SLOVENSKI STANDARD

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Napeljave in oprema za utekoļ injeni zemeljski plin - Naļ rtovanje in preskuġanje obalnih pretakaliġļ - 2. del: Naļ rtovanje in preskuġanje cevi za pretakanje

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

Anlagen und Ausrüstung für Flüssigerdgas - Auslegung und Prüfung von Schiffsübergabesystemen - Teil 2: Auslegung und Prüfung von Übergabeschläuchen

Installations et équipements de gaz naturel liquéfié - Conception et essais des systemes de transfert marins - Partie 2: Conception et essais des tuyaux de transfert

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75.200	Oprema za skladiġļ enje nafte, naftnih proizvodov in zemeljskega plina	Petroleum products and natural gas handling equipment

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

Installations et équipements de gaz naturel liquéfié - Conception et essais des systèmes de transfert marins - Partie 2: Conception et essais des tuyaux de transfert

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Contents

Page

Foreword

This document (prEN 1474-2:2006) has been prepared by Technical Committee CEN/TC 282 “Installation and equipment for LNG”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

1 Scope

This part of EN 1474 gives general guidelines for the design, material selection, qualification, certification, and testing details for Liquefied Natural Gas (LNG) transfer hose for offshore transfer or on coastal weather- exposed facilities.

To avoid unnecessary repetition, cross-reference to EN 1474-1 Design and Testing of Transfer Arms, is made for all compatible items, and for References, Definitions and Abbreviations. Where additional References, Definitions and Abbreviations are required specifically for LNG hoses, they are listed in this part.

For details of specific LNG transfer system architectures reference should be made to EN 1474-3.

Hoses used for LNG transfer are normally large bore: typically from DN 250 (10") to above DN 400 (16") and more, with working design pressures in the range of 10 bar to 20 bar in order to meet the minimum flow rate from the facility of 10 000 m^3/hour with a practical number of hoses used for LNG transfer and vapour return.

Transfer hoses have to be durable when operating in the marine environment and to be flexible with a minimum bending radius compatible with handling and the operating requirements of the transfer system.

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 1474-1, *Installation and Equipment for Liquefied Natural Gas — Design and Testing of Marine Transfer Systems — Part I: Design and Testing of Transfer Arms.*

EN 1474-3, *Installation and Equipment for Liquefied Natural Gas — Design and Testing of Marine Transfer Systems — Part III: Offshore Transfer Systems.*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions given in EN ISO 7369:2004 "Pipework — Metal hoses and hose assemblies — Vocabulary" and EN ISO 8330:2002 "Rubber and plastic hoses and hose assemblies — Vocabulary" apply.

For the purpose of this document hose assembly means the hose complete with end fittings, hose handling and lifting devices (pad eyes, collars, …), as described in clause 4.1.1.

4 Description of typical LNG transfer hose designs and accessories

4.1 A LNG transfer hose system shall consist of the following

4.1.1 A flexible hose assembly, comprising

- an inner leak-proof barrier to provide primary flow path and containment;
- reinforcement layers to provide structural support;
- an exterior leak-proof barrier to provide an external protection (note: this depends on the hose design, see clause 4.2);
- the associated end terminations and connectors;

- identification collars,

and if required:

- a leak detection system;
- an insulation system (to minimize build up of external ice);
- intermediate leak barrier(s);
- bending stiffeners or restrictors;
- hose handling device(s) (padeye or lifting lugs, lifting collar, …);
- buoyancy.

NOTE The leak proof barrier of a composite hose is comprised of many individual layers forming a labyrinth seal.

4.1.2 Connection System to LNGC

- The hose extremity connector flanges shall permit the mounting of a QCDC or a spool piece or permit direct connection to LNGC or LNG terminal or another hose assembly.

  (A description of QCDC is given in EN 1474-1 clause 6).

- Hubs, or other connectors if equivalent or superior to flanges, may be used if agreed between Purchaser and Vendor.

4.1.3 Emergency Release System

- The hose extremity connector shall permit the mounting of an Emergency Release System with Valves and ERC (Emergency Release Coupler).

  (A description of Emergency Release System is given in EN 1474-1 clause 5 and EN 1474-3 clause 7).

4.1.4 Handling

- The hose shall include necessary fittings for safe handling, coupling & uncoupling either from the LNGC or the onshore or offshore LNG terminal system as required by the system design (refer to EN 1474-3 clause 6).

4.1.5 Power Systems

- The hose may support (e.g. piggy back mounted) hydraulic or pneumatic hoses, electric cables for the powering of the ERS and QCDC systems (refer to EN 1474-3 clauses 6 and 7).

4.1.6 Leak detection, monitoring and Alarm Systems

- If required by the Purchaser the hose shall incorporate leak detection system e.g. gaseous nitrogen bleeding in the annular space (see clause 5.10).

4.2 Classification of LNG transfer hoses according to their method of construction

At present LNG transfer hoses are classed in two types according to their method of construction:

- those based on a reinforced corrugated metal hose construction, hereafter called Corrugated Metal Hose;
- those based on a construction in which polymeric films and fabrics are entrapped between a pair of close wound helical wires, hereafter called Composite Hose;
- as the technology develops, other types of hose may become available and are also to be considered covered by this standard.

4.2.1 Corrugated metal hoses

- Inner layer

The inner layer is made of stainless steel corrugations (sometimes called bellows). This ensures the inner leak-proofness of the structure, as well as sustaining the inner radial pressure.

- Armour layers (if required)

These armours sustain the axial loading whilst providing an initial thermal insulation.

- Spiral layer (if required)

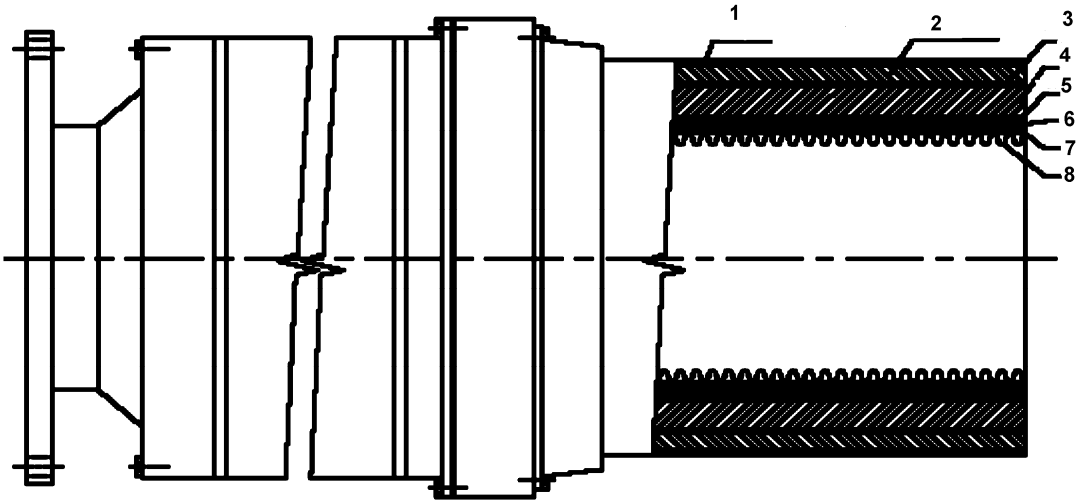
This layer ensures that the armours remain in place, as well as providing some thermal insulation.

- Thermal insulation layers

This layer (or series of layers) ensures that the inner temperature is conserved whilst preventing any build-up of ice on the exterior of the hose.

- Intermediate and outer leak-proof layers

The intermediate sheath gives the hose a double annulus, thus permitting the detection of any leak of LNG as soon as it may occur. The external sheath prevents any ingress of water from the exterior.

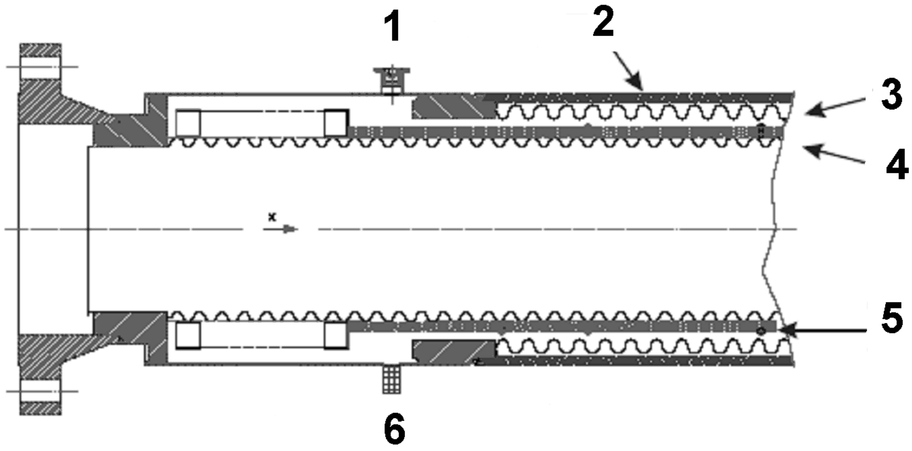


Key

1 Leakproof Layer
2 Insulation
3 Leakproof Layer
4 Insulation
5 Frette
6 Armours
7 Leakproof Layer
8 Inner Corrugated Bellows

Figure 1 — Typical hose – reinforced corrugated metal hose family

Depending on the design, the outer leak proof layer can be a corrugated stainless steel hose similar to the inner hose. In this case the annular gap between inner and outer hose may be evacuated. The pressure supervision of this annular gap results in a leak detection of inner and outer hose. The thermal insulation is maintained by layers of super insulation inside the evacuated annular gap.



Key

1 Pumping port

2 Armouring

3 Corrugated outerpipe

4 Corrugated innerpipe

5 Super insulation vacuum

6 Vacuum supervision Leal detection

Figure 2 — Sketch of a LNG flexible hose with vacuum installation option

The metal hose construction shall ensure that all materials are used within their individual range of temperature.

End fitting assembly:

The end fitting assembly is made of stainless steel, and ensures 2 primary functions.

The flexible termination, which incorporates the different layers of the flexible and ensures the integrity of each layer at its end. The construction is designed to allow the immediate detection of any LNG leak into the inner annulus.

The end connector, which is connected to the associated piping at each end of the flexible. This will typically be a standard ANSI flange (refer also to clause .1.2 Connection system).

4.2.2 Composite hoses

A composite hose consists of multiple polymeric film and fabric layers trapped between two wire helices which give the hose its shape, one being internal and one being external. Broadly, the film layers provide a fluid-tight barrier to the conveyed product and the fabric layers provide the mechanical strength of the hose.

Composite hoses are typically mandrel built, the length and diameter of the mandrel determining the finished hose length and bore.

In sequence, starting from the bore, the construction is as follows:

a) an inner metallic wire helix applied at a pre-determined close pitch;

b) polymeric fabric layers forming the bore material;

c) a pack of many polymeric film layers. The complete film pack achieves a tubular form and provides the fluid tight barrier to the conveyed product;

d) a pack of many polymeric fabric layers which reinforce the hose;

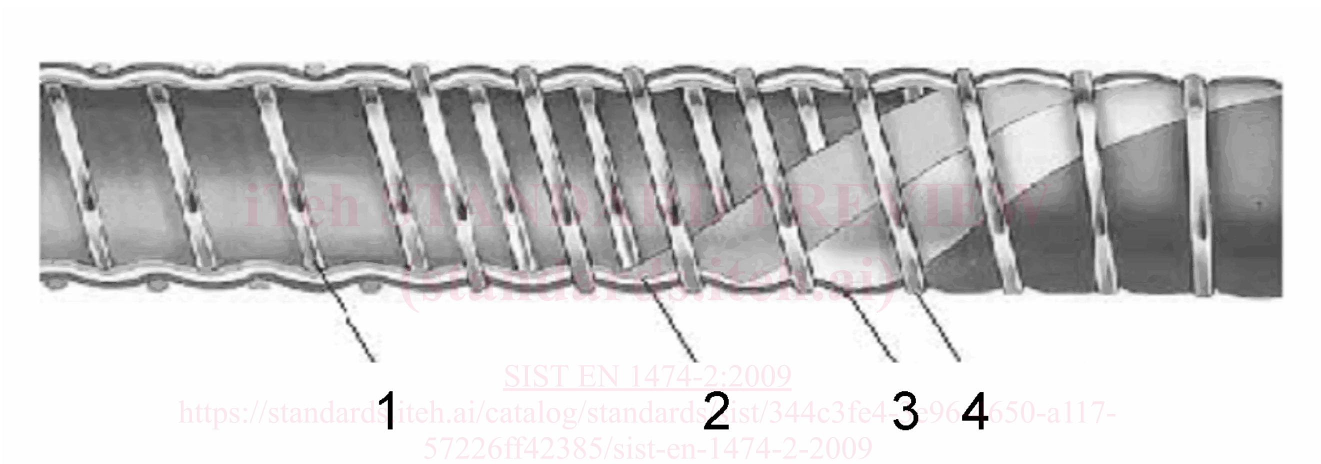
e) an outer metallic wire helix applied at half a pitch offset to the inner wire under tension. This forms the hose into the required convoluted structure.

The number and arrangement of the layers in steps c) and d) is specific to the hose size and application. The polymeric film and fabric materials are selected to be compatible with the conveyed product and the extremes of operating temperature.

Since the film and fabric layers are held securely by the inter-action of the wire helices, it is not necessary to bond the layer together in the hose e.g. by vulcanization.

Since the internal wire is an essential feature, composite hoses are always of rough bore construction.

Further layers may be included outside the external helical wire to provide insulation, buoyancy and an outer protective layer as required by the specific application.



Key

1 Inner wire

2 Film

3 Fabric

4 Outer wire

Figure 3 — Typical hose – composite hose family

5 Design features of the LNG transfer hoses and transfer hoses assemblies

The hose forms part of an overall system for the transfer of LNG - the requirements which will dictate the exact design of the hose (e.g. static and dynamic movements, …) refer to EN 1474-3 clause 6. The design process and required information is outlined below.

5.1 Application data required

The hose will form part of an overall system for the transfer of LNG - the requirements of which will dictate the exact design of the hose.

In order that the Design Loads are calculated, the Purchaser shall specify **the fixed loads, the operational loads, any accidental loads that may occur**, the intended service and the operating weather limits (wind, **wave**

and temperature), offload duration and the maximum allowable heat influx or maximum boil off rate or a rate or a ‘no icing’ criterion.

5.2 Selection of hose length

The overall hose length will be dictated by the system design and shall be sufficient to meet both storage and operational conditions.

For aerial hose configuration the hose length shall be determined by a dynamic analysis of the system ensuring that the hose bend radius and maximum loads are not exceeded and that the operability window is sufficient (note: bending radius is measured to the hose center line).

Depending on the length, system design and type, and other factors such as shipping requirements, the hose shall be either supplied as a continuous length or as a string of discrete sections.

The hose length used in the system will be such that the motion envelops as defined in EN 1474-1 clause 4 and in EN 1474-3 clause 6 are met.

Hose length shall take into account the elongation of the hose under pressure or its own weight. This elongation must be consistent with the transfer system design.

5.3 Service life

The required service life shall be specified by the Owner and is likely to be a requirement for the entire transfer system. The system design shall ensure that the life of the hose meets this requirement.

The calculation of hose life will take into account the cumulative effects of the number and amplitude of flexure, tensile, pressure and temperature cycles in operation, environmental ageing and the consequences of emergency disconnections and internal pressure surge in service.

A typically minimum service life of 5 years of the hose system is contemplated.

The relationship between the service life and fatigue life is to be agreed by the manufacturer and purchaser and shall be documented.

5.4 Selection of hose size

The Purchaser shall specify flow rate, maximum allowable working pressure, temperature, composition of product and the maximum allowable head loss. The number of hoses to be used shall be either predefined by the system or can be tailored to suit size limits and flow rate requirements.

The Vendor shall to specify maximum allowable working pressure (design pressure) of the hose assembly to allow the purchaser to size pressure relief devices etc..

5.5 Selection of buoyancy

The transfer system shall be such as the hose is either floating, aerial, or the purchaser will specify the degree of buoyancy if it is required (this will also include submersion requirements).