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Installation and equipment for liquefied natural gas - Design and testing of marine transfer systems - Part 1: Design and testing of transfer arms

Anlagen und Ausrüstung für Flüssigerdgas - Auslegung und Prüfung von Schiffsübergabesystemen - Teil 1: Auslegung und Prüfung von Verladearmen

Installations et équipements relatifs au gaz naturel liquéfié - Conception et essais des systemes de transfert marins - Partie 1: Conception et essais des bras de chargement/déchargement

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Installation and equipment for liquefied natural gas - Design and testing of marine transfer systems - Part 1: Design and testing of transfer arms

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This European Standard was approved by CEN on 1 November 2008.

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Foreword

This document (EN 1474-1:2008) 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of an identical text or by endorsement, at the latest by June 2009, and conflicting national standards shall be withdrawn at the latest by June 2009.

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

This document supersedes EN 1474:1997.

This European Standard consists of 3 parts:

— EN 1474-1, *Installation and equipment for liquefied natural gas — Design and testing of marine transfer systems — Part 1: Design and testing of transfer arms*

— 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 1474-3, *Installation and equipment for liquefied natural gas — Design and testing of marine transfer systems — Part 3: Offshore transfer systems*

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

1 Scope

This European Standard specifies the design, minimum safety requirements and inspection and testing procedures for liquefied natural gas (LNG) transfer arms intended for use on conventional onshore (LNG) terminals [1]. It also covers the minimum requirements for safe LNG transfer between ship and shore.

Although the requirements for remote control power systems are covered, the standard does not include all the details for the design and fabrication of standard parts and fittings associated with transfer arms.

The content of this European Standard is supplementary to local or national standards and regulations and is additional to the requirements of EN 1532 and EN 1473.

2 Normative references

The following referenced documents are indispensable for the application 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 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 571-1, *Non destructive testing — Penetrant testing — Part 1: General principles*

EN 875, *Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination*

EN 910, *Destructive tests on welds in metallic materials — Bend tests*

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

EN 1092-4, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 4: Aluminium alloy flanges*

EN 1160, *Installations and equipment for liquefied natural gas — General characteristics of liquefied natural gas*

EN 1435, *Non-destructive examination of welds — Radiographic examination of welded joints*

EN 1473, *Installation and equipment for liquefied natural gas — Design of onshore installations*

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 1532, *Installation and equipment for liquefied natural gas — Ship to shore interface*

EN 1759-1, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 1: Steel flanges, NPS ½ to 24*

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[1] CONVENTIONAL ONSHORE (LNG) TERMINAL - Definition: A marine transfer facility for the loading or unloading of LNG Carriers that is located in a harbour or other sheltered coastal location. It shall consist 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 shall be connected to the shore by a trestle, tunnel or other means, facilitating the transfer and ancillary pipe work and providing safe access and egress for personnel performing maintenance or operational duties." See also definitions in EN 1474-2 and -3.

EN 1991-1-4, *Eurocode 1: Actions on structures — Part 1-4: General actions — Wind actions*

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

EN 12266-1, *Industrial valves — Testing of valves — Part 1: Pressure tests, test procedures and acceptance criteria — Mandatory requirements*

EN 12266-2, *Industrial valves — Testing of valves — Part 2: Tests, test procedures and acceptance criteria — Supplementary requirements*

EN 12308, *Installation and equipment for liquefied natural gas — Suitability testing of gaskets designed for flanged joints used on LNG piping*

EN 12560-1, *Flanges and their joints — Gaskets for Class-designated flanges — Part 1: Non-metallic flat gaskets with or without inserts*

EN 12560-2, *Flanges and their joints — Gaskets for Class-designated flanges — Part 2: Spiral wound gaskets for use with steel flanges*

EN 12560-3, *Flanges and their joints — Gaskets for Class-designated flanges — Part 3: on-metallic PTFE envelope gaskets*

EN 12560-4, *Flanges and their joints — Gaskets for Class-designated flanges — Part 4: Corrugated, flat or grooved metallic and filled metallic gaskets for use with steel flanges*

EN 12560-5, *Flanges and their joints — Gaskets for Class-designated flanges — Part 5: Metallic ring joint gaskets for use with steel flanges*

EN 12560-6, *Flanges and their joints — Gaskets for Class-designated flanges — Part 6: Covered serrated metal gaskets for use with steel flanges*

EN 12567, *Industrial valves — Isolating valves for LNG — Specification for suitability and appropriate verification tests*

EN 13463-1, *Non-electrical equipment for use in potential explosive atmospheres — Part 1: Basic method and requirements*

EN 13463-2, *Non-electrical equipment for use in potential explosive atmospheres — Part 2: Protection by flow restricting enclosure 'fr'*

EN 13463-5, *Non-electrical equipment for use in potential explosive atmospheres — Part 5: Protection by constructional safety "c"*

EN 13463-8, *Non-electrical equipment for use in potential explosive atmospheres — Part 8: Protection by liquid immersion 'k'*

EN 60034-5, *Rotating electrical machines — Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) — Classification (IEC 60034-5:2000)*

EN 60079-0, *Electrical apparatus for explosive gas atmospheres — Part 0: General requirements (IEC 60079-0:2004, modified)*

EN 60079-1, *Explosive atmospheres — Part 1: Equipment protection by flameproof enclosures "d" (IEC 60079-1:2007)*

EN 60079-2, *Explosive atmospheres — Part 2: Equipment protection by pressurized enclosure "p" (IEC 60079-2:2007)*

EN 60079-5, *Explosive atmospheres — Part 5: Equipment protection by powder filling "q" (IEC 60079-5:2007)*

EN 60079-6, *Explosive atmospheres — Part 6: Equipment protection by oil immersion "o" (IEC 60079-6:2007)*

EN 60079-7, *Explosive atmospheres — Part 7: Equipment protection by increased safety "e" (IEC 60079-7:2006)*

EN 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas (IEC 60079- 10:2002)*

EN 60079-11, *Explosive atmospheres — Part 11: Equipment protection by intrinsic safety "i" (IEC 60079-11:2006)*

EN 60079-18, *Electrical apparatus for explosive gas atmospheres — Part 18: Construction, test and marking of type of protection encapsulation "m" electrical apparatus (IEC 60079-18:2004)*

EN 60079-25, *Electrical apparatus for explosive gas atmospheres — Part 25: Intrinsically safe systems (IEC 60079-25:2003)*

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

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

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

EN 62305-3, *Protection of structures against lightning — Part 3: Physical damage to structures and life hazard (IEC 62305-3:2006, modified)*

EN ISO 1460, *Metallic coatings — Hop dip galvanised coatings on ferrous materials — Gravimetric determination of the mass per unit area (ISO 1460:1992)*

EN ISO 1461, *Hop dip galvanised coatings on fabricated iron and steel articles — Specification and test methods (ISO 1461:1999)*

EN ISO 9000, *Quality management systems — Fundamentals and vocabulary (ISO 9000:2005)*

EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2000)*

EN ISO 10497, *Testing of valves — Fire type-testing requirements (ISO 10497:2004)*

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

3 Terms, definitions and abbreviations

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

3.1
adapters
see “spool (piece)” in 3.68

3.2
apex swivel
articulated, fluid-carrying joint located between the <inboard> and <outboard arms>

NOTE It provides <luffing> of the <outboard arm> relative to the <inboard arm>.

3.3
arm, inboard
fluid-carrying pipe and structural members contained between the <apex swivel> and the <trunnion swivel>

3.4
arm, outboard
fluid-carrying pipe and structural members contained between the <apex swivel> and the <triple swivel assembly>

3.5
attitude
various modes of use and/or location of the <transfer arm> (i.e. manoeuvring, stowed, connected, washing, hydrostatic test, and maintenance)

NOTE The <transfer arm> may take several positions for each <attitude>.

3.6
base riser
see “riser” in 3.58

3.7
brinelling
any permanent indentation in <swivel> raceways caused by excessive loading of <swivel> balls or bearing rollers

3.8
cantilever length
distance from the <LNG carrier’s> manifold flange face (including spool pieces), to the first permanent manifold support point on the <LNG carrier’s> cargo line

3.9
cargo control room
a control room situated on board the <LNG carrier> from which the control of the <LNG carrier’s> transfer operation is directed

NOTE See EN 1532

3.10
cargo manifold
pipe assembly mounted onboard <LNG carrier> to which the outboard flanges of the <transfer arms> are connected

3.11
cavitation
formation and collapse of bubbles in a liquid when the pressure falls to or below the liquid vapour pressure; the collapse releases energy, sometimes with an audible sound and vibration. NOTE Such low pressures occur in high velocity zones such as the inner radius of elbows, or at places with variations of diameters

NOTE “ERC” in 3.23.

3.12
centreline of transfer arm group
line equidistant between the two outside <transfer arms> of those <transfer arms> in simultaneous service

3.13
centreline of manifold group
line equidistant between the two outside manifolds (nozzles) of the group of manifolds

3.14
clash
any contact during design operational conditions, or as a result of an emergency separation, between any part of a <transfer arm> and:

— adjacent <transfer arm> while both <arms> are operating or one <arm> is operating and the other <arm> is stowed (e.g. the counterweights);

— adjacent section of the same <transfer arm> (e.g. the <triple swivel> and <outboard arm>);

— loading platform equipment (e.g. the <counterweight> and piping or valves)

3.15
column separation
development of a significant vapour cavity in a liquid flow

3.16
contact angle
α
angle between the plane of the <swivel> joint balls and the centre of contact at the ball raceway interface

3.17
CPMS
constant position monitoring system

NOTE See Annex B.

3.18
counterweight
system of weights used to balance the <inboard> and <outboard arm> assemblies

NOTE Some <transfer arms> have a single <counterweight> for this function and others have multiple <counterweights>.

3.19
coupler
manual or hydraulic mechanical device used to connect the <transfer arm> to the <LNG carrier's> manifold without employing bolts

NOTE This device is often also referred to as <QCDC>.

3.20
drift
longitudinal and/or lateral displacement of the <LNG carrier> under the influence of environmental forces

NOTE 1 See also "surge" in 3.72 and "sway" in 3.74.

NOTE 2 Longitudinal and lateral <drifts> (often resulting from a "combined <drift>") are not the same.

3.21
design pressure
pressure for which the <transfer arm> is designed

3.22
design temperature
range of temperatures for which the <transfer arm> is designed

3.23
emergency release coupling
ERC
device to provide a means of quick release of the <transfer arms> when such action is required only as an emergency measure. May be referred to as a “PERC”

3.24
emergency release system
ERS
system that provides a positive means of quick release of <transfer arms> and safe isolation of <LNG carrier> and shore

3.25
emergency shut down
ESD
method that safely and effectively stops the transfer of <LNG> and vapour between the <LNG carrier> and shore

3.26
envelope, operating
volume in which the presentation flange(s) of a (group of) <transfer arm(s)> is (are) required to operate

3.27
freeboard
vertical distance between the ship's deck and the waterline at the manifold location

3.28
freewheel
ability of a hydraulically operated <transfer arm> when connected to an <LNG carrier> to follow freely without hydraulic restraint the vertical and horizontal motions of the <LNG carrier’s> manifold (draft changes and <sway> and <surge> motions)

3.29
heave
vertical motion of the <LNG carrier> due to wave action

NOTE See Figure D.2.

3.30
included angle
angle formed between the inboard and outboard <arm>

NOTE The maximum and minimum <included angles> should be left to the Vendor. The <included angle> in the stowed position of the <transfer arms> need to be such, that the <arms> are parked with the <triple swivel assembly> behind the berthing line.

3.31
inboard arm
product-carrying pipe and any structural members contained between the <apex swivel> and the <trunnion swivel>

3.32
insulating flange
electrical insulating system, usually dedicated, which is installed in the lower end of the <outboard arm>

NOTE Its purpose is to prevent stray currents from causing an arc at the <LNG carrier’s> flange as <the transfer arm> is connected or disconnected.

3.33
jack
permanent, adjustable load-carrying mechanism potentially installed in the <triple swivel assembly> to transfer a portion of the <arm> fluid weight to the deck instead of the <LNG carrier's> manifold

3.34
jetty control centre
control centre situated on or adjacent to the jetty primarily to control the <transfer arms>

NOTE Sometimes referred to as 'jetty control room' or 'local control room'.

3.35
lean-back
position of the< transfer arm> in the connected mode when the <inboard arm> is to the rear of the <riser>

3.36
LNG
liquefied natural gas as defined in EN 1160

3.37
LNGC
LNG Carrier
liquefied natural gas carrier

NOTE A tank ship designed for the carriage of <LNG>.

3.38
LN_2
liquefied nitrogen gas

3.39
luffing
rotary motions of the <inboard> and <outboard arm> in the vertical plane

3.40
MHU
main hydraulic unit

3.41
main control room
control room situated in the terminal from which central control is directed

3.42
manifold
see "cargo manifold" in 3.10

3.43
manifold spacing
horizontal distance between the centrelines of the pipe assembly of the <cargo manifold>

3.44
MOV
motor operated valve

3.45
N_2
nitrogen gas

3.46
NG
natural gas

3.47
offset
horizontal projected distance between any two assemblies of the <transfer arm>

NOTE E.g. the apex offset is between the <inboard> and <outboard arm>; the heel offset is between the <riser> and the <inboard arm>.

3.48
owner (or designated agent)
company or group of companies for whose use the transfer arms are installed, responsible for the safe design and construction of the installation

3.49
outboard arm
product-carrying pipe and any structural members contained between the <apex swivel> and the <triple swivel assembly>

3.50
pantograph
system for transmitting balancing loads from respectively the <inboard> and <outboard arms> to the <counterweight(s)>

NOTE The system comprises an assembly of linkages and pinned connections, or a cable and sheaves system ("pantograph cables and pantograph sheaves").

3.51
pendant
see "remote pendant control" in 3.57

3.52
pitch(ing)
rotation of the <LNG carrier> around transversal horizontal axis

NOTE See Figure D.2.

3.53
presentation flange
<transfer arm> flange for connection to either the <LNG carrier> manifold or <spool piece>

3.54
product
fluid transferred using <transfer arms>

NOTE Fluids are <LNG>, <NG> or <LN_2>.

3.55
reducer
short length of pipe with flanges of different diameter for matching the manifold flange to the presentation flange

3.56
QRA
quantitative risk analysis
technique which evaluates the acceptability of a risk by comparison against pre-determined benchmarks, taking into consideration the probability of occurrence and consequences of major hazards

3.57
remote pendant control
device to facilitate the fine manoeuvring operation of the <transfer arms from> a remote location (e.g. <LNG carrier's> <cargo manifold> area)

NOTE The system can use a <trailling wire> of radio-controlled system. This system is also called remote control in this publication.

3.58
riser
vertical assembly which bolts to the loading platform and supports the articulated assembly of the <transfer arm>

NOTE Sometimes referred to as 'base riser' or 'standpost'.

3.59
riser assembly
fluid carrying system of elbow(s) and the vertical <riser swivel> mounted on top of the <riser>

3.60
riser swivel
swing joint in the <riser> assembly which permits the <inboard arm> to rotate around the base <riser>

NOTE See also 3.67.

3.61
roll(ing)
rotation of <LNG carrier> around longitudinal horizontal axis

3.62
sheave
pulley mounted at the <riser> and apex assemblies

3.63
ship/shore transfer facility
ship/shore interface equipment for receiving or exporting <LNG>

NOTE Installed on the transfer platform of a jetty or other structure designed for the purpose.

3.64
SIL
safety integrity level
statistical representations of the integrity of the safety instrumented system when a process demand occurs

NOTE See in Clause 5.

3.65
simultaneous service
use of two or more <transfer arms>

3.66
slew(ing)
horizontal, rotary motion of the <transfer arm> around the <riser>

3.67
slew swivel
swing joint on the <riser> assembly which permits horizontal rotation of the <transfer arm assembly>

NOTE See also 3.60.