IECEx OD 290

Edition 1.0 2022-11

IECEx OPERATIONAL DOCUMENT

IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres (IECEx System)

IECEx certified equipment scheme – Harmonized procedures for IECEx certification of equipment, components and systems associated with the production, dispensing and use of gaseous hydrogen

IECEx OD 290:2022-11(en)

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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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IECEx operational document OD 290 –

IECEx certified equipment scheme – Harmonized procedures for IECEx certification of equipment, components and systems associated with the production, dispensing and use of gaseous hydrogen

FOREWORD

This IECEx operational document OD 290 sets out the harmonized procedures for IECEx certification of equipment, components and systems associated with the production, dispensing and use of gaseous hydrogen.

Document history

Date	Summary
2022-11	Original issue (Version 1)

Address:

IECEx Secretariat
The Executive Centre
Australia Square, Level 33
264 George Street
Sydney, NSW 2000
Australia

Contact details:

Tel: +61 2 4628 4690
info@iecex.com
www.iecex.com

INTRODUCTION

This document has been prepared to provide a uniform approach to certification of equipment, components and systems, associated with the production, distribution, dispensing and use of hydrogen, including gaseous hydrogen dispensing equipment, components and systems for light and heavy-duty vehicles, within the international IECEx equipment certification scheme of the IECEx System.

Certification of equipment suitable for use where hydrogen or other flammable gases, vapours or mists may be present has long been covered by IECEx. This document supplements the suite of IECEx rules and standard operating procedures, referred to as operational documents, (ODs) that govern the IECEx certified equipment scheme and has been prepared in close cooperation with officers and experts from ISO/TC 197: Hydrogen technologies.

An international standardized approach to testing and certification, as provided by the IEC Conformity Assessment System, known as IECEx, facilitates international trade and supports both the traditional hydrogen industries as well as the emerging green hydrogen economy.

In support of this document, IECEx has also issued a dedicated test report format (ExTR blank) to support the consistency in reporting test and assessment results.

This document is to be used by all IECEx certification bodies and IECEx test laboratories when assessing and issuing IECEx certificates of conformity according to the requirements of IEC TS 60079-46.

Attention is drawn to work within ISO TC 197 to develop a dedicated international standard for hydrogen dispensing equipment and that, when finalized, this operational document will be updated to take this new standard into account.

Additional information concerning this document or any other aspects of the international IECEx System can be found at www.iecex.com or contacting the IECEx Secretariat info@iecex.com.

Harmonized procedures for IECEx certification of equipment, components and systems associated with the production, dispensing and use of gaseous hydrogen

1 Scope

This document sets out the approach for certification of equipment, components and systems, associated with the production, distribution, dispensing and use of hydrogen, including gaseous hydrogen dispensing equipment, components and systems for light and heavy-duty vehicles, within the IECEx equipment certification scheme. It supplements existing scheme documents such as IECEx 02, OD 009 and OD 280. It covers information relevant to:

- IECEx certification bodies (ExCBs) and IECEx testing laboratories (ExTLs);
- manufacturers/applicants seeking IECEx certification; and
- assessment processes

This document shall be used in conjunction with IECEx operational document OD 280.

NOTE The first edition of this document is currently providing explicit guidance for the certification of equipment associated with the dispensing of gaseous hydrogen. Additional work is planned to further expand the content to address the full scope targeted by this OD.

2 References

IECEx 02, *IECEx certified equipment scheme covering equipment for use in explosive atmospheres – Rules of procedure*

IECEx OD 003-1, *Assessment procedures for IECEx acceptance of candidate accepted certification bodies (ExCBs) and Ex testing laboratories (ExTLs) – Part 1: Appointment and surveillance of IECEx appointed assessors*

IECEx OD 003-2, *Assessment procedures for IECEx acceptance of candidate accepted certification bodies (ExCBs) and Ex testing laboratories (ExTLs) – Part 2: Assessment, surveillance assessment and re-assessment of ExCBs and ExTLs operating in the IECEx 02, IECEx certified equipment scheme*

ISO/IEC 80079-34, *Explosive atmospheres – Part 34: Application of quality systems for product manufacture*

IECEx OD 009, *Issuing of CoCs, ExTRs and QARs*

IECEx OD 025, *IECEx certified equipment scheme – Guidelines on the management of assessment and surveillance programmes for the assessment of manufacturer's quality systems, in accordance with the IECEx scheme*

IECEx OD 17, *Drawing and documentation guidance*

IECEx OD 024, *IECEx rules of procedure covering testing, or witnessing testing at a manufacturer's or user's facility*

IECEx OD 033, *IECEx unit verification certificates*

ISO/IEC 17065, *Conformity assessment – Requirements for bodies certifying products, processes and services*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

IECEx technical capability document (TCD)

ExTAG decision sheets (DSs)

IECEx OD 280, *IECEx certified equipment scheme – Guide to certification of non-electrical equipment and protective systems*

ISO/TR 15916, *Basic considerations for the safety of hydrogen systems*

3 Standards to be used

The following standards and technical specifications are to be used for certification of gaseous hydrogen fuel dispensing equipment, components and systems in the IECEx equipment certification scheme:

IEC TS 60079-46, *Explosive atmospheres – Part 46: Equipment assemblies*

IEC 60079 and ISO/IEC 80079 Standards as referenced in IEC TS 60079-46

ISO 19880-1, *Gaseous hydrogen – Fuelling stations* (parts as declared by the IECEx certificate applicant for declaring on the IECEx certificate)

ISO 19880-3 for valves

ISO 19880-5 for hoses

ISO 17268 for nozzles

ISO/TR 15916, *Basic considerations for the safety of hydrogen systems*

ISO 14687, *Hydrogen fuel quality – Product specification, when included in the application for certification by the manufacturer*

NOTE 1 Other standards may be identified or developed and this guide will be updated as necessary to address them.

NOTE 2 Attention is drawn to work within ISO TC 197 in the preparation of future international standard, ISO 19880-2. However, to ensure a consistent application of IEC TS 60079-46 and best possible alignment with future ISO 19880-2, the qualification and routine tests contained in Annex A of this OD 290 have been selected following close consultation with ISO TC 197 experts.

4 Summary of the IECEx certification process

The IECEx certification process under the IECEx 02 on certified equipment scheme is detailed in IECEx OD 009. Additional information can be found on the IECEx website (www.iecex.com) in the information tab and IECEx Guide 02A.

5 Requirements to be met by ExCBs and ExTLs

5.1 Applications

In order to issue IECEx certificates of conformity, IECEx test reports (ExTRs) and IECEx quality assessment reports (QARs), in line with this OD 290, ExCBs and ExTLs shall have the following standards within their scope, in addition to the standards listed in Clause 5.2 below:

- IEC TS 60079-46
- ISO 80079-36
- ISO 80079-37
- ISO 19880-1
- ISO 19880 parts as they become available and selected by the ExCB and ExTL

New ExCB and ExTL applications shall be made using the forms F-008 and F-009 respectively.

Scope extensions to include standards listed above shall be made using form F-011.

All IECEx application forms are available at www.iecex.com/publications/iecex-forms/forms-f-xxx.

5.2 Acceptance of ExCBs and ExTLs

In order for ExCBs and ExTLs to have the relevant ISO Standards, e.g. ISO 1988X and according to this OD 290, included in their scope, they must also have IEC 60079-0, IEC 60079-1, IEC 60079-2, IEC 60079-7, IEC 60079-11, IEC 60079-13, IEC 60079-18, IEC TS 60079-46, ISO 80079-36 and ISO 80079-37 within their scope.

Therefore, acceptance of ExCBs and ExTLs to conduct testing and certification according this OD shall be as follows, as applicable:

a) New ExCBs/ExTLs seeking to join IECEx would be subject to a full initial assessment in accordance with IECEx 02 for the standards intended to be included in their scope, including all the standards specifically mentioned in b).

b) Existing ExCBs/ExTLs seeking to include IEC 60079-1, IEC 60079-2, IEC 60079-7, IEC 60079-11, IEC 60079-18, IEC TS 60079-46, ISO 80079-36 and ISO 80079-37 within their scope would be treated under existing scope extension approaches requiring a scope extension assessment and ballot voting by the ExMC.

c) In addition to b), the ExCBs and ExTLs shall require addition of “Gaseous hydrogen fuelling stations” to their scope, based on:

   - Completed F-011 “ExTL/ExCB capability declaration” scope extension form submitted to the IECEx Secretariat, also declaring that they have staff resources with a thorough understanding of ISO/TR 15916 along with the ISO 19880 parts of standards, relating to equipment and components of hydrogen dispensing systems, e.g. Part 1 (relevant clauses), Part 3 and Part 5 of ISO 19880.
   - ExCB/ExTL shall also develop and submit their written procedure based on OD 290, especially if it is related to the assessment of the gaseous hydrogen dispensers as an assembly (annex A of OD 290).
   - Assessment by an IECEx assessor(s) shall be covered during the next scheduled IECEx assessment (annual assessment/mid-term assessment or re-assessment, whichever occurs first).

NOTE IECEx OD 280 sets out requirements for ExCBs and ExTLs seeking to include ISO 80079-36 and ISO 80079-37 within their scope.

5.3 Ignition hazard assessment and project plan

The following is an extract from IECEx OD 280 and shall be applied when conducting an ignition hazard assessment.

[Extract from IECEx OD 280 Clause 5.3]

ExCBs/ExTLs are expected to have their own procedures on how they deal with an ignition hazard assessment based on the requirements of ISO 80079-36 and -37 and the project plan

that is developed from this assessment. In general, the following would be expected to be addressed in their procedures:

- Recognition that the manufacturer must prepare and submit an initial ignition hazard assessment along the lines of ISO 80079-36. This should identify the failure modes and ignition hazards as well as mitigation described into the ignition hazard assessment.
- The ExCB/ExTL forms a team of people who are familiar with the product and associated control systems. If necessary one or more representatives from the manufacturer may be included. This team will consider the initial ignition hazard assessment provided by the manufacturer and make a determination on the appropriate standards and mitigation measures that are acceptable.
- The ExCB/ExTL then develops and agrees on a project plan which takes account of any other standards that need to be invoked. If appropriate the manufacturer may be consulted while the project plan is being developed.
- The project plan may incorporate both the test and assessment requirements at the ExTL and the plan for witness testing in accordance with OD 024 if appropriate.
- The ExTL applies the requirements detailed in the above plan.
- On successful completion of the project, an ExTR will be issued including detail of the ignition hazard assessment together with other information showing compliance with the standards.

5.4 Compliance with the technical requirements of the standards

5.4.1 Protection technique standards

Standards ISO 80079-36 and -37, and the ISO 19880 parts, include some tests that differ in detail from those in the IEC 60079 series, but the compliance methodologies are similar. Some test methods used in accordance with the IEC 60079 series may be adapted to suit specific situations when applying ISO 19880 parts and ISO 80079-36 and -37.

5.4.2 Product standards

For product related standards (e.g. valves, hoses, nozzles, hydrogen dispensers) the requirements of the relevant clauses of the ISO 19880 series of standards would be applied as they relate to the equipment being certified. In practice it is expected that the manufacturer would provide test reports and certificates issued by independent testing laboratories accredited under ISO/IEC 17025 by ILAC members. The test report and test data will be rigorously reviewed prior to acceptance.

Alternatively, testing by a manufacturer, testing at other locations under the provisions of IECEx OD 024, is also accepted regarding testing requirements of the standard(s).

5.5 Acceptance of third-party data

The ExCB/ExTL will need to make a decision on what third-party data can be accepted. In practice it is likely to be the review prior to acceptance of test data along the lines already being applied for items such as RTI/TI information, metallic materials composition, plastic materials composition, UV resistance data, plastic/elastomeric material and temperature range data, material properties (e.g. strength, hydrogen brittleness), hydrogen material compatibility and materials with dissimilar corrosion potentials.

The following list provides examples of aspects of the above items of concern that third-party test data shall be required to address.

- Hydrogen materials

  Equipment and components shall be designed for the expected operating conditions, and specified ambient conditions.

- Material hydrogen compatibility

  The materials (steels, aluminium and polymers, etc.) utilized shall be compatible with hydrogen at the temperatures and pressures utilized. Due consideration shall be given when selecting ferrous materials for hydrogen service. Further information on the selection of materials, particularly the choice of steels resistant to hydrogen embrittlement can be found in ISO/TR 15916, ISO 11114-1 and ISO 16573. ISO 11114-4 can be used to determine the test methods for selecting metallic materials resistant to hydrogen embrittlement.

- Other material recommendations

  It is presupposed that material selection is made in accordance with local environment requirements, avoiding the use of the materials banned by the AHJ (in EU e.g. the Directive 2011/65/EU RoHS).

- Materials with dissimilar corrosion potentials

  Care should be taken to prevent contact between dissimilar metals to prevent galvanic corrosion. Metal fittings should be compatible with metal tubing materials.

5.6 Acceptance of manufacturer's data

Where tests are required to demonstrate compliance with the standards, manufacturer's data can be accepted if tests are witnessed in accordance with IECEx operational document OD 024.

In general, data from the manufacturer can be accepted to support their ignition hazard assessment. It can also be used to assist in establishing the temperature class, in particular where this needs to be done by calculation.

NOTE Guidance is given in IEC 60079-10-1. It can also be used to assist in classification of areas of the dispenser, in particular where this needs to be done by calculation.

6 Requirements of manufacturers

Manufacturers will be expected to provide the ExCB with the following:

- An overview of how they deem that their equipment complies with the standards to which they are applying for IECEx certification. This may include the preparation and submission to ExCB of an initial ignition hazard assessment as defined in ISO 80079-36.
- If required, make personnel with knowledge of the product available to assist the ExCB/ExTL personnel review the ignition hazard assessment.
- Provide documentation in the form addressed by OD 017 and as required by the relevant standards (for example Clause 9.1 of ISO 80079-36 mandates the provision of certain information and there are also requirements in ISO 80079-37).
- Provide equipment as required for testing and assessment.

7 Treatment of equipment, components and systems for IECEx certification

7.1 Treatment of equipment, components and systems associated with gaseous hydrogen, other than hydrogen fuel dispensers

Manufacturers may apply for an IECEx certificate of conformity, for compliance to an ISO or IEC International Standard related to gaseous hydrogen, to an ExCB in accordance with the IECEx scheme rules of IECEx 02 and related IECEx operational documents, e.g. OD 009 and provide the ExCB with the information and detail specified in Clause 6 above.

Where an IEC or ISO Standard dedicated to the equipment, component or systems application to hydrogen exists, then that IEC or ISO Standard shall be used.

Where no dedicated ISO or IEC Standard exists for the equipment, component or system then ISO 80079-36 or ISO 8079-37 shall be used.

The routine tests specified in Annex A shall be applied.

7.2 Treatment of equipment, components and systems associated with gaseous hydrogen fuel dispensers

When assessing hydrogen fuel dispensing equipment for the purposes of IECEx certification, equipment shall be covered as follows:

a) Individual items such as pressurized enclosures, flowmeters, hoses, valves, nozzles and other items may be treated as equipment and covered by an IECEx certificate of conformity.

b) Specific component parts that may comprise elements for equipment such as hoses, valves, nozzles may be treated as components and an IECEx component certificate (U) be issued, with the ExCB to whom application is made to determine following consultation with the applicant.

c) Collection of individual items/components forming a single operational unit (e.g. hydrogen fuel dispensers) shall be regarded as an assembly and covered by a single IECEx certificate of conformity, with IEC TS 60079-46 used as the primary standard for certification. In this situation, gaseous hydrogen fuel dispensing units shall also be subjected to the qualification and routine tests detailed in Annex A. The IECEx report package shall include the report cover, the IECEx ExTR blank for IEC TS 60079-46, ExTR Addendum_1A for H2 dispensers (associated with this OD 290) and other IECEx ExTRs as necessary for the individual items/components.

NOTE Refer to IECEx operational document OD 033 for IECEx unit verification certificates issued for a defined number of products/items.

For hydrogen fuel dispensers being treated as assemblies, it is expected that only the equipment on the assembly and the interconnections within the assembly will be covered by certification but not the installation aspects (e.g. services to the assembly).

In some cases, certain tests may only be possible after assembly on site, e.g. for pressure withstand, temperature rise. Final certificates should only be issued after these tests are completed successfully.

IEC TS 60079-46, Clause 4.3.2 requires that equipment assembly with its own source of release require that the manufacturer shall document the suitability of the equipment assembly for the intended end-site hazardous area classification and for the defined installation conditions.

IECEx OD 024 may need to be applied where testing on site is required.

8 Clarity of equipment covered by IECEx certification

The manufacturer applying for certification has the options provided in Clause 7 above. It is necessary to apply the specific requirements for gaseous hydrogen refuelling to the equipment being certified.

As an example for the above, where valves for use with hydrogen fuel dispensing equipment are certified, the IECEx certificate description would be expected to state "*valves for use with gaseous hydrogen fuel dispensing equipment*".

a) Where equipment to be certified includes a combination of both electrical and non-electrical equipment such as a complete hydrogen fuel dispenser as an assembly, the following applies:

- IEC TS 60079-46 shall be shown on the certificate along with other Ex protection standards used in the certification process along with the relevant ISO Standards relating to the equipment covered, e.g. ISO 19880-3 for valves. The supporting ExTR shall include additional detail including a clear description of which parts/clauses of the relevant ISO Standard have been applied.
- The description of the equipment must make it clear what parts of the equipment are covered by the certification, noting the ability to add attachments to IECEx certificates.

As an example for the above, where a hydrogen fuel dispenser is being certified, the IECEx certificate would be expected to include the following as a minimum:

"Equipment" field on Page 1:	*"Gaseous hydrogen fuel dispenser type XXXXX"*
	"Gaseous hydrogen fuel valves XXXXX »
	"Gaseous hydrogen fuel meters XXXXX »
	"Gaseous hydrogen (part name) valves XXXXX"
"Equipment" description on Page 3:	Details of the parameters, such as:
	Rated working pressure
	Maximum working pressure
	Maximum flow rate
	Rated voltage
	Rated power

Where IECEx certification is requested only for specific batch of the dispensers, then an IECEx unit verification certificate can be issued according to IECEx OD 033.

9 Marking for IECEx Certification

9.1 General

The marking will have the IECEx certificate number with an "X" or "U" where required by IEC 60079-0.

For items certified under Clause 7 items a) and b), the marking requirements of the IEC or ISO Standard to which the equipment, part or component is certified to shall be met, e.g. marking requirements of ISO 19880-3 shall be applied when issuing IECEx certificates to valves according to ISO 19880-3.

9.2 Marking requirements of collection of individual items/components forming a single operational unit (e.g. hydrogen fuel dispensers).

For an assembly certified under Clause 7 item c) the Ex marking code will be similar to that provided in IEC 60079-46 or other applicable 60079 or 80079 series marking requirements, with next line after the Ex code to contain the following "Meant for gaseous hydrogen fuelling Hxx" where the xx number is the Pressure Class according to ISO 19880-1.

Example 1:

IECEx ABC 22.0001X
Ex '60079-46' IIC T3 Gc
Meant for gaseous hydrogen fuelling H70

Example 2:

IECEx ABC 22.0001X
Ex '60079-46' IIB+H2 T3 Gc
Meant for gaseous hydrogen fuelling H70

Annex A
(normative)

Qualification and routine tests to be conducted when assessing gaseous hydrogen dispensers as an assembly

A.1 Scope and general

A.1.1 Scope

This annex applies to gaseous hydrogen dispensing units and sets out the minimum assessment and qualification tests that are to be conducted when assessing gaseous hydrogen dispensers as an assembly according to IEC TS 60079-46, in order to ensure a consistent application of IEC TS 60079-46 when applied to gaseous hydrogen dispensers.

NOTE The tests specified in Clause A2 and A3 have been selected in consultation with ISO TC 197: Hydrogen technologies, experts to align with their current work on gaseous hydrogen dispensers.

A.1.2 General construction

When applying requirements of “Design of equipment assemblies” (Clause 5 of IEC 60079-46 edition 1.0), an assessment shall be made to confirm that the construction of all parts of a gaseous hydrogen dispenser is to be in accordance with industry-recognized engineering principles related to safety, durability and maintainability and fit for intended use, taking into account the following specific parameters.

a) The dispenser cabinet is durable and structurally adequate to protect equipment, components and parts contained within as well as protection to the operator and general public.
b) Individual components and parts associated with the dispenser must be capable of operating within the temperature and pressure range as specified by the manufacturer.
c) The assembly of components and parts within the dispensers are secure to guard against damage and any effects of vibration.
d) Provisions for adequate mounting to provide over support during operation.
e) Components and parts that require servicing, adjustment or replacement are readily accessible.
f) Provision of a means to protect the fuelling hose and nozzle from damage when not in use.
g) Material in contact with hydrogen is compatible with particular attention given to hydrogen embrittlement, permeability and hydrogen accelerated fatigue. The material compatibility shall be documented by the component manufacturer or an independent third party.

A.2 Qualification tests

The following tests have been selected in consultation with ISO TC 197 experts to support a common approach in assessing gaseous hydrogen fuel dispensers and shall be conducted by the ExTL as part of the type testing programme when issuing an IECEx test report (ExTR) using the IECEx ExTR blank IEC 60079-46, along with the ExTR Addendum_1A for H2 dispensers (associated with this OD 290), which are available from the IECEx website at www.iecex.com/members-area/documents/extr-blanks.

The purpose of these tests is to ensure proper assembly within the dispenser system.

A.2.1 Test conditions

Samples selected for testing shall be representative of production and be conducted with the test gas and liquids specified for the tests as:

a) hydrogen, helium, hydrogen mixtures or helium mixtures for leakage tests; or

b) hydrogen, helium, nitrogen or dry air for all other tests

All tests shall be conducted with the inlet pressure maintained at least 110% of the manufacturer's specified maximum allowable working pressure (MAWP), unless otherwise specified.

Tests are to be conducted at room temperature. Unless otherwise stated, testing at room temperature shall be conducted between 15 °C minimum and 30 °C maximum.

A.2.2 Leakage test

A.2.2.1 Method

This test shall be conducted using test gases for leak tests as specified in A.2.1.

All manual and shut-off valves shall be held in the normal operating position for fuelling.

The dispenser, including any fuel temperature cooling system associated with the dispenser, shall be tested at the higher value of either the MAWP or no less than 90% of the set point of the pressure relief device protecting the dispenser components and vehicle tank.

A.2.2.2 Acceptance criteria

Excluding leakage to a safe vent during the disconnection of a nozzle, all dispenser parts, including joints and connections, shall be bubble-free for at least 1 min and not show detectable pressure loss.

A.2.3 Impact test

A.2.3.1 Method

This test shall be conducted at room temperature and minimum temperature specified by the manufacturer.

The non-metallic (plastic) panel should be in place on the dispenser cabinet. It shall be struck with a single impact produced by a pendulum consisting of a 50 mm diameter steel ball weighing 0,525 kg suspended by a cable that provides a minimum of 1,3 m between the centre of the ball and the hinge point at the other end of the cable. See Figure A.1 for the test setup.

The ball shall have an at-rest position not more than 25 mm clear of the panel without any object interfering with the cable. The point of impact shall be determined as the point most likely to result in a failure when hit. The pendulum shall be raised along its arc until the ball is 1,3 m vertically above its at-rest position, and then released.

For the cold impact test, samples shall be conditioned at minimum ambient temperature specified by the manufacturer for at least 24 h.

The conditioned samples shall be removed from the conditioning environment, quickly clamped into place on the dispenser cabinet, and impacted as previously described.

Alternatively, the resistance to impact test in IEC 60079-0 may be used.

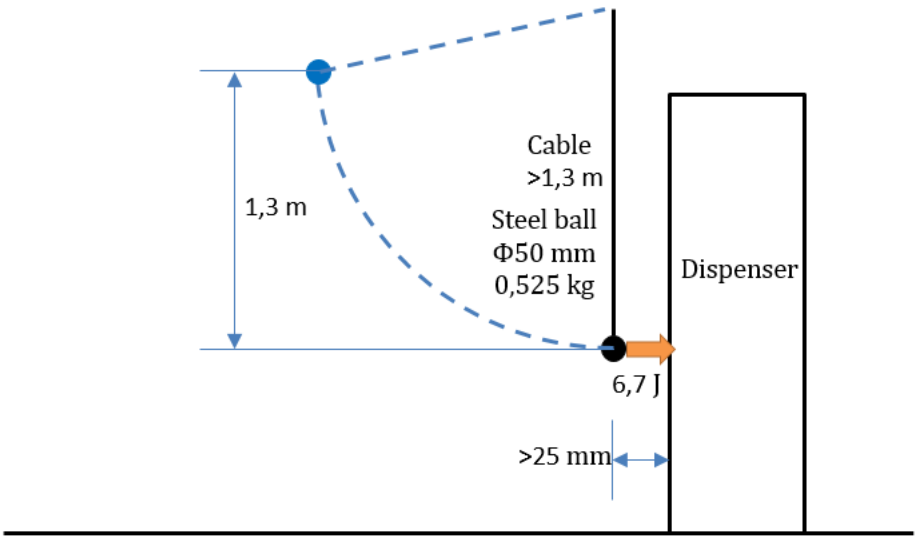

Figure A.1 – Impact test

A.2.3.2 Acceptance criteria

Non-metallic (including plastic) panels used as part of a dispenser cabinet shall withstand a single impact of 6,7 J without developing cracks or other openings that expose bare live parts or gas-confining parts when subjected to room temperature and cold temperature impacts.

A.2.4 Dispenser shutdown test

A.2.4.1 Method

A device simulating an emergency shutdown system (ESS) shall be provided on the dispenser in accordance with the dispenser manufacturer's instructions. The dispenser shall be used to fill an appropriate storage container. The gas supply pressure to the dispenser shall be maintained within the pressure limits specified by the dispenser manufacturer for normal operation.

The dispenser shall be operated to allow gas to flow into the storage container. While gas is flowing, the simulated ESS shall be activated. The dispenser shall cause gas flow to stop within 5 s of the activation of the ESS.

This test shall be conducted for all inputs that can activate the ESS.

A.2.4.2 Acceptance criteria

A dispenser shall disable the flow of gas to the vehicle within 5 s when the ESS is activated.

A.2.5 Hose rupture

A.2.5.1 Method

A tee fitting shall be installed at the downstream of the dispenser fuelling hose and upstream of the nozzle. The hose shall be attached to one of the "through" ports of the tee fitting. A fast-opening valve shall be installed on the other "through" port. The nozzle shall be attached to the "stub" port of the tee. The test setup is shown in Figure A.2. The tank size (storage container in Figure A.2) shall be between 50 l and 249 l. The tee fitting and valve shall have a combined flow coefficient (Cv) as close as practical to that of the hose. A valve permanently mounted inside the dispenser with a Cv less than the hose may be used in place of the temporary test

setup. For safety reasons, the valve shall be secured so as not to move when the valve is opened to allow full flow. The nozzle shall be attached to an appropriate storage container.

The gas supply pressure to the dispenser shall be maintained at least 90% of the maximum operating pressure (MOP). With the valve closed, the dispenser shall be operated to cause gas to flow into the storage container. After the fuelling hose pressure reaches 100% of the MOP, the test valve shall be opened. The dispenser shall cause the flow of gas to stop within 5 s of the opening of the fast-opening valve. This test shall be successfully conducted 5 times.

A.2.5.2 Acceptance criteria

Dispenser controls shall incorporate shutdown protection in the event of a rupture or rapid depressurization of the fuelling hose during refuelling.

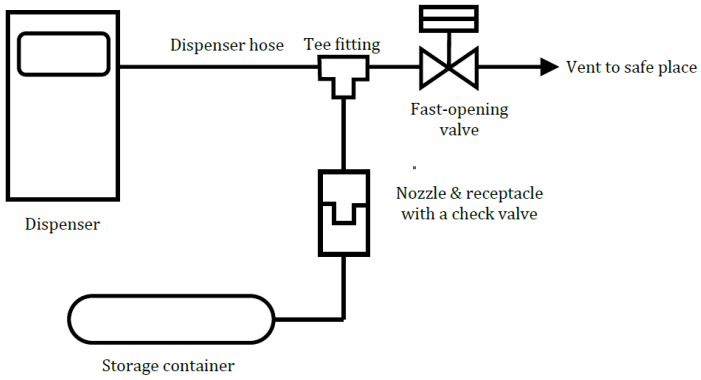

Figure A.2 – Hose rupture test setup

A.2.6 Hose breakaway test

A.2.6.1 Method

The device being tested shall be installed as specified by the manufacturer in a simulated dispenser with a breakaway device and simulated fuelling hose assembly. The test shall be performed at ambient temperature and the maximum allowable working pressure (MAWP) in the most critical direction. If the most critical direction cannot be determined, then additional tests will be required to test all directions that are a concern.

A direct tensile force shall be applied in the most critical direction beginning at a force less than 220 N and increasing until the device separates. The device shall separate between 220 N and 1 000 N. The flow of gas from either half shall cease and shall not leak in excess of the specification in ISO 19880-3.

A.2.6.2 Acceptance criteria

The device shall separate upon application of a maximum pull force of 1 000 N but not less than 220 N when the device is installed as specified by the manufacturer. Upon separation under the pressurized condition, the flow of gas from the inlet component shall cease, and the flow of gas from the outlet component shall either (1) cease within 1 s or (2) relieve the hydrogen in a safely controlled manner, for example through a maximum 1,5 mm orifice.

Additionally, there shall be no significant damage, distortion or deformation of the hardware attaching the breakaway to the dispenser.

A.2.7 Electrostatic discharge test

A.2.7.1 Method

To prevent harmful effects of electrostatic discharge, an electrical potential ranging from 0 to 1 000 V dc shall be applied between the outlet of the dispenser nozzle and the point on the dispenser intended for attachment of the electrical grounding means. The current between these two points shall be measured. The electrical resistance shall be calculated using the following equation:

$$R = V / I$$

where

R = resistance (Ω)

V = applied potential (V dc)

I = measured current (A)

NOTE 1 The above bonding connection(s) may be also connected to the bonding connection to ground in A.2.8.

NOTE 2 See ISO 19880-1 for guidance.

Perform the resistance test at a value less than or equal to 24 V.

A.2.7.2 Acceptance criteria

The dispenser nozzle and fuelling hose shall be electrically continuous with the dispenser electrical grounding means.

The bonding resistance from the point where the nozzle contacts the vehicle receptacle back to the bonding connection to ground shall be less than 1 MΩ.

NOTE Even though the fuelling assembly needs to provide the electrical continuity required to meet this requirement, the hose assembly does not necessarily have to meet this requirement if separate bonding is provided within the fuelling assembly.

All dispenser hydrogen piping, equipment, frames and enclosures not addressed in A.2.8 shall also be bonded to less than 1 MΩ to the bonding connection to ground described above or another ground.

A.2.8 Earth (ground) continuity

A.2.8.1 Method

The electrical resistance between the point of connection of the equipment bonding means and each non-current-carrying metal part shall be determined by measuring the potential drop between the two points when an alternating current of 20 A, derived from a power supply of not more than 12 V, is passed between the two points, dividing the measured potential drop by the current.

A.2.8.2 Acceptance criteria

A dispenser shall be constructed so the dispenser cabinet, frame and similar non-current-carrying metal parts are electrically continuous to the means provided for equipment bonding. This provision shall be deemed met when the electrical resistance between the point of connection of the equipment grounding means and any non-current-carrying metal part is not more than 10 Ω, unless not in compliance with applicable electrical codes (nonconductive finishes may be scraped from the test points).

Electrical equipment and associated frames and enclosures that can become energized under first fault conditions shall be bonded and designed to be grounded as defined in IEC 60204-1 to prevent electric shock.

A.2.9 Dielectric voltage-withstand test

A.2.9.1 Method

When connected in the manner intended to a supply circuit of rated voltage and frequency, the dispenser shall be operated to equilibrium temperature. At the conclusion of the operating period specified, the applicable dielectric withstand test(s) specified below shall be conducted.

During the dielectric withstand tests, a 500 V-A or larger transformer, having an essentially sinusoidal output voltage which can be varied, shall be used. The applied potential shall be increased gradually from zero until the required test voltage is reached and shall be held at that value for at least 1 min. The use of a 500 V-A or larger transformer is not necessary if the high-potential testing equipment used maintains the specified high-potential voltage at the equipment during the test.

a) A dispenser shall be capable of withstanding, for at least 1 min without breakdown, the application of a rated frequency potential between high-voltage live parts and dead metal parts, and between live parts of high- and low-voltage circuits. The test potential shall be:

   1 000 V plus twice rated voltage; except:

   1 000 V for motors rated at not more than 373 W and not more than 250 V.

   When higher than rated voltage is developed in a motor circuit through the use of capacitors, the rated voltage of the appliance shall be employed to determine the dielectric withstand test potential, unless the developed steady state capacitor voltage exceeds 500 V, in which case the test potential for the parts affected shall be 1 000 V plus twice the developed voltage.

b) A low-voltage circuit shall be capable of withstanding, for at least 1 min without breakdown, a rated frequency potential of 500 V applied between low-voltage live parts of opposite polarity and between low-voltage live parts and dead metal parts.

   The dielectric withstand test between low-voltage parts of opposite polarity need not be conducted on the complete assembly if the components have been separately subjected to this test condition.

   The arrangement of the test circuit shall be such that, if the dielectric material breaks down, a positive signal will be obtained, rather than depending upon a visual inspection of the material.

A.2.9.2 Acceptance criteria

Adequate dielectric shall be interposed between ungrounded current-carrying parts and those external surfaces which can be contacted and shall be capable of withstanding the voltages of A.2.9.1.

A.2.10 Cabinet test for dispensers designed for outdoor use (IP test)

A.2.10.1 Method

Dispenser cabinets shall be subjected to the IP test aligned with the IP rating declared by the manufacturer but as a minimum shall be subjected to IP23 in accordance with IEC 60529.

A.2.10.2 Acceptance criteria

Dispensers designed for outdoor use shall satisfy the IP rating as tested in A.2.10.1.

A.2.11 Marking and label adhesion and legibility test

A.2.11.1 Method

The test shall be conducted as follows.

a) Adhesive-type marking materials shall be applied to the particular type of finish used on the dispenser in production. A sample metal panel of this finish shall be cleaned with a solvent and dried. Half of the panel shall be wiped with a clean cloth lightly oiled with SAE-30 medium machine oil. Two samples of marking material shall be applied to the panel, one on the dry area and one on the oiled area. Test samples shall be applied with firm pressure, unless the manufacturer's application instructions specify otherwise. Each sample shall be allowed to set for 24 h at room temperature.

   Each sample of marking material shall exhibit

   i) good adhesion and no curling at edges;
   ii) no illegible or defaced printing when rubbed with thumb or finger pressure; and
   iii) good adhesion when a dull metal blade (as the back of a pocketknife blade) is held at 90 degrees (1,57 rad) to the applied marking and scraped across the edges of the marking.

b) Non-adhesive-type marking material shall exhibit no illegible or defaced printing when rubbed with thumb or finger pressure. Two samples of marking material shall be tested.

c) Samples of both adhesive- and non-adhesive-type marking materials shall then be placed in an oven for a period of 2 weeks with the oven temperature maintained at:

   i) 175 °C for Class II A1, II A2, II A3, II A4 and III A1 marking materials, or
   ii) 120 °C for Class III A2 and III B marking materials.

Following the oven test, adhesion and legibility of the samples shall be checked again as specified in items a) and b) above.

Samples shall then be immersed in water for a period of 24 h, after which adhesion and legibility shall be rechecked as specified in items a) and b) above.

Good adhesion and legibility qualities shall be obtained for all samples under the above-specified test conditions.

Final acceptance of marking materials shall be based on the suitability of the application of the marking material to the dispenser.

A.2.11.2 Acceptance criteria

The adhesive quality and the legibility of marking materials shall not be adversely affected when the marking materials are exposed to heat and moisture as specified in the following test method.

A.3 Routine tests

Each dispensing device assembly shall satisfy the acceptance criteria specified in A.2.2.2 when tested according to the test method described in A.2.2.1, as a routine production line test.

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
info@iec.ch
www.iec.ch