



DPC: 24/30473042 DC

**BSI Group Headquarters**

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 19 December 2024

Origin: European

**Latest date for receipt of comments: 11 February 2025**

Project No. 2023/00893

Responsible committee: GSE/40 Gas supply equipment for natural gas vehicles

Interested committees:

Title: Draft BS EN ISO 16924 BS ISO 16924 Natural gas fuelling stations. LNG stations for fuelling vehicles.

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

**WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 11 February 2025**

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email [cservices@bsigroup.com](mailto:cservices@bsigroup.com). British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

## Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

## UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

## Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

## Template for comments and secretariat observations

|                  |                        |
|------------------|------------------------|
| Date: xx/xx/20xx | Document: ISO/DIS xxxx |
|------------------|------------------------|

| 1  | 2                                          | (3)                          | 4               | 5                                                                                                                                  | (6)                                                                      | 7                                                  |
|----|--------------------------------------------|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| MB | Clause No./ Subclause No./Annex (e.g. 3.1) | Paragraph/ Figure/Table/Note | Type of comment | Comment (justification for change) by the MB                                                                                       | Proposed change by the MB                                                | Secretariat observations on each comment submitted |
|    | 3.1                                        | Definition 1                 | ed              | Definition is ambiguous and needs clarifying.                                                                                      | Amend to read '...so that the mains connector to which no connection...' |                                                    |
|    | 6.4                                        | Paragraph 2                  | te              | The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK. | Delete reference to UV photometer.                                       |                                                    |



# DRAFT International Standard

## ISO/DIS 16924

### Natural gas fuelling stations — LNG stations for fuelling vehicles

*Stations-service de gaz naturel — Stations GNL pour le  
ravitaillement de véhicules*

ICS: 75.200

ISO/TC 340

Secretariat: **AFNOR**

Voting begins on:  
**2024-12-19**

Voting terminates on:  
**2025-03-13**

This document is circulated as received from the committee secretariat.

## ISO/CEN PARALLEL PROCESSING

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENTS AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

Reference number  
ISO/DIS 16924:2024(en)

Full document details: 24/30473042 DC

© ISO 2024  **Documents**  
Document Sharing Hub



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2024

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

|                                                        |            |
|--------------------------------------------------------|------------|
| <b>Foreword</b>                                        | <b>vii</b> |
| <b>1 Scope</b>                                         | <b>1</b>   |
| <b>2 Normative references</b>                          | <b>1</b>   |
| <b>3 Terms and definitions</b>                         | <b>3</b>   |
| <b>4 Abbreviated terms</b>                             | <b>10</b>  |
| <b>5 Risk management</b>                               | <b>10</b>  |
| 5.1 Risk assessment                                    | 10         |
| 5.1.1 General                                          | 10         |
| 5.1.2 Protection against overpressure                  | 11         |
| 5.1.3 Static electricity                               | 11         |
| 5.2 Fire protection                                    | 11         |
| 5.2.1 Hazardous area classification                    | 11         |
| 5.2.2 Sources of ignition                              | 12         |
| 5.2.3 Fire fighting                                    | 12         |
| 5.3 Explosion protection measures                      | 12         |
| <b>6 General design requirements</b>                   | <b>13</b>  |
| 6.1 General                                            | 13         |
| 6.1.1 Design philosophy                                | 13         |
| 6.1.2 Buildings and civil works                        | 13         |
| 6.1.3 Installation and construction                    | 14         |
| 6.2 Site layout                                        | 15         |
| 6.2.1 Separation distances                             | 15         |
| 6.2.2 Traffic management                               | 15         |
| 6.2.3 Security                                         | 16         |
| 6.2.4 Requirements for location of equipment           | 16         |
| 6.3 Environmental considerations                       | 16         |
| 6.3.1 Noise attenuation                                | 16         |
| 6.3.2 Prevention of venting of natural gas             | 16         |
| <b>7 Fuel supply to the fuelling station</b>           | <b>17</b>  |
| 7.1 Application                                        | 17         |
| 7.2 Equipment compatibility                            | 17         |
| 7.3 Filling connector                                  | 17         |
| 7.4 Requirements for filling                           | 18         |
| 7.4.1 General requirements                             | 18         |
| 7.4.2 Prevention of overpressurization and overfilling | 19         |
| 7.5 Prevention of back flow                            | 19         |
| 7.6 Bleed connections                                  | 19         |
| 7.7 Draining of liquid from the LNG storage tank       | 19         |
| 7.8 LNG tanker                                         | 19         |
| 7.8.1 Immobility                                       | 19         |
| 7.8.2 Anti-drive-away equipment                        | 20         |
| 7.8.3 Turning off the engine                           | 20         |
| 7.8.4 Equalizing the potentials                        | 20         |
| <b>8 Storage</b>                                       | <b>20</b>  |
| 8.1 LNG storage                                        | 20         |
| 8.1.1 Design and construction                          | 20         |
| 8.1.2 Safety requirements                              | 22         |
| 8.1.3 Installation guidance                            | 25         |
| 8.2 CNG buffer storage                                 | 26         |
| <b>9 Pumps and compressors</b>                         | <b>26</b>  |
| 9.1 Connection of LNG pumps to the LNG storage tank    | 26         |
| 9.1.1 General                                          | 26         |

|           |                                                                                 |           |
|-----------|---------------------------------------------------------------------------------|-----------|
| 9.1.2     | NPSH requirements .....                                                         | 27        |
| 9.1.3     | Vapour return .....                                                             | 27        |
| 9.1.4     | Protection against weather .....                                                | 27        |
| 9.1.5     | Accessibility .....                                                             | 27        |
| 9.2       | LNG centrifugal pump (including ancillaries) .....                              | 27        |
| 9.2.1     | General provisions .....                                                        | 27        |
| 9.2.2     | Liquid inlet to the centrifugal pump .....                                      | 27        |
| 9.2.3     | Centrifugal pump design .....                                                   | 27        |
| 9.2.4     | Vibration .....                                                                 | 28        |
| 9.2.5     | Detection of shaft seal leak .....                                              | 28        |
| 9.2.6     | Detection of cavitation .....                                                   | 28        |
| 9.3       | LNG reciprocating pump for LCNG fuelling stations (including ancillaries) ..... | 28        |
| 9.3.1     | General provisions .....                                                        | 28        |
| 9.3.2     | Liquid supplied to the reciprocating pump .....                                 | 28        |
| 9.3.3     | Design .....                                                                    | 28        |
| 9.3.4     | Vibration .....                                                                 | 28        |
| 9.3.5     | Pulsation .....                                                                 | 29        |
| 9.4       | Commonalities for LNG centrifugal and reciprocating pumps .....                 | 29        |
| 9.4.1     | Suction line .....                                                              | 29        |
| 9.4.2     | Instrumentation .....                                                           | 29        |
| 9.4.3     | Markings of a pump .....                                                        | 29        |
| 9.4.4     | Instructions .....                                                              | 30        |
| 9.5       | Natural gas compressor .....                                                    | 30        |
| <b>10</b> | <b>Dispensers .....</b>                                                         | <b>30</b> |
| 10.1      | LNG dispensers .....                                                            | 30        |
| 10.1.1    | General requirements .....                                                      | 30        |
| 10.1.2    | Breakaway system .....                                                          | 32        |
| 10.1.3    | Fuelling hoses .....                                                            | 32        |
| 10.1.4    | Fuelling nozzles .....                                                          | 33        |
| 10.1.5    | Dispenser enclosure .....                                                       | 34        |
| 10.1.6    | Other requirements .....                                                        | 34        |
| 10.2      | CNG dispensers .....                                                            | 35        |
| <b>11</b> | <b>Vaporizers and heaters .....</b>                                             | <b>35</b> |
| 11.1      | Application .....                                                               | 35        |
| 11.2      | Design of vaporizers and heaters .....                                          | 35        |
| 11.3      | Ambient air vaporizer .....                                                     | 36        |
| 11.3.1    | General .....                                                                   | 36        |
| 11.3.2    | Defrosting .....                                                                | 36        |
| 11.3.3    | Aluminium vaporizers .....                                                      | 36        |
| 11.4      | Electric vaporizer/heater .....                                                 | 37        |
| 11.5      | Water bath vaporizer .....                                                      | 37        |
| 11.6      | Fired vaporizers .....                                                          | 37        |
| 11.7      | Remotely heated vaporizers .....                                                | 37        |
| <b>12</b> | <b>Odorization .....</b>                                                        | <b>37</b> |
| 12.1      | General requirements .....                                                      | 37        |
| 12.2      | High-pressure odorizer .....                                                    | 38        |
| 12.3      | Safety .....                                                                    | 38        |
| 12.4      | Monitoring .....                                                                | 38        |
| 12.5      | Odorant .....                                                                   | 39        |
| 12.5.1    | Dynamics of function .....                                                      | 39        |
| <b>13</b> | <b>Pipework .....</b>                                                           | <b>39</b> |
| 13.1      | General .....                                                                   | 39        |
| 13.2      | Pipework design .....                                                           | 39        |
| 13.2.1    | General .....                                                                   | 39        |
| 13.2.2    | Overground pipework .....                                                       | 40        |
| 13.2.3    | Underground pipework .....                                                      | 40        |
| 13.2.4    | Pipework in ducts .....                                                         | 40        |

|           |                                                                 |           |
|-----------|-----------------------------------------------------------------|-----------|
|           | 13.2.5 Flexible connections.....                                | 41        |
| <b>14</b> | <b>Electrical equipment and wiring.....</b>                     | <b>41</b> |
| 14.1      | General.....                                                    | 41        |
| 14.2      | Main considerations.....                                        | 41        |
| 14.2.1    | Grounding.....                                                  | 41        |
| 14.2.2    | Lightning.....                                                  | 41        |
| 14.2.3    | Contact with live parts.....                                    | 41        |
| 14.2.4    | Cables.....                                                     | 41        |
| 14.2.5    | Static electricity.....                                         | 42        |
| 14.3      | Other considerations.....                                       | 42        |
| 14.3.1    | Interface.....                                                  | 42        |
| 14.3.2    | Primary seal.....                                               | 42        |
| 14.3.3    | Additional seal.....                                            | 42        |
| 14.3.4    | Conduit seals.....                                              | 42        |
| 14.3.5    | Detection vents.....                                            | 43        |
| <b>15</b> | <b>Instrumentation and control system.....</b>                  | <b>43</b> |
| 15.1      | General.....                                                    | 43        |
| 15.2      | Gas detectors.....                                              | 43        |
| 15.3      | Flame detectors.....                                            | 43        |
| 15.4      | Pressure gauges.....                                            | 43        |
| 15.5      | Temperature sensors.....                                        | 43        |
| 15.6      | Manual emergency shutdown devices.....                          | 43        |
| 15.7      | Uninterruptible Power Supply Unit (UPS).....                    | 44        |
| <b>16</b> | <b>Emergency shutdown.....</b>                                  | <b>44</b> |
| 16.1      | Application.....                                                | 44        |
| 16.2      | Procedure.....                                                  | 44        |
| 16.3      | Activation.....                                                 | 44        |
| 16.4      | ESD action.....                                                 | 45        |
| 16.5      | Reset.....                                                      | 45        |
| <b>17</b> | <b>Special configurations.....</b>                              | <b>45</b> |
| 17.1      | Movable LNG fuelling station.....                               | 45        |
| 17.1.1    | General requirements.....                                       | 45        |
| 17.1.2    | Anchoring.....                                                  | 45        |
| 17.1.3    | Containment.....                                                | 46        |
| 17.2      | Mobile LNG fuelling station.....                                | 46        |
| 17.2.1    | General requirements.....                                       | 46        |
| 17.2.2    | Anchoring.....                                                  | 46        |
| 17.2.3    | Containment.....                                                | 46        |
| 17.2.4    | Design.....                                                     | 46        |
| 17.2.5    | Additional requirements for operation.....                      | 46        |
| <b>18</b> | <b>Testing and commissioning.....</b>                           | <b>47</b> |
| 18.1      | Testing.....                                                    | 47        |
| 18.1.1    | Electrical testing.....                                         | 47        |
| 18.1.2    | Pressure strength testing.....                                  | 47        |
| 18.1.3    | Leak testing.....                                               | 47        |
| 18.2      | Commissioning.....                                              | 48        |
| 18.2.1    | General provisions.....                                         | 48        |
| 18.2.2    | Purging.....                                                    | 48        |
| 18.2.3    | Functional testing.....                                         | 48        |
| 18.2.4    | First filling of the LNG storage tank and other components..... | 48        |
| <b>19</b> | <b>Operations.....</b>                                          | <b>49</b> |
| 19.1      | LNG tanker unloading.....                                       | 49        |
| 19.2      | Fuelling procedure.....                                         | 49        |
| 19.3      | Safety signs.....                                               | 49        |
| 19.3.1    | General on identification labels.....                           | 49        |
| 19.3.2    | Equipment marking.....                                          | 50        |

|                                                                                                               |                                                            |           |
|---------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------|
| 19.4                                                                                                          | Equipment and pipework identification .....                | 50        |
| 19.5                                                                                                          | Training.....                                              | 51        |
| 19.6                                                                                                          | Installation and operating instructions.....               | 51        |
| 19.7                                                                                                          | Emergency plan .....                                       | 52        |
| 19.8                                                                                                          | Maintaining the emergency shutdown .....                   | 52        |
| <b>20</b>                                                                                                     | <b>Inspection and maintenance.....</b>                     | <b>52</b> |
| 20.1                                                                                                          | Inspection .....                                           | 52        |
| 20.1.1                                                                                                        | General requirements.....                                  | 52        |
| 20.1.2                                                                                                        | Inspection and testing of electrical systems.....          | 53        |
| 20.1.3                                                                                                        | Inspection and re-testing of the safety relief valves..... | 53        |
| 20.1.4                                                                                                        | Safety and fire protection equipment.....                  | 53        |
| 20.2                                                                                                          | Maintenance.....                                           | 54        |
| 20.2.1                                                                                                        | Preventive maintenance planning.....                       | 54        |
| 20.2.2                                                                                                        | Maintenance procedures.....                                | 54        |
| 20.2.3                                                                                                        | Maintenance safety .....                                   | 54        |
| 20.2.4                                                                                                        | Draining of the LNG storage tank.....                      | 54        |
| <b>Annex A (informative) Examples of hazardous zones classification .....</b>                                 |                                                            | <b>55</b> |
| <b>Annex B (normative) Separation distances .....</b>                                                         |                                                            | <b>59</b> |
| <b>Annex C (informative) Example flow diagram of an LNG fuelling station.....</b>                             |                                                            | <b>63</b> |
| <b>Annex D (informative) Example flow diagram of an LCNG fuelling station.....</b>                            |                                                            | <b>64</b> |
| <b>Annex E (informative) Example flow diagram of an LNG and LCNG fuelling station.....</b>                    |                                                            | <b>65</b> |
| <b>Annex F (informative) Process requirements for the effective cryogenic pump operation.....</b>             |                                                            | <b>66</b> |
| <b>Annex G (informative) Recommendations for installation of a centrifugal pump .....</b>                     |                                                            | <b>67</b> |
| <b>Annex H (informative) Recommendations for centrifugal pump design .....</b>                                |                                                            | <b>68</b> |
| <b>Annex I (informative) Recommendations for installation of a reciprocating pump .....</b>                   |                                                            | <b>69</b> |
| <b>Annex J (informative) Recommendations on the content of the cryogenic pump operation instructions.....</b> |                                                            | <b>71</b> |
| <b>Annex K (informative) LNG identification mark of an LNG fuelling station.....</b>                          |                                                            | <b>73</b> |
| <b>Annex L (informative) Explosion-proof Static Grounding Control System.....</b>                             |                                                            | <b>74</b> |
| <b>Bibliography .....</b>                                                                                     |                                                            | <b>75</b> |

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 340, *Natural gas fuelling stations*.



# Natural gas fuelling stations — LNG stations for fuelling vehicles

## 1 Scope

This document specifies the design, construction, operation, maintenance and inspection of stations for fuelling liquefied natural gas (LNG) to vehicles, including equipment, safety and control devices. This document also specifies the design, construction, operation, maintenance, and inspection of fuelling stations for using LNG as an onsite source for fuelling CNG to vehicles (LCNG fuelling stations), including safety and control devices of the station and specific LCNG fuelling station equipment.

NOTE Specific CNG equipment is dealt with in ISO 16923.

This document is applicable to fuelling stations receiving LNG and other liquefied methane-rich gases that comply with local applicable gas composition regulation or with the gas quality requirements of ISO 13686.

This document includes all equipment from the LNG storage tank filling connection up to the fuelling nozzle on the vehicle. The LNG storage tank filling connection itself and the vehicle fuelling nozzle are not covered in this document.

This document includes fuelling stations having the following characteristics:

- private access;
- public access (self-service or assisted);
- metered dispensing and non metered dispensing;
- fuelling stations with fixed LNG storage;
- fuelling stations with mobile LNG storage;
- movable fuelling stations;
- mobile fuelling stations;
- multi-fuel stations.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4126 (all parts), *Safety devices for protection against excessive pressure*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 10380, *Pipework — Corrugated metal hoses and hose assemblies*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 12617, *Road vehicles — Liquefied natural gas (LNG) refuelling connector — 3,1 MPa connector*

ISO 13709, *Centrifugal pumps for petroleum, petrochemical and natural gas industries*

ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding*

ISO 15609-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding*

ISO 15609-3, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 3: Electron beam welding*

ISO 15609-4, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 4: Laser beam welding*

ISO 15609-5, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 5: Resistance welding*

ISO 15609-6, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 6: Laser-arc hybrid welding*

ISO 20421-1, *Cryogenic vessels — Large transportable vacuum-insulated vessels — Part 1: Design, fabrication, inspection and testing*

ISO 21009-1, *Static vacuum-insulated vessels, Part 1: Design, fabrication, inspection and tests*

ISO 21011, *Cryogenic vessels — Valves for cryogenic service*

ISO 21012, *Cryogenic vessels — Hoses*

ISO 21013-1, *Cryogenic vessels — Pressure-relief accessories for cryogenic service — Part 1: Reclosable pressure-relief valves*

ISO 21013-3, *Cryogenic vessels — Pressure-relief accessories for cryogenic service — Part 3: Sizing and capacity determination*

ISO 21029-1, *Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 litres volume — Part 1: Design, fabrication, inspection and tests*

ISO 24490, *Cryogenic vessels — Pumps for cryogenic service*

ISO 24671, *Road vehicles — Qualification and certification of technical personnel dealing with natural gas vehicles (NGVs)*

ISO 31000, *Risk management — Principles and guidelines*

ISO 20607, *Safety of machinery — Instruction handbook — General drafting principles*

ISO 80079-36, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements*

IEC 31010, *Risk management — Risk assessment techniques*

IEC 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres*

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

IEC 60079-17, *Explosive atmospheres — Part 17: Electrical installations inspection and maintenance*

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

IEC 60079-29-4, *Explosive atmospheres - Part 29-4: Gas detectors - Performance requirements of open path detectors for flammable gases*

IEC 60079-32, *Explosive atmospheres - Part 32-1: Electrostatic hazards, guidance*

IEC 60204-1:2005, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 61511 (all parts), *Functional safety — Safety instrumented systems for the process industry sector*

IEC 62305, *Protection against lightning*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

#### 3.1 ambient vaporizer

heat exchanger that vaporizes LNG with the heat of ambient air

#### 3.2 assembly

sub-system of the fuelling station comprising several components

#### 3.3 approved

having approval for the intended usage from an authority having jurisdiction or having the manufacturer's declaration for intended use

#### 3.4 boil-off gas

gas produced from evaporation of LNG in the LNG storage tank and other parts of the fuelling station including the gas returned from the vehicle tank

#### 3.5 breakaway device

coupling which separates at a predetermined section to protect the fuelling station from damage by vehicles driving away while still connected to the station.

Note 1 to entry: Each separated section contains a self-closing shut-off valve which seals automatically

#### 3.6 buffer storage

one or more suitable pressure vessels designed for the purpose of storing compressed natural gas

#### 3.7 building

structure, usually enclosed by walls and a roof, constructed to provide support or shelter for an intended occupancy

#### 3.8 bund

elevated boundary of the containment, like wall, dike or embankment

#### 3.9 burst pressure

pb  
pressure that causes failure and consequential fluid loss through the component envelope

#### 3.10 canopy

roof, overhead shelter, or hood, that affords a degree of weather protection

**3.11**

**cold end**

cryogenic part of a reciprocating LNG pump

**3.12**

**competent person**

person having the ability, appropriate training, knowledge and experience, to supervise or carry out the work being undertaken in a safe and proper manner

**3.13**

**compressed natural gas**

**CNG**

natural gas which has been compressed and stored for use as a vehicle fuel

[SOURCE: ISO 15500-1:2000, 3.2]

**3.14**

**compressor**

machine that increases the pressure of gas

**3.15**

**conduit**

casing, tubing or liner, either metallic or non-metallic

[SOURCE: ISO 14310:2008, 3.6]

**3.16**

**containerized fuelling station**

type of movable LNG fuelling station installed on a single container type skid

**3.17**

**containment**

area, surrounded by a bund, to contain spilled LNG within that area

**3.18**

**cryogenic**

intended for service over the temperature of  $-153\text{ }^{\circ}\text{C}$  and  $-196\text{ }^{\circ}\text{C}$ , the lower point being the normal boiling point of nitrogen

**3.19**

**cryogenic pump**

pump that delivers cryogenic fluid at a higher pressure

Note 1 to entry: Pumps used for delivery of LNG to the LNG dispenser are typically centrifugal pumps; however, slow speed reciprocating pumps are also used.

Note 2 to entry: Pumps used for delivery of high-pressure liquid into the high-pressure vaporizer are typically reciprocating piston pumps.

**3.20**

**detachable joint**

mechanical joint that can be readily disassembled

EXAMPLE Flanges, threaded joints and similar.

**3.21**

**dispenser**

equipment through which the fuel is supplied to the vehicle

Note 1 to entry: This equipment can include metering.

**3.22**

**dry air**

air with a maximum dew point of  $-40\text{ }^{\circ}\text{C}$

**3.23**

**enclosure**

structure, not being a building or canopy, that encloses a component of the fuelling station

EXAMPLE      Housing, container and machine cabinet.

**3.24**

**explosive gas atmosphere**

mixture of substances with air, under atmospheric conditions, in the form of gases, vapours or mists in which, after ignition has occurred, combustion spreads to the entire unburned mixture

Note 1 to entry: Derived from definition of “explosive atmosphere” in IEC 61340-4-4:2014, 11, 3.4.

**3.25**

**fail-safe**

design feature that ensures that safe conditions are maintained in the event of a malfunction of a control device or an interruption of a supply source

**3.26**

**filling**

process of transferring LNG into the LNG storage tank

**3.27**

**fire resistance**

property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under specified conditions

**3.28**

**fire wall**

wall or separating partition erected to reduce the effects of radiated heat

**3.29**

**flash gas**

gas generated from liquid when delivered to the tank to lower pressure than is its boiling pressure at its temperature

**3.30**

**fuelling**

transfer of fuel from dispenser to the vehicle

**3.31**

**fuelling nozzle**

device which permits quick connection and disconnection of the fuelling hose to/from the refuelling receptacle

**3.32**

**fuelling pressure**

pressure at which the fuel is delivered to the vehicle

**3.33**

**fuelling station**

facility at which vehicle fuels are dispensed

**3.34**

**grounding**

electrical connection of potentially live exposed metallic parts to earth

**3.35**

**hazardous area**

area in which an explosive gas atmosphere is present, or can be expected to be present, in quantities such as to require special precautions for the construction, installation and use of apparatus to prevent ignition

[SOURCE: IEC 60079-10-1:2015, 3.3]

**3.36**

**hose**

pipeline of flexible material with end fittings attached

**3.37**

**hose assembly**

hose, or hoses, with ancillary components, such as bend restrictors, breakaways and nozzles, attached

**3.38**

**interlock**

Instrument that delivers positive signal on grounding

**3.39**

**LCNG fuelling station**

facility at which CNG derived from LNG is dispensed to vehicles

**3.40**

**liquefied natural gas**

**LNG**

natural gas that has been liquefied, after processing, for storage or transportation purposes

**3.41**

**LNG fuelling station**

facility at which LNG is **unloaded, stored, filled, metered, and** dispensed to vehicles

Note 1 to entry: facility is automatically controlled, and safety monitored

Note 2 to entry: facility integrates LNG storage tanks, pumps or equivalent, dispensers, pipeline systems, vaporizers, instrument systems, control systems, instrument air systems, and other equipment

**3.42**

**LNG unloading area**

area where the LNG tanker connects to the LNG fuelling station for unloading LNG into the LNG storage tank

**3.43**

**LNG pump**

cryogenic pump for transferring LNG

**3.44**

**LNG storage tank**

cryogenic vessel used for the purpose of storing LNG

**3.45**

**LNG tanker**

vehicle that delivers LNG for unloading to the LNG storage tank at the LNG fuelling station

**3.46**

**LNG transfer point**

connection point between the hose of the LNG tanker and the fixed pipeline to the LNG storage tank

**3.47**

**lower explosion limit**

**LEL**

volume concentration of flammable gas or vapour in air, below which the mixture is not flammable

[SOURCE: ISO 19372:2015, 3.7, modified — “explosive” has been changed to “flammable”.]

**3.48**

**maximum allowable working pressure**

**MAWP**

maximum pressure to which a component or system is designed to be subjected and which is the basis for determining the strength of the component or system

[SOURCE: ISO 12991:2012, 3.10, modified — “or system” has been added and “under consideration” has been removed.]

**3.49**

**maximum fuelling pressure**

maximum pressure to which the vehicle tank can be filled

**3.50**

**mobile LNG fuelling station**

LNG fuelling station (and/or LCNG fuelling station) having an LNG storage tank capacity of more than 1 000 litres that can be transported with LNG onboard

**3.51**

**mobile storage**

LNG storage tank assembly, having a gross volume of more than 1 000 litres, mounted on a vehicle and used at the LNG fuelling station as a temporary LNG storage tank

**3.52**

**movable LNG fuelling station**

LNG fuelling station (and/or LCNG fuelling station) having an LNG storage tank capacity of more than 1 000 litres and consisting of one or more units intended for easy installation and possible relocation

**3.53**

**multi-fuel station**

fuelling station that can fuel natural gas as well as other fuels, for example diesel, petrol, LPG

**3.54**

**natural gas**

complex gaseous mixture of hydrocarbons, primarily methane, but generally includes ethane, propane and higher hydrocarbons, and some non-combustible gases such as nitrogen and carbon dioxide

Note 1 to entry: Natural gas can also contain components or containments such as sulphur compounds and/or other chemicals.

[SOURCE: ISO 14532:2014, 2.1.1.1]

**3.55**

**net positive suction head**

**NPSH**

inlet total head increased by the head (in flowing liquid) corresponding to the atmospheric pressure at the test location and decreased by the sum of the head corresponding to the vapour pressure of the pump liquid at the inlet temperature and the inlet impeller height

[SOURCE: ISO 24490:2016, 3.5]

**3.56**

**non-combustible**

not capable of undergoing combustion under specified conditions

[SOURCE: ISO 13943:2008, 4.239]

**3.57**

**normal operation**

situation when the equipment is operating within its design parameters

[SOURCE: ISO 16110-1:2007, 3.50]

**3.58**

**odorant**

intensely smelling organic chemical or combination of chemicals added to natural gas at low concentration and capable of imparting a characteristic and distinctive (usually disagreeable) warning odour so gas leaks can be detected at concentrations below their lower flammability limit

Note 1 to entry: ISO/TR 16922 gives the specifications and guidelines for the methods to be used in the odorization of natural gas under a safety point of view and specifies the principles for the odorization technique (including handling and storage of odorants) and the control of odorization of natural gas.

[SOURCE: ISO 14532:2014, 2.8.1, modified — Note 1 to entry has been added.]

**3.59**

**odorization**

process of introducing odorant(s) into natural gas

**3.60**

**odorizer**

equipment used to introduce odorant into natural gas

**3.61**

**overpressure**

condition under which the pressure exceeds the maximum allowable working pressure

**3.62**

**pump unit**

unit that transfers LNG and that consists of one or more pumps, including all associated piping and equipment

**3.63**

**refuelling connector**

joined assembly of LNG fuelling nozzle and LNG refuelling receptacle

**3.64**

**refuelling receptacle**

<LNG> device connected to a vehicle or storage system, which receives the LNG fuelling nozzle and permits safe transfer of fuel

Note 1 to entry: The receptacle consists as minimum of a receptacle body and a check valve mounted inside the body.

[SOURCE: ISO 12617:2015, 3.9]

**3.65**

**separation distance**

minimum separation between a hazard source and an object, which is required to mitigate the effect of a likely foreseeable incident and prevent a minor incident escalating into a larger incident

**3.66**

**saturation pressure**

pressure at which the liquid boils

Note 1 to entry: Saturation pressure is used as an expression of the thermal state of LNG. LNG of different compositions will have a different temperature at the same saturation pressure.

**3.67**

**test pressure**

$p_t$

pressure at which the installation or part of the installation is tested

Note 1 to entry: Different test pressures can be required for storage pressure vessels and other components.

**3.68**

**thermal relief valve**

relief valve that is installed to relieve excess pressure caused by vaporization of cryogenic liquid trapped in an isolated section of a pipeline or other small components of the LNG fuelling station

**3.69**

**trim heater**

heat exchanger that heats the gas from the vaporizer to a temperature acceptable for the downstream equipment

Note 1 to entry: Trim heater is typically an electric heater or hot water bath.

**3.70**

**try cock**

valve connected to a pipe, the inlet of which is at the position of the maximum fill level of the tank

**3.71**

**unloading**

process of transferring LNG from the LNG tanker.

**3.72**

**vaporizer**

heat exchanger that vaporizes LNG and delivers it in the gaseous phase

**3.73**

**vehicle tank**

cryogenic tank mounted on a vehicle for the storage of LNG as a fuel for that vehicle

**3.74**

**ventilation**

movement of air and its replacement with fresh air due to the effects of wind, temperature gradients, or mechanical means (for example fans or extractors)

**3.75**

**venting**

controlled release of natural gas to the atmosphere

**3.76**

**vent stack**

pipe that allows gas to be vented at a safe elevation and location

**3.77**

**warm end drive**

non-cryogenic part of a reciprocating LNG pump, comprising the pump drive part

### 3.78

#### **water bath vaporizer**

heat exchanger that vaporizes LNG using the heat from water that is warmed by the ambient air or an external source of energy including water from natural sources (e.g. river, sea)

### 3.79

#### **zone**

hazardous area classified based upon the frequency of the occurrence and duration of an explosive gas atmosphere

[SOURCE: IEC 60079-10-1:2015, 3.3.3, modified — “gas” has been added.]

## 4 Abbreviated terms

|      |                                          |
|------|------------------------------------------|
| CNG  | compressed natural gas                   |
| DGS  | dry gas seal                             |
| ESD  | emergency shut-down                      |
| LCNG | compressed natural gas, sourced from LNG |
| LEL  | lower explosive limit                    |
| LNG  | liquefied natural gas                    |
| MAWP | maximum allowable working pressure       |
| NGV  | natural gas vehicle                      |
| NPSH | net positive suction head                |

## 5 Risk management

### 5.1 Risk assessment

#### 5.1.1 General

Risks shall be managed throughout the life cycle of the LNG fuelling station through the adoption of a risk management policy and framework that systematically identifies, analyses and evaluates the risks to personnel, the environment and equipment. The principles and guidelines of ISO 12100, ISO 31000 and IEC 31010 shall be followed in developing a risk management policy and a risk management framework. One or more of the risk assessment techniques described in IEC 31010 shall be used to conduct risk assessments. Appropriate risk mitigation measures can then be identified and implemented to reduce the risks to as low as reasonably practicable. Risk mitigation can be achieved through various measures to reduction of the probability and/or the consequences of a risk scenario. Risk mitigation measures may include one or more of the following:

- the use of inherently safe designs and technologies;
- the use of protective devices and systems;
- the adoption of specific operating and maintenance procedures;
- the use of personal protective equipment;
- the provision of information and training;
- the adoption of emergency planning and emergency procedures.

## 5.1.2 Protection against overpressure

### 5.1.2.1 Safety devices

**5.1.2.1.1** The LNG fuelling station shall be equipped with safety devices that prevent overpressure in all parts of the LNG fuelling station.

**5.1.2.1.2** Safety devices shall

- be independent of other functions, and
- comply with the requirements of ISO 4126.

### 5.1.2.2 Auxiliary safety devices

Auxiliary safety devices shall include at least the following:

- one or more emergency stop buttons which shall be compatible with requirements of [section 15.6](#)
- automatic emergency isolation valves to isolate:
  - a) the LNG storage tank content from the rest of the LNG fuelling station equipment;
  - b) the CNG dispenser(s), as specified in ISO 16923;
  - c) the LNG dispensers.

### 5.1.2.3 Protection against over pressurization of vehicle tank

The LNG dispensing system shall be equipped with at least one safety system to prevent over pressurization of the vehicle tank.

If the LNG dispensing system is capable of delivering LNG to the vehicle tank at a pressure that is higher than the maximum allowable working pressure of the vehicle tank, the LNG dispensing system shall be equipped with at least two independent safety systems to prevent over pressurization of the vehicle tank.

EXAMPLE 1 An automatic safety system, which interrupts the power supply to the pump.

EXAMPLE 2 A sufficiently-sized relief valve.

### 5.1.2.4 Maximum fuelling pressure of CNG

The maximum fuelling pressure of CNG shall be in accordance with ISO 16923.

## 5.1.3 Static electricity

Measures shall be taken to avoid electrostatic risk. Protection against static electricity shall be carried out according to applicable standards such as IEC 60079-32-1 and ISO 80079-36, etc.

## 5.2 Fire protection

### 5.2.1 Hazardous area classification

**5.2.1.1** A hazardous area classification analysis according to IEC 60079-10-1 shall be undertaken for all the locations in which an explosive gas atmosphere can be present in quantities such as to require special precautions in relation to electrical and other sources of ignition. [Annex A](#) provides recommendations for determining the size of hazardous areas for the major units of the LNG fuelling station.

**5.2.1.2** Special attention shall be given to existing equipment such as high voltage cables and their insulation and protection. Vaulted or underground installations shall be deemed to provide engineered protection from overhead power lines.

**5.2.1.3** If other combustible or hazardous liquids can encroach on any parts of the LNG fuelling station, means shall be provided to protect those parts.

**5.2.1.4** Fired equipment (flame heated equipment) shall be located outside hazardous areas.

**5.2.1.5** The hazardous area shall not exceed the boundaries of the LNG fuelling station within the separation distances as defined in [Tables B.1](#) to [B.3](#), unless a complementary risk assessment is carried out.

## **5.2.2 Sources of ignition**

**5.2.2.1** Sources of ignition are not permitted at

- the LNG unloading area while transfer of LNG is in progress, and
- the LNG dispensing area during fuelling of vehicles.

**5.2.2.2** LNG fuelling facilities shall be free from rubbish, debris, and other material that present a fire hazard.

**5.2.2.3** Combustible materials shall not be stored or left uncontrolled in the hazardous areas of the LNG fuelling station. Vegetation shall not be permitted to develop within the fuelling station. Grass from unpaved areas shall be removed before it gets dry.

## **5.2.3 Fire fighting**

**5.2.3.1** Fire-fighting equipment shall be available at the LNG fuelling station in accordance with the requirements of the local fire prevention authority. Access routes for movement of fire-fighting equipment to an LNG fuelling station shall be maintained at all times.

**5.2.3.2** There shall be at least one dry powder fire extinguisher of suitable size near every dispenser.

**5.2.3.3** Fire-fighting procedures approved by the local fire prevention authority shall be available at the LNG fuelling station.

**5.2.3.4** A simplified version of fire-fighting procedures shall be displayed at (a) suitable place(s) on the site. Indication of the positions of ESD manual buttons should be included in the procedures.

## **5.3 Explosion protection measures**

**5.3.1** Explosion protection measures shall be taken in accordance with the applicable parts of IEC 60079.

**5.3.2** All electrical and non-electrical equipment and components used in hazardous areas shall be designed and manufactured according to good engineering practice and shall conform with the requirements categories for Group II, Class T1 equipment to ensure avoidance of any ignition source as specified in IEC 60079.

**5.3.3** Ignition in explosive atmospheres shall be prevented by the use of protection systems defined in the applicable parts of IEC 60079 series where the applicable hazard zones are defined in IEC 60079-10-1.

**5.3.4** Non-electrical equipment and components used in potentially explosive atmospheres shall comply with the requirements of applicable standards, e.g. ISO 80079-36, EN 1127-1.

**5.3.5** ALARP (As Low as Reasonably Practicable) assessment shall be carried out to identify a potential credible BLEVE scenario with the proper risk mitigations.

## 6 General design requirements

### 6.1 General

#### 6.1.1 Design philosophy

**6.1.1.1** All equipment, components, pipework, fittings and materials shall be assembled in a manner suitable for their intended use, for the full range of process conditions [pressures, fluids, temperatures, and weather conditions (maximum and minimum ambient temperature, maximum wind, maximum rainfall, maximum snowfall, etc.)] and loadings that can occur under normal and extreme conditions, such as an earthquake. Equipment shall be installed and used in accordance with the manufacturer's instructions.

**6.1.1.2** The design shall take into consideration the need to depressurize pressurized components prior to removal for maintenance purposes. This can be achieved by the provision of valves and gauges to validate that sections are depressurized before service interventions.

**6.1.1.3** The LNG fuelling station shall be designed and constructed such that any maintenance or servicing of the LNG fuelling station does not adversely affect the composition of LNG supplied from the LNG fuelling station. In particular, moisture shall be prevented from entering the LNG equipment. If this cannot be achieved, the equipment shall be dried prior to operation with LNG.

**6.1.1.4** Examples of general flow diagrams of the LNG, LCNG and combined LNG and LCNG fuelling stations are presented in [Annex C](#), [Annex D](#), and [Annex E](#), respectively.

#### 6.1.2 Buildings and civil works

**6.1.2.1** Consideration shall be given to local building regulations.

**6.1.2.2** The LNG fuelling station shall be installed on adequate foundations. The design of foundations shall follow applicable standards taking into account local geological, wind, precipitation and seismic conditions.

**6.1.2.3** The design of the buildings and civil works shall be such that any LNG released

- does not enter the surface water drainage system (e.g. canalization) or other underground infrastructure (e.g. sewers, cable ducts or pipeworks),
- does not enter another installation where hazardous substances or combustible materials are stored or used,
- does not enter the access roads, and
- cannot accumulate under the LNG transfer point, the LNG tanker, the vehicle being fuelled with LNG.

**6.1.2.4** The design of the surface of the working area shall take into consideration applicable loads, drainage of rain water, removal of snow and drainage of LNG in the event of an accidental release. The surface of the working area shall be constructed of non-combustible material.

**6.1.2.5** Consideration shall be given to accessibility by fire fighters and their equipment.

#### 6.1.2.6 Enclosures and canopies

**6.1.2.6.1** It is common practice to install any cryogenic pump (centrifugal or reciprocating) or storage facility in the open air. However, where this is unacceptable, for reasons of safety, security, noise, or weather

protection requirements, for example, consideration may be given to the use of an enclosure with adequate ventilation.

**6.1.2.6.2** Cryogenic pumps (centrifugal and/or reciprocating) and storage facilities, including their ancillaries, may be housed in the same compartment.

**6.1.2.6.3** The enclosure or canopy, intended to house or cover equipment that forms part of the LNG and/or LCNG fuelling station shall not be used for any other purpose with the exception of an enclosure or canopy used to cover the LNG and/or CNG dispensers.

#### **6.1.2.7 Requirements on CNG part of LCNG fuelling station**

The CNG part of the LCNG fuelling stations shall be in accordance with ISO 16923.

#### **6.1.2.8 Fire wall**

If a fire wall is constructed for the purpose of reducing the separation distances, it shall be of at least one hour fire-resistant construction. Characteristics of the firewall shall correspond to a methane fire with respect to assumed intensity. The fire wall shall not restrict the access of fire fighters and their equipment.

### **6.1.3 Installation and construction**

#### **6.1.3.1 Materials**

**6.1.3.1.1** All materials used for the LNG fuelling station shall conform to the required specifications. Documentation shall be provided by the material manufacturer affirming compliance with the specification.

**6.1.3.1.2** If light alloy materials are used for components that contain gas or LNG, appropriate measures shall be taken to automatically isolate the component in the event of fire.

**6.1.3.1.3** The manufacturer of the LNG fuelling station shall document the compliance with the design and materials with the appropriate standards for the construction of pressurized parts.

**6.1.3.1.4** The manufacturer shall select the materials taking into account that the materials shall:

- a) have suitable properties for all operating conditions and for all test conditions. For cryogenic parts, only materials suitable for cryogenic service shall be used. Reference can be made to ISO 21028-1 or other applicable standards;
- b) avoid galvanic corrosion when the various materials are in direct contact.

**6.1.3.1.5** Elastomeric material shall comply with an applicable code, e.g. EN 682.

#### **6.1.3.2 Prerequisites for various elements of assembly**

**6.1.3.2.1** The design of the LNG fuelling station components shall take into account the range of operating conditions and the conditions that the components can be exposed to during manufacturing, assembly, installation and testing.

**6.1.3.2.2** All components shall be protected against corrosion by the use of non-corrosive or low-corrosive materials, and/or by means of suitable coating systems, such as painting, and/or by cathodic protection, taking into account environmental conditions.

### 6.1.3.3 Permanent joints

**6.1.3.3.1** Any joining of components shall only be performed by a competent person. In particular, welded connections shall only be produced by a welder qualified in accordance with applicable standards.

**6.1.3.3.2** Welding shall be performed in accordance with a procedure specified in ISO 15609-1 or ISO 15609-2 taking into account any necessary heat treatment and traceability of materials.

**6.1.3.3.3** Brazed connections shall be made with a brazing filler material having a melting point exceeding 538 °C.

**6.1.3.3.4** Permanent joints shall be subject to non-destructive tests carried out by qualified personnel, e.g. in accordance with ISO 9712.

### 6.1.3.4 Traceability

A system shall be established to ensure traceability of materials, components and accessories used in the installation.

### 6.1.3.5 Documentation

A process and instruments (P&I) diagram and wiring schematic with installation, operation, maintenance and commissioning instructions detailing all external and internal subsystem connections shall be provided with every LNG fuelling station. The schematic and associated instructions shall identify all safety critical connections and materials required to comply with the manufacturer's recommendations for electrical safety.

When the construction and installation of the LNG fuelling station is completed, handover documents that includes all records of the manufacturing and processes, and the tests performed in accordance with [Clause 18](#) shall be compiled.

### 6.1.3.6 Installation of electrical equipment

The installation of electrical equipment shall comply with IEC 60079-14.

## 6.2 Site layout

### 6.2.1 Separation distances

**6.2.1.1** Site location and internal layout shall comply with separation distances, as specified in the [Annex B](#), unless otherwise determined by risk assessment and local regulations.

**6.2.1.2** At multi-fuel stations the separation distances shall follow the requirements of applicable fuel standards. The potential of hazardous interaction between different fuels shall be considered.

### 6.2.2 Traffic management

**6.2.2.1** Consideration shall be given to the flow of vehicles on the LNG fuelling station premises.

**6.2.2.2** The LNG fuelling station components shall be adequately protected against collision of vehicles, for example, by using guard rails or steel poles filled with concrete, or by equivalent protection designed to withstand the expected collision force. Special consideration shall be given to collision protection of the LNG storage tank and the dispenser.

**6.2.2.3** The entry and exit routes to the LNG unloading area should be unobstructed and provide easy access for the LNG tanker, with a minimum of manoeuvring. In the event of an emergency, the LNG tanker should be able to drive away in a forward direction.

**6.2.2.4** Dispensers shall be positioned so that vehicles have adequate space for manoeuvring into and out of the fuelling position.

### **6.2.3 Security**

**6.2.3.1** Adequate means of security shall be provided such that the safety of operation cannot be affected by unauthorized access.

**6.2.3.2** Wherever security fences or similar protection are used, at least two emergency exits, located such that they provide easy exit from all parts of the area, shall be provided.

### **6.2.4 Requirements for location of equipment**

#### **6.2.4.1 Location of LNG containing equipment**

LNG containing equipment should be located outdoors and in a naturally ventilated environment. Such equipment may be placed under a canopy, or in a room or building provided attention is paid to ventilation, gas detection and other precautions relevant to confined spaces.

#### **6.2.4.2 Location of ambient air vaporizers**

Ambient air vaporizers shall be located so that atmospheric air circulation around the vaporizer is not restricted. Vaporizers should be separated from traffic areas so that fog, generated by cooling the air around the vaporizer, does not impact the safety of vehicles and of people.

#### **6.2.4.3 CNG part of the LCNG fuelling station**

CNG equipment that is part of the LCNG fuelling station shall be located so as to avoid exposure to temperatures that are lower than the minimum design temperature of the equipment.

#### **6.2.4.4 Location of electrical equipment**

Electrical equipment and non-electrical equipment that is capable of producing an ignition source shall be designed for use in hazardous areas, as determined by a hazardous area classification analysis, or shall be located outside the hazardous areas.

#### **6.2.4.5 Access**

Safe means of access and sufficient space for inspection, maintenance and service shall be provided to all equipment requiring maintenance or operator intervention.

### **6.3 Environmental considerations**

#### **6.3.1 Noise attenuation**

Control of noise shall comply with local legislation and site requirements.

#### **6.3.2 Prevention of venting of natural gas**

**6.3.2.1** The design and operation of the fuelling station shall minimize the venting of boil-off gas to the atmosphere.

**6.3.2.2** During normal operation, venting should be limited to minor releases of gas resulting, for example, from disconnection of hoses.

There shall be no venting during vehicle fuelling, except when connecting and disconnecting fuelling nozzle from vehicle receptacle where gas release to atmosphere is unavoidable. Vapours recovered from vehicle tanks shall be returned to storage tank. Venting of boil-off gas is permissible if not venting e.g. vehicle tank over pressure, could pose a safety risk.

As per [7.3.3](#), the use of QCDC (Quick-Connect and Dis-Connect) is preferred. Where QCDC is not used e.g. screwed couplings, venting should be kept at a minimum. Preferably the content in the hose shall be purged into the storage tank or delivery tank/tanker using gaseous nitrogen.

**6.3.2.3** Boil-off gas from other parts of the LNG fuelling station may be returned to the LNG storage tank for accumulation and/or treated in other suitable ways.

**6.3.2.4** In the case of emergency, venting of boil-off gas to the atmosphere is permitted provided that it is vented in a safe manner to a safe location.

Two valves in series should serve as protection means. If one valve starts to leak, the second one can prevent gas from release, another one can be replaced.

The vented flow shall be heated to a temperature, at which density of methane is lower than density of ambient air at the lowest ambient temperature. If assumed heating of methane in the vent stack is not sufficient, an appropriate solution shall be implemented or installed so as to ensure that the density of methane in the vented flow enables a rapid enough dispersion through the atmosphere. EXAMPLE Through a vent stack.

The secondary relief valve output may be headed directly to the atmosphere.

**6.3.2.5** During maintenance, repairs, refurbishment and purging of equipment venting of natural gas to the atmosphere should be minimized and the quantity and flowrate should be limited in order to prevent the formation of an explosive atmosphere.

## **7 Fuel supply to the fuelling station**

### **7.1 Application**

This clause specifies the requirements for safe delivery of LNG from the LNG tanker to the LNG fuelling station and protection against overpressurization and overfill of the LNG storage tank.

When LNG is delivered to the fuelling station, the temperature of LNG should not be higher than -145 °C.

### **7.2 Equipment compatibility**

The equipment of the LNG fuelling station shall be suitable for the LNG supplied.

### **7.3 Filling connector**

**7.3.1** The filling receptacle shall be placed so that it is easily accessible by the driver of the LNG tanker or other competent person for connection of the unloading hose without entering the containment.

**7.3.2** The type of filling receptacle shall be compatible with the filling nozzle of the unloading hose of the LNG tanker. Similar rules shall be applied in those cases where an unloading arm is used.

**7.3.3** A dry connect LNG unloading connector is recommended for the LNG transfer between LNG road tanker and LNG storage. The profile of the LNG unloading receptacle shall be specified and shall be