following print types are used:

– requirements proper and normative annexes: roman type;

– *compliance statements and test specifications: italic type;*

– notes in the text and in tables: smaller roman type;

– terms that are defined on Clause 3 and in IEC 60950-1: SMALL CAPITALS.

The following differing practices of a less permanent nature exist in the countries indicated below.

– 4.1: Outdoor equipment demand special design at temperatures down to –50 °C (Finland, Norway, Sweden)

– 4.3: Rise of earth potential requirements (USA, Canada)

– 8.5.1: Enclosure types specifications (USA, Canada).

– D.4: In Canada and United States, IRM Immersion Oil No. 903 is accepted (USA, Canada).

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This standard proposes safety requirements for information technology equipment intended to be installed, when exposed wholly or partly, in a location where protection from the weather and other outdoor influences such as rain, dust, etc. normally provided by a building or other structure is limited or non-existent. There are many examples of information technology equipment in use throughout the world that are housed in special ENCLOSURES located on pavements, mounted on telecommunications poles and situated underground. Presently, ~~IEC 60950~~ CAN/CSA-C22.2 No. 60950/UL 60950 has no requirements for such equipment and this proposal would rectify this omission. The proposed requirements would not apply to portable or transportable equipment that may be occasionally used outdoors, but are not intended to be installed in conditions of inclement weather. DE DE

It is expected that IEC TC108 will continue to coordinate the output of its work with other technical committees dealing with equipment installed outdoors, such as IEC TC70 (Degrees of protection provided by enclosures, responsible for IEC 60529) and IEC TC 48 (Electrical connectors and mechanical structures for electrical and electronic equipment).

Annex E describes the rationale behind the treatment of specific safety aspects in this standard.

INFORMATION TECHNOLOGY EQUIPMENT – SAFETY – Part 22: Equipment to be installed outdoors

1 Scope

1.1 Equipment covered *NAE*

This part of IEC 60950 applies to information technology equipment intended to be installed in an OUTDOOR LOCATION.

The requirements for OUTDOOR EQUIPMENT also apply, where relevant, to OUTDOOR ENCLOSURES suitable for direct installation in the field and supplied for housing information technology equipment to be installed in an OUTDOOR LOCATION.

1.2 Additional requirements

Each installation may have particular requirements. Some examples are given in 4.2. In addition, requirements for protection of the OUTDOOR EQUIPMENT against the effects of direct lightning strikes are not covered by the standard. For information on this subject, see ~~IEC 62305-1~~ NFPA 780 or CAN/CSA-B72. D2 D2

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. All references to IEC 60950-1 in this standard are replaced by the equivalent UL and CSA 60950-1 binational Standards as listed below. (Either the first or second editions of CSA/UL 60950-1 may be used.) All relevant Standards referenced in the Part 1 Standard (Annex P, including P.1 and P.2) also apply to this Part 22 Standard. All references to clauses and subclauses in IEC 60950-1 are to the second edition. If the relevant clause or subclause has been renumbered in IEC 60950-1, second edition, the first edition reference is identified in parentheses directly after the second edition reference. D2 D2 D2 D2 D2 D2 D2

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

CSA C22.2 No. 94.1, *Enclosures for Electrical Equipment, Non-Environmental Considerations* D1

CSA C22.2 No. 94.2, *Enclosures for Electrical Equipment, Environmental Considerations* D1

CAN/CSA C22.2 No. 144, *Ground Fault Circuit Interrupters* D1

CSA C22.2 No. 269 series, *Surge Protective Devices* D1

CAN/CSA-C22.2 No. 60950-1-03 or CAN/CSA-C22.2 No. 60950-1-07, *Information Technology Equipment – Safety – Part 1: General Requirements* D2 D2

CAN/CSA-C22.2 No. 62368-1-12 or CAN/CSA-C22.2 No. 62368-1-14, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements* D2 D2

CSA C22.1, *Canadian Electrical Code, Part I* D1

CSA C22.3, *Canadian Electrical Code, Part III* D1

IEC 60068-2-11, *Environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*, IEC 60529:1989/AMD1:1999, IEC 60529:1989/AMD2:2013

~~IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*,~~ D2
~~IEC 60950-1:2005/AMD1:2009, IEC 60950-1:2005/AMD2:2013~~ D2

~~IEC 62368-1:2014, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*~~ D2 D2

IEEE C2, *National Electrical Safety Code* D1

IEEE C62.11, *Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV)* DC

ISO 178, *Plastics – Determination of flexural properties*

ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

ISO 180, *Plastics – Determination of Izod impact strength*

ISO 527 (all parts), *Plastics – Determination of tensile properties*

ISO 3231, *Paints and varnishes – Determination of resistance to humid atmospheres containing sulfur dioxide*

ISO 4892-1, *Plastics – Methods of exposure to laboratory light sources – General guidance*

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

ISO 4892-4, *Plastics – Methods of exposure to laboratory light sources – Open-flame carbonarc lamps*

ISO 8256, *Plastics – Determination of tensile-impact strength*

ISO/TS 18173:2005, *Non-destructive testing – General terms and definitions*

ASTM D471-98, *Standard Test Method for Rubber Property-Effect of Liquids*

NFPA 70, *National Electrical Code* D1

UL 50, *Enclosures for Electrical Equipment, Non-Environmental Considerations* D1

UL 50E, *Enclosures for Electrical Equipment, Environmental Considerations* D1

UL 157, *Gaskets and Seals* DC

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

UL 943, *Ground-Fault Circuit-Interrupters* D1

UL 1449, *Surge Protective Devices* DC

UL 60950-1, First or Second Edition, *Information Technology Equipment – Safety – Part 1: General Requirements* D2
D2

UL 62368-1, First or Second Edition, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements* D2
D2

3 Terms and definitions *NAE*

For the purposes of this document, the terms and definitions given in IEC 60950-1 and the following apply.

3.1 OUTDOOR LOCATION: location for equipment where protection from the weather and other outdoor influences provided by a building or other structure is limited or non-existent

3.2 OUTDOOR EQUIPMENT: equipment specified by the manufacturer to be installed where exposed wholly or partly to the conditions in an OUTDOOR LOCATION

Note 1 to entry: TRANSPORTABLE EQUIPMENT, for example, a laptop or notebook computer, or a telephone, is not OUTDOOR EQUIPMENT unless specified by the manufacturer for continuous use in an OUTDOOR LOCATION.

3.3 OUTDOOR ENCLOSURE: part of OUTDOOR EQUIPMENT that is exposed to the adverse conditions in an OUTDOOR LOCATION and that is intended to protect the interior of the equipment from those conditions

Note 1 to entry: An OUTDOOR ENCLOSURE can also perform the functions of one or more of the following: a FIRE ENCLOSURE; an ELECTRICAL ENCLOSURE; a MECHANICAL ENCLOSURE.

Note 2 to entry: A separate cabinet or housing into which the equipment is placed can provide the function of an OUTDOOR ENCLOSURE.

4 Conditions for outdoor equipment *NAE*

4.1 Ambient air temperature

OUTDOOR EQUIPMENT and OUTDOOR ENCLOSURES shall be suitable for use at any temperature in the range specified by the manufacturer. If not specified by the manufacturer, the range shall be taken as:

– minimum ambient temperature: –33 ºC;
– maximum ambient temperature: +40 ºC.

Compliance is checked by inspection and by evaluation of the data provided by the manufacturer.

NOTE 1 The temperature values are based on IEC 60721-3-4 class 4K2. These temperatures do not take into account severe environments (for example, extremely cold or extremely warm), nor do they include provision for heating by radiation from the sun (solar loading).

NOTE 2 Attention is drawn to IEC 61587-1 for additional information on performance levels C1, C2 and C3.

NOTE 3 In Finland, Norway and Sweden, the temperature in winter can be extremely low. For OUTDOOR EQUIPMENT this will demand special design so that the equipment can stand transport, erection and operation/service at temperatures down to –50 °C.

4.2 Mains supply *NAE*

4.2.1 General

Mains-operated OUTDOOR EQUIPMENT shall be suitable for the highest MAINS TRANSIENT VOLTAGE expected in the installation location.

Consideration shall be given to the following:

– the prospective fault current of the supply to OUTDOOR EQUIPMENT can be higher than for indoor equipment, see IEC 60364-4-43; and

– the MAINS TRANSIENT VOLTAGE for OUTDOOR EQUIPMENT can be higher than for indoor equipment.

Within a certain overvoltage category, components within OUTDOOR EQUIPMENT that reduce the MAINS TRANSIENT VOLTAGE or the prospective fault current shall comply with the requirements of the IEC 61643-series.

As an alternative, components used to reduce the overvoltage category may comply with ANSI/IEEE C62.11, the appropriate part of the CSA C22.2 No. 269 series – Surge Protective Devices, or UL 1449. Suitability of the component for the application shall be determined for the intended installation. (For example, some devices are suitable for installation on the load side of the service entrance only, and some are suitable for use with cord-connected equipment only.) DC DC DC DC DC

NOTE 1 The overvoltage category of OUTDOOR EQUIPMENT is normally considered to be one of the following:

– if powered via the normal building installation wiring, overvoltage category II;

– if powered directly from the mains distribution system, overvoltage category III;

– if at, or in the proximity of, the origin of the electrical installation, overvoltage category IV.

NOTE 2 For further information regarding protection from overvoltages, see IEC 60364-5-53.

Compliance is checked by inspection of the equipment and the installation instructions.

4.2.2 Mains transient voltage on AC mains supply

Equipment that is part of the building installation, or that may be subject to transient overvoltages exceeding those for overvoltage category II, shall be designed for overvoltage category III or IV, unless additional protection is to be provided internally or externally to the equipment. In this case, the installation instructions shall state the need for such additional protection. Clearances in equipment designed for overvoltage category III or IV shall comply with Annex G of IEC 60950-1:2005. The insulation system used in such equipment shall be capable of withstanding the test voltage given in Table 5C of IEC 60950-1:2005/AMD2:2013.

4.2.3 Mains transient voltage on DC mains supply

The transient on a D.C. MAINS SUPPLY depends on the source and the installation of the D.C. MAINS SUPPLY. When determining the D.C. MAINS TRANSIENT VOLTAGE, the installation and the source of the D.C. MAINS shall be taken into account. If these are not known, the MAINS TRANSIENT VOLTAGE on the D.C. MAINS SUPPLY shall be assumed to be 1,5 kV.

The manufacturer shall declare the MAINS TRANSIENT VOLTAGE on the D.C. MAINS SUPPLY in the installation instructions.

4.3 Rise of earth potential

Attention is drawn to the fact that during fault clearing conditions, HAZARDOUS VOLTAGES may exist and be accessible for longer periods than for indoor equipment and special earthing conditions may be necessary. These are typically specified in local installation codes.

NOTE In the USA, these requirements are contained in the National Electrical Code. In Canada, they are contained in the Canadian Electrical Code.

Compliance is checked by evaluation of the installation instructions.

5 Marking and instructions *NAE*

The installation instructions for OUTDOOR EQUIPMENT shall include details of any special features needed for protection from conditions in the OUTDOOR LOCATION (see 1.7.2 of IEC 60950-1:2005).

If a manufacturer of an OUTDOOR ENCLOSURE classifies a product in accordance with IEC 60529, the IP code shall be declared, however it is not required to mark the IP code on the OUTDOOR ENCLOSURE. It is not required to make such a declaration for OUTDOOR EQUIPMENT.

Additionally, OUTDOOR ENCLOSURES shall be classified and marked in accordance with UL 50 or UL 50E, or CSA C22.2 No. 94.1 or CSA C22.2 No. 94.2. D1 D1

Compliance is checked by inspection.

6 Protection from electrical shock in an outdoor location

6.1 Voltage limits of user-accessible parts in outdoor locations

USER-accessible conductive parts in an OUTDOOR LOCATION shall meet the requirements for an SELV CIRCUIT in 2.2.2 and 2.2.3 of IEC 60950-1:2005/AMD2:2013, except that the voltage limits shall not exceed:

– 15 V a.c., 21,2 V peak, or 30 V d.c. under normal operating conditions (see 2.2.2),

– 15 V a.c., 21,2 V peak, or 30 V d.c. for longer than 0,2 s under single fault conditions (see 2.2.3). Moreover, the voltage shall not exceed 30 V a.c., 42,4 V peak or 60 V d.c.

The exception in 2.2.3 of IEC 60950-1:2005/AMD2:2013 relating to 2.3.2.1 b) of the same publication, does not apply to USER-accessible conductive parts.

NOTE 1 Lower voltage limits apply because the contact resistance of the body is reduced when subjected to wet conditions.

NOTE 2 In Denmark, the installation rules require the maximum safe to touch nominal voltage to be 6 V a.c. r.m.s. or 15 V ripple-free d.c. for outside environment, where the installation normally can be humid or wet due to the weather condition including area with shelters, but not in protected walls e.g. carports.

Compliance is checked by measurement.

6.2 Limited current circuits in outdoor locations

The requirements of 2.4 of IEC 60950-1:2005/AMD1:2009/AMD2:2013, apply without change.

6.3 Protection for socket-outlet in outdoor locations *NAE*

A residual current protective device (RCD) with rated residual operating current not exceeding 30 mA shall be used in the MAINS SUPPLY to socket-outlets intended for general use and with a rated current not exceeding 20 A.

The RCD shall be an integral part of the equipment or of the building installation. If the RCD is part of the building installation, instructions for installations of the RCD shall be provided with the equipment.

7 Wiring terminals for connection of external conductors *NAE*

The mains supply terminations for OUTDOOR EQUIPMENT that is intended to be powered:

– via the normal building installation wiring, shall be as specified in 3.3 of IEC 60950-1:2005/AMD2:2013;

– directly from the mains distribution system, shall be as specified in the IEC 60364 parts.

The applicable parts of the Canadian Electrical Code, Part I, CSA C22.1; Canadian Electrical Code, Part III, CSA C22.3; the National Electrical Code, NFPA 70; and the National Electrical Safety Code, ANSI/IEEE C2, shall apply as appropriate. D1 D1 D1

NOTE For other terminals, IEC 60950-1 applies.

Compliance is checked by inspection.

8 Construction requirements for outdoor enclosures

8.1 General

Protection against corrosion shall be provided by the use of suitable materials or by the application of a protective coating applied to the exposed surface, taking into account the intended conditions of use.

Parts, such as dials or connectors, that serve as a functional part of an OUTDOOR ENCLOSURE shall comply with the same environmental protection requirements as for the OUTDOOR ENCLOSURE.

NOTE 1 Aspects affecting safety which require the integrity of the OUTDOOR ENCLOSURE through the life of the product include:

– continued protection against access to hazardous parts, including after mechanical strength tests;

– continued protection against ingress of dust and water;

– continued provision of earth continuity.

An OUTDOOR ENCLOSURE shall not be used to carry current during normal operation if this could cause corrosion that would impair safety. This does not preclude connection of a conductive part of an OUTDOOR ENCLOSURE to protective earth for the purpose of carrying fault currents.

NOTE 2 The action of a current flowing through a joint can increase corrosion under wet conditions.

Where a conductive part of an OUTDOOR ENCLOSURE is connected to protective earth for the purpose of carrying fault currents, the resulting connection shall meet the requirements of 2.6 of IEC 60950-1:2005/AMD1:2009/AMD2:2013, after the appropriate weather conditioning tests, see 8.3.

Compliance is checked by inspection and, if necessary, by the tests of 2.6 of IEC 60950-1:2005/AMD1:2009/AMD2:2013 and 8.3 of this standard.

8.2 Resistance to ultra-violet radiation

Non-metallic parts of an OUTDOOR ENCLOSURE required for compliance with this standard shall be sufficiently resistant to degradation by ultra-violet (UV) radiation.

Table 1 – Minimum property retention limits after UV exposure

Parts to be tested	Property	Standard for the test method	Minimum retention after test
Parts providing mechanical support	Tensile strength [a] or	IS0 527	70 %
	Flexural strength [a, b]	ISO 178	70 %
Parts providing impact resistance	Charpy impact [c] or	ISO 179	70 %
	Izod impact [c] or	ISO 180	70 %
	Tensile impact [c]	ISO 8256	70 %
All parts	Flammability classification	1.2.12 and Annex A of IEC 60950-1:2005	see [d]

[a] Tensile strength and flexural strength tests are to be conducted on specimens no thicker than the actual thicknesses.

[b] The side of the sample exposed to UV radiation is to be in contact with the two loading points when using the three-point loading method.

[c] Tests conducted on 3,0 mm thick specimens for Izod impact and tensile impact tests and 4,0 mm thick specimens for Charpy impact tests are considered representative of other thicknesses, down to 0,8 mm.

[d] The flammability classification may change as long as it does not fall below that specified in Clause 4 of IEC 60950-1:2005/AMD1:2009/AMD2:2013.

Compliance is checked by examination of the construction and of available data regarding the UV resistance characteristics of the ENCLOSURE material and any associated protective coating. If such data is not available, the tests in Table 1 are carried out on the parts.

Samples taken from the parts, or consisting of identical material, are prepared according to the standard for the test to be carried out. They are then conditioned according to Annex C. After conditioning, the samples shall show no signs of significant deterioration, such as crazing or cracking. They are then kept at room ambient conditions for not less than 16 h and not more than 96 h, after which they are tested according to the standard for the relevant test.

In order to evaluate the percent retention of properties after test, samples that have not been conditioned according to Annex C are tested at the same time as the conditioned samples. The retention shall be as specified in Table 1.

As an alternative, materials tested in accordance with the requirements and test procedures of UL 746C, Sections 25 (UV Exposure) and 57 (UV Light Exposure Test), or CAN/CSA-C22.2 No. 0.17, Clause 5.9, are considered equivalent and acceptable for this application. DC DC DC

8.3 Resistance to corrosion

8.3.1 General

Metallic parts of OUTDOOR ENCLOSURES, with or without protective coatings, shall be resistant to the effects of water-borne contaminants.

Compliance is checked by either:

– inspection and by evaluation of data provided by the manufacturer; or

– the tests and criteria as specified in 8.3.2 through 8.3.4; or

– the applicable performance level (A1, A2 or A3) of IEC 61587-1.

NOTE Enclosures made of the following materials are considered to comply with the outdoor corrosion requirements: DC

a) Copper, aluminum, or stainless steel; and DC

b) Bronze or brass containing at least 80 percent copper. DC

8.3.2 Test apparatus

The apparatus for the salt spray test shall consist of a test chamber and spraying devices as described in IEC 60068-2-11.

The apparatus for the test in a water-saturated sulphur dioxide atmosphere shall consist of an inert, hermetically sealed, chamber containing a water-saturated sulphur dioxide atmosphere (see Annex A) in which the test specimens and their supports are held. The chamber is as described in ISO 3231.

8.3.3 Test procedure

The test shall consist of two identical and successive 12 day periods.

Each 12 day period consists of test a) followed by test b):

test a) – 168 h of exposure to the salt spray atmosphere. The concentration of the saline solution forming the salt spray atmosphere is 5 % ± 1 % by weight and the temperature of the test chamber is maintained at 35 °C ± 2 °C.

test b) – 5 exposure cycles each consisting of an 8 h exposure to a water-saturated sulphur dioxide-rich atmosphere, (see Annex A), during which the temperature of the test chamber is maintained at 40 °C ± 3 °C , followed by 16 h at rest with the test chamber door open.

After each 12 day period, the test specimens are washed with demineralized water.

Alternatively, the test procedures as described in the following standards may be used to show compliance:

– ISO 21207 Method B; or

– ISO 14993; or

– any other equivalent standard.

8.3.4 Compliance criteria

Compliance is checked by visual inspection. The equipment shall not show rust, other than surface corrosion of the protective coating, cracking or other deterioration that will jeopardize the safety aspects as follows:

– continued protection against access to hazardous parts, including after mechanical strength tests; and

– continued protection against ingress of dust and water; and

– continued provision of earth continuity.

However, surface corrosion of the protective coating is permitted.

8.4 Bottoms of fire enclosures

The bottom of a FIRE ENCLOSURE of OUTDOOR EQUIPMENT shall comply with 4.6.2 of IEC 60950-1:2005, except there are no requirements for the bottoms of FIRE ENCLOSURES of OUTDOOR EQUIPMENT provided that the installation instructions specify that the equipment is to be mounted directly and permanently on a non-combustible surface (such as concrete or metal). There is no need for a marking on the equipment.

Compliance is checked by inspection.

8.5 Gaskets

8.5.1 General

When gaskets are used as the method providing protection against the ingress of potential contaminants, 8.5.1 through 8.5.3 shall apply as appropriate.

NOTE In Canada and the United States, ENCLOSURE types are specified in the Canadian Electrical Code and the U.S. National Electrical Code.

Joints for all devices closing openings into the equipment cavity of an ENCLOSURE subjected to splashing or seepage of oil, as well as any door or cover for such an ENCLOSURE, shall include a gasket in the full length of the joint.

A gasket of elastomeric or thermoplastic material, or a composition gasket utilizing an elastomeric material that is provided on an ENCLOSURE subjected to water or dust, shall meet requirements of this standard.

Compliance is checked by inspection and by applying the relevant tests of Annex D.

As an alternative, gasket materials tested in accordance with UL 157, or the gasket tests in CSA C22.2 No. 94.2/UL 50E, are considered acceptable for this application. DC DC

8.5.2 Oil resistance

A gasket provided on an ENCLOSURE subjected to oil or coolant shall be oil resistant.

Compliance is checked by inspection and by the oil immersion test of Clause D.4.

8.5.3 Securing means

A gasket shall be secured with adhesive or by mechanical means. The gasket and its securing means shall not be damaged when the joint is opened.

Compliance is checked by inspection.

9 Protection of equipment within an outdoor enclosure

9.1 Protection from moisture *NAE*

The OUTDOOR ENCLOSURE shall provide adequate protection from the effect of moisture on the enclosed equipment. Examples of constructions regarded as meeting the requirements are shown in Table 2.

NOTE 1 This does not preclude OUTDOOR ENCLOSURE or OUTDOOR EQUIPMENT being constructed with segmented volumes, each providing a different pollution degree.

NOTE 2 For consideration of the effects of the presence of conductive pollution, as opposed to non-conductive pollution which can become conductive only due to the presence of moisture, see the relevant requirements in IEC 60529.

Table 2 – Examples of the provision of pollution degree environments

Pollution degree	Method of achievement
Pollution degree 3	The use of an ENCLOSURE meeting IPX4 or the Annex B requirements relating to the ingress of water is considered to provide a pollution degree 3 environment within the ENCLOSURE.
Reduction of pollution degree 3 to pollution degree 2	Reduction of the pollution degree 3 environment to pollution degree 2 can be accomplished by either: – providing continuous energization of the enclosed equipment; or – providing separate climate conditioning which prevents condensation within the OUTDOOR EQUIPMENT or OUTDOOR ENCLOSURE; or – the use of an ENCLOSURE meeting IP54.
Reduction to pollution degree 1	Control of the environment at the insulation surface to pollution degree 1 can be accomplished by the methods in IEC 60950-1, for example, encapsulation, potting or coating.

Where necessary, the ENCLOSURE of OUTDOOR EQUIPMENT shall be provided with drain holes to control the accumulation of moisture due to:

– entrance of water through openings; and

– condensation, when this is likely to occur (for example, keeping the equipment energized or separately heating the equipment is considered to keep it free of condensation).

The provision of drain holes and their location shall be taken into consideration when determining the IP rating.

See Clause 5. DC

Compliance is checked by inspection and, if necessary, by the relevant tests of IEC 60529 or Annex B.

Prior to testing, the equipment shall be mounted, so far as is reasonably practicable, according to the manufacturer's installation instructions. If fans or other means for ventilation are provided, which could affect the ingress of water, the test shall be conducted with the ventilation means both on and off unless it is evident that one of the modes of operation will produce the more onerous result.

At the conclusion of the test the following conditions shall exist:

– For OUTDOOR ENCLOSURES – no water shall have entered the ENCLOSURE.

– For OUTDOOR EQUIPMENT – water is permitted to enter the ENCLOSURE provided it does not:

a) deposit on insulation where it could lead to tracking along the CREEPAGE DISTANCE,

b) deposit on bare live parts or wiring, or on windings not designed to operate when wet, or

c) enter any supply wiring space, see 3.2.9 of IEC 60950-1:2005.

9.2 Protection from plants and vermin

If entry by plants and vermin is a consideration, OUTDOOR EQUIPMENT shall have adequate protection.

NOTE For protection against plants and vermin, see IEC 61969-3.

Compliance is checked by inspection.

9.3 Protection from excessive dust

9.3.1 General

Unless the equipment is developed according to the requirements of Pollution Degree 3, OUTDOOR EQUIPMENT shall have adequate protection against the ingress of the dust through the use of an appropriately rated IP5X or IP6X ENCLOSURE, or equivalent (e.g. an equivalent NEMA rated ENCLOSURE).

NOTE Dust from road vehicles is not considered to be conductive.

ENCLOSURE Types 3, 3X, 3S, 3SX, 4, 4X, 6, and 6P as described in CSA C22.2 No. 94.2/UL 50E are considered to comply with 9.3.2. D1 D1

ENCLOSURE Types 3, 3X, 3S, and 3SX as described in CSA C22.2 No. 94.2/UL 50E are considered to comply with 9.3.3. D1 D1

Compliance is checked by inspection and, if necessary, by the relevant tests of CSA C22.2 No. 94.2/UL 50E, or IEC 60529 or alternatively, by the tests of 9.3.2 or 9.3.3 using the acceptance conditions of IEC 60529:1989/AMD1:1999, Clause 5, 13.5.2 and 13.6.2. D1 D1

9.3.2 IP5X equipment

Dust-proof equipment (first characteristic IP numeral 5) shall be tested in a dust chamber similar to that shown in Figure 2 of IEC 60529:1989, in which talcum powder is maintained in suspension by an air current. The chamber shall contain 2 kg of powder for every cubic meter of its volume. The talcum powder used shall be able to pass through a square-meshed sieve whose nominal wire diameter is 50 µm and whose nominal free distance between wires is 75 µm. It shall not have been used for more than 20 tests. The test shall proceed as follows:

a) the equipment is suspended outside the dust chamber and operated at rated supply voltage until operating temperature is achieved;

b) the equipment, whilst still operating, is placed with the minimum disturbance in the dust chamber;

c) the door of the dust chamber is closed;

d) the fan/blower causing the talcum powder to be in suspension is switched on;

e) after 1 min, the equipment is disconnected and allowed to cool for 3 h whilst the talcum powder remains in suspension.

NOTE The 1 min interval between switching on the fan/blower and switching off the equipment is to ensure that the talcum powder is properly in suspension around the equipment during initial cooling, which is most important with smaller equipment. The equipment is operated initially as in item a) to ensure the test chamber is not overheated.

9.3.3 IP6X equipment

Dust-tight equipment (first characteristic IP numeral 6) shall be tested in accordance with 9.3.2.

10 Mechanical strength of enclosures

10.1 General

OUTDOOR ENCLOSURES and OUTDOOR EQUIPMENT shall have adequate mechanical strength and shall provide protection against access to energized parts and other hazards within the equipment throughout the intended ambient operating range.

Compliance is checked by the inspection of the construction and available data and, if necessary, by the test of 10.2. After the test the following criteria shall be met:

– the level of protection shall remain in accordance with 9.1; and

– the requirements of 4.2.1 of IEC 60950-1:2005/AMD1:2009/AMD2:2013, shall be met.

10.2 Impact test

For equipment with an ENCLOSURE made of polymeric material, the ENCLOSURE of the equipment should be subjected to the low temperature conditioning before the impact test. Subsequently OUTDOOR ENCLOSURES and OUTDOOR EQUIPMENT are to be subjected to the impact test of 4.2.5 of IEC 60950-1:2005/AMD1:2009/AMD2:2013. Where the ENCLOSURE is made of polymeric material, the test is carried out at an ambient temperature equal to the minimum ambient temperature specified by the manufacturer or –33 °C if no minimum ambient temperature is specified, for 24 h. The test can be applied to a portion of the enclosure representing the largest unreinforced area, supported in its normal position.

NOTE For requirements in Finland, Norway and Sweden, see 4.1, Note 3.

The impacts are applied to doors, covers, seams and the like which could affect the ingress of dust and moisture. The test is performed whether or not failure would give direct access to hazardous parts. The impacts are applied within 2 min of removal from the climatic chamber.

11 Outdoor equipment containing valve regulated or vented batteries *NAE*

11.1 Risk of explosion from lead acid, NiCd and NiMH batteries

The compartment housing a valve regulated or vented battery, where gassing is possible during normal usage or over-charging, shall have adequate ventilation.

In a compartment containing both, a battery and electrical components, the risk of ignition of local concentrations of hydrogen and oxygen by adjacent operational arcing parts, such as contactors and switches close to battery vents or valves, shall be controlled. This shall be achieved, for example, by the use of fully enclosed components, separation of battery compartments or adequate ventilation.

The ventilation system shall be so constructed that any potential fault, including distortion of the battery cases due to overheating or thermal runaway, does not result in the ventilation system failing to vent explosive gasses.

If ventilation tubes are used for conducting explosive gas from the battery cases to the outside air, they shall not be the only means of eliminating the build-up of gas from the cabinet. An independent means of natural ventilation that adequately ventilates the enclosure containing the batteries shall be provided.

If mechanical or forced-air ventilation is used, adequate ventilation shall continue to be provided under single-fault failure conditions.

ENCLOSURES with mechanical or electromechanical dampers shall continue to provide adequate ventilation when the damper is in the closed position.

NOTE Test methods and requirements for stationary batteries are given in IEC 60896-21, IEC 60896-22 and IEC 62485-2.

Compliance is checked by inspection of the ventilation system for compliance with the above, by verifying that the capability of the housing to ventilate hydrogen is in accordance with 11.2 and, if necessary, by the test in 11.3.

Boost charging shall be assumed, unless it can be verified that float charging is maintained under normal and single-fault conditions.

For charging conditions where the boost charge voltage exceeds those found in Table 3, the test in 11.3 shall be conducted.

11.2 Ventilation preventing an explosive gas concentration

The requirements of M.7 of IEC 62368-1:2014 apply.

Table 3 shall be used for the calculation of the ventilation air flow instead of Table M.1 of IEC 62368-1:2014.

Table 3 – Values for current I_{float} and I_{boost}, factors f_g and f_s, and voltages U_{float} and U_{boost}

Parameter	Lead-acid batteries vented cells Sb < 3 % [a]	Lead-acid batteries VRLA cells	NiCd batteries vented cells [b]
Gas emission factor f_g	1	0,2	1
Gas emission safety factor f_s (incl. 10 % faulty cells and ageing)	5	5	5
Float charge voltage U_{float} [c] V/cell	2,23	2,27	1,40
Typical float charge current I_{float} A/Ah	1	1	1
Current (float) I_{gas} mA/ Ah (under float charge conditions relevant for air flow calculation)	5	1	5
Boost charge voltage U_{boost} [c] V/cell	2,40	2,40	1,55
Typical boost charge current I_{boost} mA/Ah	4	8	10
Current (boost) I_{gas} mA/Ah (under boost charge conditions relevant for air flow calculation)	20	8	50
[a] For an antimony (Sb) content higher than 3 %, the current used for calculations shall be doubled. [b] For recombination type NiCd and NiMH cells consult the manufacturer. [c] Float and boost charge voltage can vary with the specific gravity of electrolyte in lead-acid cells.			
The values of float and boost charge current increase with temperature. The consequences of an increase in temperature, up to a maximum of 40 °C, have been accommodated in the values in Table 1. In case of use of gas recombination vent plugs, the gas producing current I_{gas} the values for vented cells can be reduced to 50 % of the values for vented cells. The ventilation air volume requirements, for example, for two 48 V strings of VRLA cells in the same battery cabinet and each with 120 Ah rated C_{10} capacity amount, under float and under boost charge service conditions are: – service with float charge condition only: $Q = 0,05 \times 24 \times 1 \times 120 \times 0,001 = 0,144$ m^3/h per string or 288 l/h total; – service with boost charge condition: $Q = 0,05 \times 24 \times 8 \times 120 \times 0,001 = 1,15$ m^3/h per string or 2 300 l/h total.			

For the purpose of calculating the area of ventilation openings required for natural ventilation of this subclause, the air velocity is assumed to be 0,1 m/s.

Alternatively, the following equation can be used:

$$A = 28 \times Q$$

where:

Q is the ventilation rate of fresh air (m^3/h);

A is the free area of openings in air inlet and outlet (cm^2)

11.3 Ventilation test

The following test shall be used to measure gas concentration if the adequacy of the required ventilation is not obvious.

Samples of the atmosphere within the battery compartment are to be taken after 7 h of operation. The samples are to be taken at locations where the greatest concentration of hydrogen gas is likely. The hydrogen gas concentration shall not be more than 1 % by volume if the mixture is in proximity to an ignition source, or exceeding 2 % by volume if the mixture is not in proximity to an ignition source. See 4.3.8 of IEC 60950-1:2005/AMD2:2013 for evaluating the overcharging of a rechargeable battery.

Annex A
(normative)
Water-saturated sulphur dioxide atmosphere
(see 8.3.2 and 8.3.3)

If the test chamber has an internal volume of 300 l ± 30 l the water-saturated sulphur dioxide atmosphere is created by the introduction of 0,2 l of sulphur dioxide with a concentration of 0,067 % by volume into the closed test chamber. The sulphur dioxide can either be introduced from a gas cylinder or by creating a specific reaction within the chamber. For test chambers having a different internal volume the quantity of sulphur dioxide is varied accordingly.

Sulphur dioxide can be formed inside the test apparatus by treating sodium pyrosulphite ($Na_2S_2O_5$) with a relatively strong acid, sulphamic acid (HSO_3NH_2).

NOTE 1 The method consists of dissolving excess sodium pyrosulphite in water, giving the reaction:

$$Na_2S_2O_5 + H_2O \rightarrow 2\ NaHSO_3$$

A stoichiometric quantity of sulphamic acid is then added giving the reaction:

$$NaHSO_3 + HSO_3NH_2 \rightarrow NaSO_3NH_2 + H_2O + SO_2$$

The resulting overall reaction is:

$$Na_2S_2O_5 + 2\ HSO_3NH_2 \rightarrow 2\ NaSO_3NH_2 + H_2O + 2\ SO_2$$

To obtain 1 l of SO_2 under normal conditions of 0 ºC temperature and 1,013 3 × 105 Pa, air pressure, 4,24 g sodium pyrosulphite and 4,33 g sulphamic acid are required.

NOTE 2 Sulphamic acid is the only solid mineral acid that is easy to conserve.

Annex B
(normative)
Water spray test
(see 9.1)

The water-spray test apparatus, using fresh water, is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure B.1. Spray heads are to be constructed in accordance with the details shown in Figure B.2. The ENCLOSURE is to be positioned in the focal area of the spray heads so that the greatest quantity of water is likely to enter the ENCLOSURE. The water pressure is to be maintained at 34,5 kPa at each spray head. The ENCLOSURE is to be exposed to the water spray for 1 h.

Unless the construction is such that a test on one side of the ENCLOSURE is representative of a test on another side, the test is to be repeated on other sides of the ENCLOSURE as necessary.

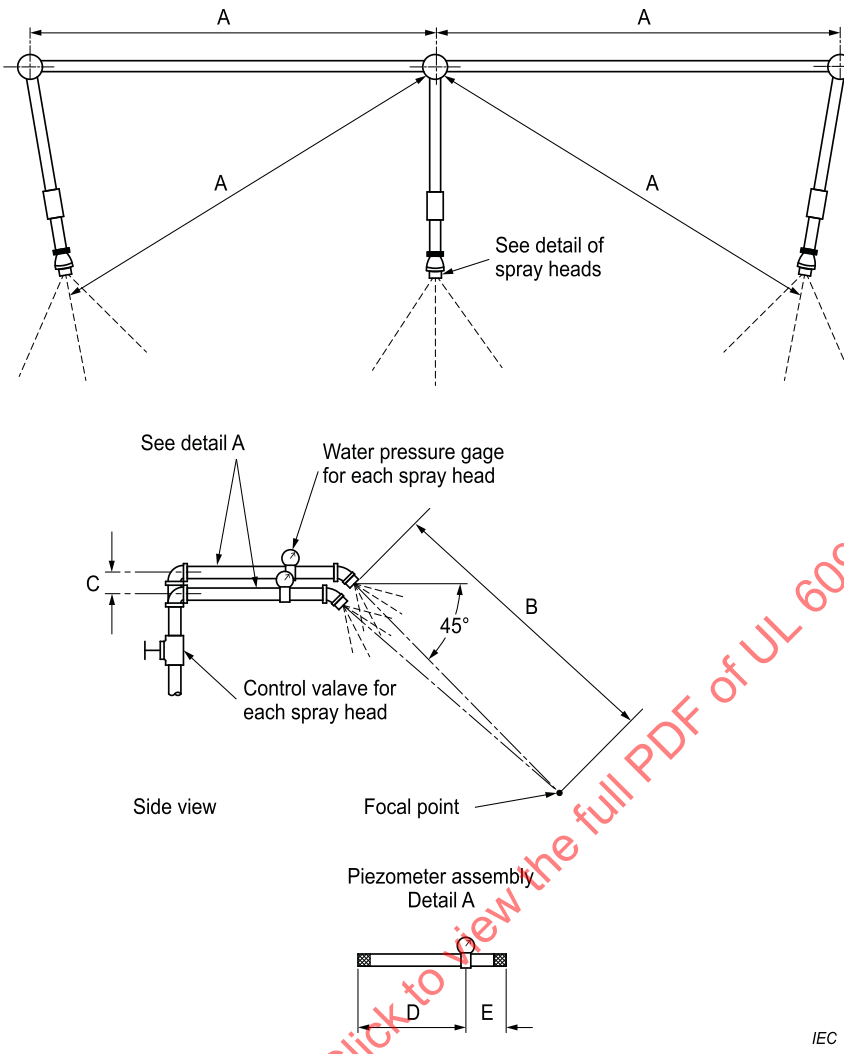
The water spray is to produce a uniform spray over the surface or surfaces under test. The various vertical surfaces of an ENCLOSURE may be tested separately or collectively, provided that a uniform spray is applied.

The top surface of the OUTDOOR ENCLOSURE shall be tested by applying a uniform spray from nozzles located at proper heights (see the focal point in Figure B.1), if

a) there are openings in the top surface, or

b) from an examination of the construction, it is determined that run-off from the top surface could cause water ingress at a vertical surface which would not be detected by the test of the vertical surface.

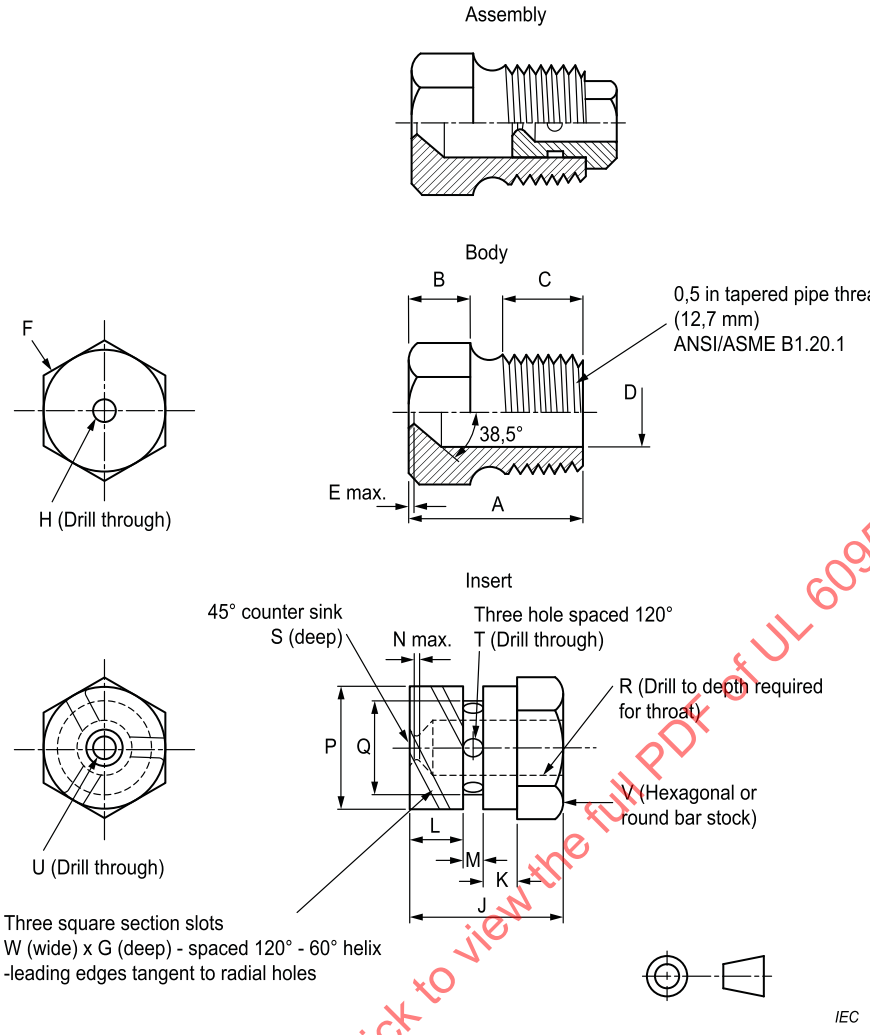
If there are openings in a vertical surface, located lower than 250 mm above ground level, such that water ingress from rain bouncing upwards from the ground surface might occur, a test shall be performed, spraying water on the ground surface in front of such openings, over such distance necessary to cause the deflected spray to reach the OUTDOOR ENCLOSURE. This test is not carried out if, from an examination of the construction, it is determined that the test of the vertical surface adequately assures compliance.



Key

Item	mm
A	710
B	1 400
C	55
D	230
E	75

Figure B.1 – Water-spray test spray-head piping



Item	mm	Item	mm
A	31,0	N	0,80
B	11,0	P	14,61
C	14,0		14,63
D	14,68	Q	11,51
	14,73		11,53
E	0,40	R	63,5
F	Optional – To serve as a wrench grip	S	0,80
G	1,52	T	2,80
H	5,0	U	2,50
J	18,3	V	16,0
K	3,97	W	16,0
L	6,35		
M	2,38		

Figure B.2 – Water-spray test spray head

Annex C
(normative)
Ultraviolet light conditioning test
(see 8.2)

C.1 Test apparatus

Samples are exposed to ultraviolet light by using one of the following apparatus:

a) a twin enclosed carbon-arc, (see Clause C.3), with continuous exposure for a minimum of 720 h. The test apparatus shall operate with a black-panel temperature of (63 ± 3) °C in a relative humidity of (50 ± 5) %; or

b) a xenon-arc (see Clause C.4), with continuous exposure for a minimum of 1 000 h. The test apparatus shall operate with a 6 500 W, water-cooled xenon-arc lamp, a spectral irradiance of 0,35 W/m^2 at 340 nm, a black-panel temperature of (63 ± 3) °C in a relative humidity of (50 ± 5) %.

C.2 Mounting of test samples

The samples are mounted vertically on the inside of the cylinder of the light exposure apparatus, with the widest portion of the sample facing the arcs. They are mounted so that they do not touch each other.

C.3 Carbon-arc light-exposure apparatus

The apparatus described in ISO 4892-4, or equivalent, is used in accordance with the procedures given in ISO 4892-1 and ISO 4892-4 using a type 1 filter, with water spray.

C.4 Xenon-arc light-exposure apparatus

The apparatus described in ISO 4892-2, or equivalent, is used in accordance with the procedures given in ISO 4892-1 and ISO 4892-2 using method A, with water spray.

Annex D
(normative)
Gasket tests
(see 8.5)

D.1 Gasket tests

The relevant tests specified in Clause D.2 or D.3, depending on the type of gasket material used, are applicable to gaskets employed on an ENCLOSURE *subjected to water or dust. The additional test of Clause D.4 is applicable to gaskets employed on an* ENCLOSURE *subjected to oil or coolant. A set of three specimens of the gasket material shall be subjected to the relevant tests.*

D.2 Tensile strength and elongation tests

This test is applicable to gaskets, which can stretch (such as O-rings). Gasket material shall be of such quality that samples subjected to a temperature of 69 °C to 70 °C in circulating air for 168 h have a tensile strength of not less than 75 % and an elongation of not less than 60 % of values determined for unaged samples. At the conclusion of the tests, there shall be no visible deterioration, deformation, melting, or cracking of the material and the material shall not harden as determined by normal hand flexing.

D.3 Compression test

This test is applicable to gaskets with closed cell construction. The set of specimens of gasket material shall be tested to the requirements of a), b) and c) (see Figure D.1). On completion of each test, the specimens shall not show signs of deterioration or cracks that can be seen with normal or corrected vision.

a) A cylindrical weight sufficient to apply 69 kPa shall be placed on the middle portion of each specimen for a period of 2 h. At the end of that time the weight shall be removed and the specimen allowed to rest at a room temperature of 25 °C ± 3 °C for 30 min. The thickness of the gasket shall then be determined and compared with a measurement obtained before the application of the weight. The compression set shall not exceed 50 % of the initial thickness of the specimen.

b) Following the test specified in a), the same specimens shall be suspended in an air oven at a temperature of 70° C for a period of 5 days. The specimens shall then be tested for compliance with a), approximately 24 h after removal from the oven.

c) Following the test specified in b), the same specimens shall be cooled to the minimum temperature specified by the manufacturer or –33 °C if no minimum ambient temperature is specified for a period of 24 h and then subjected to an impact from a hammer of 1,35 kg mass falling from a height of 150 mm upon removal from the cold chamber. The hammer head shall be steel, 28,6 mm in diameter and have a flat striking surface, 25,4 mm in diameter with slightly rounded edges. The specimens being tested shall be placed on short lengths of 50 mm by 100 mm minimum wooden pieces (clear spruce) when being impacted. Following the impact the specimens shall be examined for evidence of cracking or other adverse effects. The test shall be continued and the specimens impacted every 24 h for two more days. The specimens shall then be removed from the cold chamber, allowed to rest at a room temperature of 25 °C ± 3 °C for approximately 24 h, and then again tested for compliance with a).

NOTE For requirements in Finland, Norway and Sweden, see 4.1, Note 3.

D.4 Oil immersion test

Gasket material shall not swell more than 25 % or shrink more than 1 % as a result of immersion in oil for 70 h at a room temperature of 25 °C ± 3 °C. Specifications are provided in ISO 18173:2005 or ASTM D471-98.

NOTE In Canada and United States, IRM Immersion Oil No. 903 is accepted.