

SLOVENSKI STANDARD

SIST EN 1473:2021

01-julij-2021

Nadomešča:
SIST EN 1473:2016

Napeljave in oprema za utekočinjeni zemeljski plin - Načrtovanje kopenskih napeljav

Installation and equipment for liquefied natural gas - Design of onshore installations

Anlagen und Ausrüstung für Flüssigerdgas - Auslegung von landseitigen Anlagen

Installations et équipements de gaz naturel liquéfié - Conception des installations terrestres

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Ta slovenski standard je istoveten z: EN 1473:2021

ICS:

75.200

Oprema za skladiščenje
naftne, naftnih proizvodov in
zemeljskega plina

Petroleum products and
natural gas handling
equipment

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en,fr,de

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1473

May 2021

ICS 75.200

Supersedes EN 1473:2016

English Version

Installation and equipment for liquefied natural gas - Design of onshore installations

Installation et équipements de gaz naturel liquéfié -
Conception des installations terrestres

Anlagen und Ausrüstung für Flüssigerdgas - Auslegung
von landseitigen Anlagen

This European Standard was approved by CEN on 15 February 2021.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 1473:2021) has been prepared by Technical Committee CEN/TC 282 "Installation and equipment for LNG", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2021, and conflicting national standards shall be withdrawn at the latest by November 2021.

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

This document supersedes EN 1473:2016.

Due to the incorporation of pressurized storage the standard has been re-structured and revised. In comparison with EN 1473:2016, the following changes have been made:

- duplications detected and deleted;
- terms and definitions adjusted;
- normative references updated;
- changed subject in Annex H;
- risk assessment requirements improved;
- storage tanks classification improved.

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According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The objective of this document is to give functional guidelines for on-shore LNG installations. It recommends procedures and practices that will result in safe and environmentally acceptable design, construction and operation of LNG plants.

Given the wide range of facilities from small to large, with high and low risk profile, etc., the acceptability criteria could vary depending on the project and are subject to conclusions by the normative risk assessment.

Seveso, PED, and ATEX Directives are expected to be followed. Where national and/or local regulations exist in which some of the requirements are equal or more stringent than in this document, it is up to agreement with national and/or local regulators to determine which of the requirements apply.

It does not need to be applied retrospectively, but application is recommended when major modifications of existing installations are being considered.

This document is also recommended for debottlenecking, revamping and plant life extension in the limits that will be defined by the local authority. The appliance of the European Directives to the existing facilities is part of the limits to be defined together with the local authority.

In case of plant expansion, this document is applicable for the new facilities. The application of these recommendations for the tie-ins and connections to the existing facilities will be defined by the local authority. The limits of such application should consider the practicality of such appliance. In the same way, the limits of the European Directives appliance will be accurately defined with the local authority.

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1 Scope

This document gives guidelines for the design, construction and operation of all onshore liquefied natural gas (LNG) installations for the liquefaction, storage, vaporization, transfer and handling of LNG and natural gas (NG).

This document is applicable for plants with an LNG storage capacity above 200 t.

The designated boundary limits are LNG inlet/outlet by the ship's manifold including vapour return connection, the truck loading/unloading connection including vapour return, the rail car loading/unloading connection including vapour return and the natural gas in and outlet boundary by piping systems.

Terminals or plant types have one or more boundary limits as described in this scope (see Figure 1).

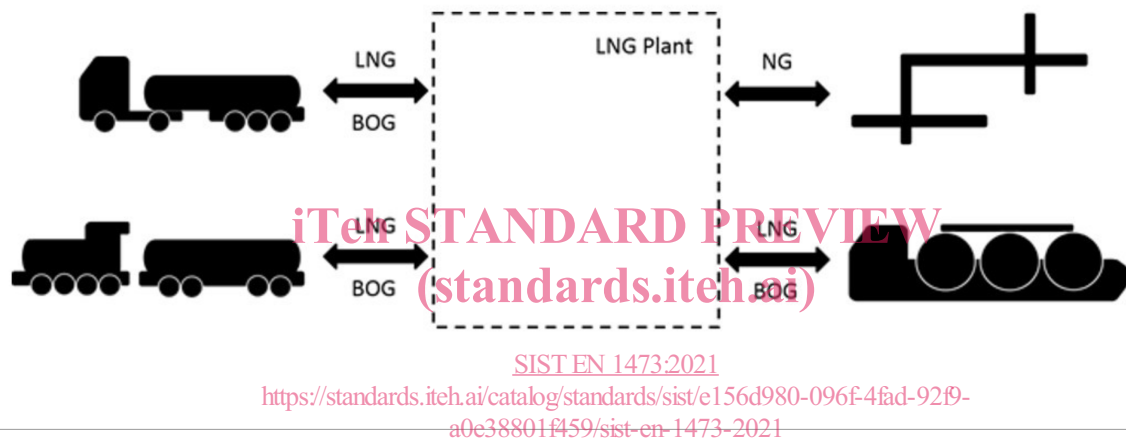


Figure 1 — Boundary limits of onshore liquefied natural gas (LNG) installations

A short description of each of these installations is given in Annex G.

Feed gas for LNG liquefaction installations (plant) can be from gas field, associated gas from oil field, piped gas from transportation grid or from renewables.

Floating solutions (for example FPSO, FSRU, SRV), whether off-shore or near-shore, are not covered by this document even if some concepts, principles or recommendations could be applied. However, in case of berthed FSRU with LNG transfer across the jetty, the following recommendations apply for the jetty and topside facilities.

In case of solutions using floating storage unit (FSU) and land-based re-gasification solution, the on-shore part is covered by these standard recommendations.

Plants with a storage inventory from 5 t up to 200 t are covered by [5].

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.

EN 809, *Pumps and pump units for liquids - Common safety requirements*

EN 1092-1, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges*

EN 1127-1, *Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology*

EN 1474-2, *Installation and equipment for liquefied natural gas - Design and testing of marine transfer systems - Part 2: Design and testing of transfer hoses*

EN 1514-1, *Flanges and their joints - Dimensions of gaskets for PN-designated flanges - Part 1: Non-metallic flat gaskets with or without inserts*

EN 1591 (all parts), *Flanges and their joints - Design rules for gasketed circular flange connections*

EN 1776, *Gas infrastructure - Gas measuring systems - Functional requirements*

EN 1990, *Eurocode - Basis of structural design*

EN 1991 (all parts), *Eurocode 1: Actions on structures*

EN 1992 (all parts), *Eurocode 2: Design of concrete structures*

EN 1993 (all parts), *Eurocode 3: Design of steel structures*

EN 1994-1-1, *Eurocode 4: Design of composite steel and concrete structures - Part 1-1: General rules and rules for buildings*

EN 1994-1-2, *Eurocode 4 - Design of composite steel and concrete structures - Part 1-2: General rules - Structural fire design*

EN 1997-1:2004,¹ *Eurocode 7: Geotechnical design - Part 1: General rules*

EN 1997 (all parts), *Eurocode 7 - Geotechnical design*

EN 1998 (all parts), *Eurocode 8: Design of structures for earthquake resistance*

EN 10204, *Metallic products - Types of inspection documents*

EN 12065, *Installations and equipment for liquefied natural gas - Testing of foam concentrates designed for generation of medium and high expansion foam and of extinguishing powders used on liquefied natural gas fires*

EN 12162, *Liquid pumps - Safety requirements - Procedure for hydrostatic testing*

¹ As impacted by EN 1997-1:2004/AC:2009.

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EN 12483, *Liquid pumps - Pump units with frequency inverters - Guarantee and compatibility tests*

EN 13445 (all parts), *Unfired pressure vessels*

EN 13458 (all parts), *Cryogenic vessels - Static vacuum insulated vessels*

EN 13480 (all parts), *Metallic industrial piping*

EN 13766, *Thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for the transfer of liquid petroleum gas and liquefied natural gas - Specification*

EN 14197 (all parts), *Cryogenic vessels - Static non-vacuum insulated vessels*

EN 14620 (all parts), *Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -165 °C*

EN 60079-0, *Explosive atmospheres - Part 0: Equipment - General requirements (IEC 60079-0)*

EN 60079-1, *Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d" (IEC 60079-1)*

EN 60079-2, *Explosive atmospheres - Part 2: Equipment protection by pressurized enclosure "p" (IEC 60079-2)*

EN 60079-5, *Explosive atmospheres - Part 5: Equipment protection by powder filling "q" (IEC 60079-5)*

EN 60079-6, *Explosive atmospheres - Part 6: Equipment protection by liquid immersion "o" (IEC 60079-6)*

EN 60079-7, *Explosive atmospheres - Part 7: Equipment protection by increased safety "e" (IEC 60079-7)*

EN 60079-10-1, *Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres (IEC 60079-10-1)*

EN 60079-10-2, *Explosive atmospheres - Part 10-2: Classification of areas - Explosive dust atmospheres (IEC 60079-10-2)*

EN 60079-11, *Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i" (IEC 60079-11)*

EN 60079-13, *Explosive atmospheres - Part 13: Equipment protection by pressurized room "p" and artificially ventilated room "v" (IEC 60079-13)*

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

EN 60079-15, *Explosive atmospheres - Part 15: Equipment protection by type of protection "n" (IEC 60079-15)*

EN 60079-17, *Explosive atmospheres - Part 17: Electrical installations inspection and maintenance (IEC 60079-17)*

EN 60079-18, *Explosive atmospheres - Part 18: Equipment protection by encapsulation "m" (IEC 60079-18)*

EN 60079-19, *Explosive atmospheres - Part 19: Equipment repair, overhaul and reclamation (IEC 60079-19)*

EN 60079-20-1, *Explosive atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data (IEC 60079-20-1)*

EN 60079-25, *Explosive atmospheres - Part 25: Intrinsically safe electrical systems (IEC 60079-25)*

EN 60204-1, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1)*

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

EN 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems (IEC 61508 series)*

EN 61800 (all parts), *Adjustable speed electrical power drive systems (IEC 61800 all parts)*

EN 62305 (all parts), *Protection against lightning (IEC 62305 all parts)*

EN ISO 1460, *Metallic coatings - Hot dip galvanized coatings on ferrous materials - Gravimetric determination of the mass per unit area (ISO 1460)*

EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods (ISO 1461)*

EN ISO 3452-1, *Non-destructive testing - Penetrant testing - Part 1: General principles (ISO 3452-1)*

EN ISO 6974 (all parts), *Natural gas - Determination of composition with defined uncertainty by gas chromatography (ISO 6974 all parts)*

EN ISO 6976, *Natural gas - Calculation of calorific values, density, relative density and Wobbe indices from composition (ISO 6976)*

EN ISO 9606-1, *Qualification testing of welders - Fusion welding - Part 1: Steels (ISO 9606-1)*

EN ISO 9712, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712)*

EN ISO 9906, *Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1, 2 and 3 (ISO 9906)*

EN ISO 10380, *Pipework - Corrugated metal hoses and hose assemblies (ISO 10380)*

EN ISO 10497, *Testing of valves - Fire type-testing requirements (ISO 10497)*

EN ISO 10715, *Natural gas - Sampling guidelines (ISO 10715)*

EN ISO 10723, *Natural gas - Performance evaluation for analytical systems (ISO 10723)*

EN ISO 12241, *Thermal insulation for building equipment and industrial installations - Calculation rules (ISO 12241)*

EN ISO 12944 (all parts), *Paints and varnishes - Corrosion protection of steel structures by protective paint systems (ISO 12944 all parts)*

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

EN ISO 15607, *Specification and qualification of welding procedures for metallic materials - General rules (ISO 15607)*

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

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1)*

EN ISO 16903:2015, *Petroleum and natural gas industries - Characteristics of LNG, influencing the design, and material selection (ISO 16903:2015)*

EN ISO 16904, *Petroleum and natural gas industries - Design and testing of LNG marine transfer arms for conventional onshore terminals (ISO 16904)*

EN ISO 17636-1, *Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film (ISO 17636-1)*

EN ISO 17636-2, *Non-destructive testing of welds - Radiographic testing - Part 2: X- and gamma-ray techniques with digital detectors (ISO 17636-2)*

EN ISO 17637, *Non-destructive testing of welds - Visual testing of fusion-welded joints (ISO 17637)*

EN ISO 17640, *Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment (ISO 17640)*

EN ISO 20519, *Ships and marine technology - Specification for bunkering of liquefied natural gas fuelled vessels (ISO 20519)*

EN ISO 21012, *Cryogenic vessels - Hoses (ISO 21012)*

EN ISO 28460, *Petroleum and natural gas industries - Installation and equipment for liquefied natural gas - Ship-to-shore interface and port operations (ISO 28460)*

EN ISO 28921 (all parts), *Industrial valves - Isolating valves for low-temperature applications (ISO 28921 all parts)*

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

IEC 61511, *Functional safety - Safety instrumented systems for the process industry sector*

ISO 6578, *Refrigerated hydrocarbon liquids - Static measurement - Calculation procedure*

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3 Terms, definitions and abbreviated terms

3.1 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:

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

3.1.1

abnormal operation

operation of the plant, or plant thereof, under the effect of internal failures or under the effect of foreseeable influences outside the specified operational conditions

[SOURCE: ISO 23552-1:2007, 3.10]

3.1.2

accidental event

event that arises from an uncontrolled or unplanned situation with safety and/or environmental consequences

3.1.3

action

- a) set of forces (loads) applied to the structure (direct action) or
- b) set of imposed deformation or accelerations (indirect action)

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Note 1 to entry: Imposed deformation or acceleration could be caused, for example, by temperature changes, moisture variation, uneven settlement or earthquakes.

3.1.4

base slab

continuous concrete base supporting the tank (either on the ground or elevated)

3.1.5

boil-off gas

BOG

natural gas resulting from slow evaporation of LNG at its equilibrium state or rapid evaporation of LNG, also called flashing, inside equipment

3.1.6

boundary

property line on land or water inside of which the operator/owner has full control and authority, or exclusive use

3.1.7

bund wall

raised impermeable structure, able to withstand the hydrostatic pressure and temperature of the spilled liquid, around the perimeter of an impounding area for the confinement of hydrocarbon spills, usually associated with storage areas

EN 1473:2021 (E)**3.1.8****condensate**

hydrocarbon liquids (liquid state at standard conditions) produced from primary separation of natural gas from a reservoir

Note 1 to entry: Natural gas condensates consist primarily of pentanes and heavier components, although quantities of propane and butane could be dissolved within the mixture.

3.1.9**control room**

core functional entity, and its associated physical structure, where control room operators are stationed to carry out centralized control, monitoring and administrative responsibilities

[SOURCE: EN ISO 11064-5:2008, 3.9]

3.1.10**control room operator**

individual whose primary duties relate to the conduct of monitoring and control functions, usually at a control workstation, either on their own or in conjunction with other personnel both within the control room or outside

Note 1 to entry: In special cases based on the evaluated risk, control room operators may perform their duties for the installation via remote access.

[SOURCE: EN ISO 11064-3:1999, 3.5]

3.1.11**conventional onshore LNG terminal**

LNG export or receiving terminal that is located on-shore and has a marine transfer facility for the loading or unloading of LNG carriers

Note 1 to entry: The transfer facility is located in a harbour or other coastal location and consists of a fixed structure, or wharf, capable of withstanding the berthing loads of a fully laden LNG carrier of a given specification and mooring the vessel safely alongside. The structure is connected to the shore by a trestle, tunnel or other means, facilitating the LNG transfer and ancillary services and providing safe access and egress for personnel performing maintenance or operational duties.

3.1.12**emergency shut down****ESD**

method that safely and effectively stops the whole plant or individual sections to minimize incident escalation

3.1.13**fire area**

area of the plant delimited by physical boundaries or separations from other fire areas by boundaries such as site roads

Note 1 to entry: Multiple trains in a large plant are each a fire area. Different processing units each separated by plant roads are individual fire areas. A fire area is often self-defining in that it may be a single plant unit, a storage or utility area or a separate operating area such as a road tanker loading bay.

Note 2 to entry: The typical firewater ring main routing often encloses each fire area.

Note 3 to entry: Pipe racks joining plant areas are not considered to affect fire area considerations.

3.1.14**fire zone**

area of the plant or process system within a fire area that requires it to be isolated by ESD valves in the event of a fire to control and minimize the fire event, or in the event of a process upset or malfunction to minimize the extent of the process upset

3.1.15**flammable gas**

gas or vapour which, when mixed with air in certain proportions, will form a combustible gas mixture

3.1.16**flare**

system to ignite the vapour on a safe location in a controlled manner

3.1.17**flash gas**

gas resulting from sudden evaporation of LNG due to change of equilibrium condition

3.1.18**foundation**

element of the construction required to support equipment

3.1.19**frequency**

number of occurrences per unit of time

3.1.20**harm**

physical injury or damage to the health of people or damage to property or the environment

[SOURCE: ISO/TS 16901:2015, 3.13]

3.1.21**hazard**

potential source of harm

[SOURCE: ISO/TS 16901:2015, 3.14]

3.1.22**impounding area**

area defined at the site for the purpose of collecting any accidental spill of hydrocarbons

3.1.23**impounding basin**

container or leak-tight area connected to an impounding area or spill collection area where liquid hydrocarbon spills can be collected and safely confined and controlled

3.1.24**inner tank**

metallic self-supporting cylindrical primary container

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