INTERNATIONAL STANDARD

ISO 19901-3

Second edition
2014-12-15

Petroleum and natural gas industries — Specific requirements for offshore structures —

Part 3: Topsides structure

Industries du pétrole et du gaz naturel — Exigences spécifiques relatives aux structures en mer —
Partie 3: Superstructures

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 19901-3 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 7, *Offshore structures*.

This second edition cancels and replaces the first edition (ISO 19901-3:2010), which has been technically revised.

ISO 19901 consists of the following parts, under the general title *Petroleum and natural gas industries — Specific requirements for offshore structures*:

— *Part 1: Metocean design and operating considerations*

— *Part 2: Seismic design procedures and criteria*

— *Part 3: Topsides structure*

— *Part 4: Geotechnical and foundation design considerations*

— *Part 5: Weight control during engineering and construction*

— *Part 6: Marine operations*

— *Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units*

— *Part 8: Marine soil investigations*

A future Part 9 dealing with structural integrity management is under preparation.

The first edition of ISO 19901-3:2010 included a number of serious typographical errors. A 'Corrected' version of the first edition was issued in December 2011. This 'Corrected' version first edition was subsequently issued by some national standards organisations. To ensure all national standards bodies issue a 'Corrected' version of the document, TC 67/SC 7 decided to produce a second edition of 19901-3 which incorporates the following changes from the original issue in 2010:

— in 4.1, the symbol S_d for design internal force or moment has been added;

— in 8.1, Formulae (7), (8) and (9) have been amended to include symbol S_d and the second paragraph has been reworded to reflect the changes in the equations;

— in 9.18, first paragraph, new values have been given for variable action for the grating and plating as well as for the contribution of personnel to the total variable action allowance;

— in A.7.10.4.2.2, the text has been reworded and Formula (A.1) has been amended, in line with the modifications in 8.1;

— in A.8.1, Formula (A.5) has been corrected by changing “max” to “min”;

— in B.2, Table B.1, the value of Young’s modulus has been amended so as to be in accordance with the default value recommended in ISO 19902;

— in Tables B.3, B.4, B.5, B.7, B.8 and B.9, some values have been updated to reflect the change in Young’s modulus;

— in B.3.3, Table B.4, the symbol for utilization has been corrected;

— in B.4.5, Table B.10, all values for compression and for compression and bending have been amended, as well as the value for the minimum ratio;

— in B.4.5, first and second paragraphs, the building code correspondence factor has been amended and a sentence about its applicability has been added;

— in Annex C, Table C.1, the existing building code correspondence factor has been amended and a second correspondence factor, relating to CSA S16-09, has been added;

— in the Bibliography, Reference[3] has been updated with a more recent edition; references in the text (see A.5.2, A.8.3.1, A.8.3.2, A.8.3.3 and A.8.3.4) have been updated accordingly.

In producing the second edition the following additional minor corrections have been applied to the 2011 ‘Corrected’ version of the first edition:

— in 9.5.3.4 the units of the area-imposed action corrected to kN/m^2;

— in 9.6.2 the description of off-lead and side-lead in Table 5 improved;

— in A.7.10.4.2.3 the reference to section A.7.10.2.4 changed to A.7.10.4.2.4;

— in A.11.3 minor text correction;

— in Annex B Table B.1, symbols for bending amplification reduction factor corrected to $C_{m,y}$ and $C_{m,z}$

ISO 19901 is one of a series of International Standards for offshore structures. The full series consists of the following International Standards:

— ISO 19900, *Petroleum and natural gas industries — General requirements for offshore structures*

— ISO 19901 (all parts), *Petroleum and natural gas industries — Specific requirements for offshore structures*

— ISO 19902, *Petroleum and natural gas industries — Fixed steel offshore structures*

— ISO 19903, *Petroleum and natural gas industries — Fixed concrete offshore structures*

— ISO 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars*

— ISO 19905-1, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 1: Jack-ups*

— ISO/TR 19905-2, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 2: Jack-ups commentary and detailed sample calculation*

— ISO 19906, *Petroleum and natural gas industries — Arctic offshore structures*

Introduction

The series of International Standards applicable to types of offshore structure, ISO 19900 to ISO 19906, constitutes a common basis covering those aspects that address design requirements and assessments of all offshore structures used by the petroleum and natural gas industries worldwide. Through their application, the intention is to achieve reliability levels appropriate for manned and unmanned offshore structures, whatever the type of structure and the nature or combination of the materials used.

It is important to recognize that structural integrity is an overall concept comprising models for describing actions, structural analyses, design rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design in isolation can disturb the balance of reliability inherent in the overall concept or structural system. The implications involved in modifications, therefore, need to be considered in relation to the overall reliability of all offshore structural systems.

The series of International Standards applicable to types of offshore structure is intended to provide wide latitude in the choice of structural configurations, materials and techniques, without hindering innovation. Sound engineering judgement is therefore necessary in the use of these International Standards.

This part of ISO 19901 has been prepared for those structural components of offshore platforms which are above the wave zone and are not part of the support structure or of the hull. Previous national and international standards for offshore structures have concentrated on design aspects of support structures, and the approach to the many specialized features of topsides has been variable and inconsistent, with good practice poorly recorded.

Historically, the design of structural components in topsides has been performed to national or regional codes for onshore structures, modified in accordance with experience within the offshore industry, or to relevant parts of classification society rules. While this part of ISO 19901 permits use of national or regional codes, and indeed remains dependent on them for the formulation of component resistance equations, it provides modifications that result in a more consistent level of component safety between support structures and topsides structures.

In some aspects, the requirements for topsides structures are the same as, or similar to, those for fixed steel structures; in such cases, reference is made to ISO 19902, with modifications where necessary. Annex A provides background to, and guidance on, the use of this part of ISO 19901, and is intended to be read in conjunction with the main body of this part of ISO 19901. The clause numbering in Annex A follows the same structure as that in the body of the normative text in order to facilitate cross-referencing.

Annex B provides an example of the use of national standards for onshore structures in conjunction with this part of ISO 19901.

Regional information on the application of this part of ISO 19901 to certain specific offshore areas is provided in Annex C.

In International Standards, the following verbal forms are used:

— “shall” and “shall not” are used to indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted;

— “should” and “should not” are used to indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited;

— “may” is used to indicate a course of action permissible within the limits of the document;

— “can” and “cannot” are used for statements of possibility and capability, whether material, physical or causal.

Petroleum and natural gas industries — Specific requirements for offshore structures —

Part 3: Topsides structure

1 Scope

This part of ISO 19901 gives requirements for the design, fabrication, installation, modification and structural integrity management for the topsides structure for an oil and gas platform. It complements ISO 19902, ISO 19903, ISO 19904-1, ISO 19905-1 and ISO 19906, which give requirements for various forms of support structure. Requirements in this part of ISO 19901 concerning modifications and maintenance relate only to those aspects that are of direct relevance to the structural integrity of the topsides structure.

The actions on (structural components of) the topsides structure are derived from this part of ISO 19901, where necessary in combination with other International Standards in the ISO 19901 series. The resistances of structural components of the topsides structure can be determined by the use of international or national building codes, as specified in this part of ISO 19901. If any part of the topsides structure forms part of the primary structure of the overall structural system of the whole platform, the requirements of this part of ISO 19901 are supplemented with applicable requirements in ISO 19902, ISO 19903, ISO 19904-1, ISO 19905-1 and ISO 19906.

This part of ISO 19901 is applicable to the topsides of offshore structures for the petroleum and natural gas industries, as follows:

— topsides of fixed offshore structures;

— discrete structural units placed on the hull structures of floating offshore structures and mobile offshore units;

— certain aspects of the topsides of arctic structures.

This part of ISO 19901 is not applicable to those parts of the superstructure of floating structures that form part of the overall structural system of the floating structure; these parts come under the provisions of ISO 19904-1. This part of ISO 19901 only applies to the structure of modules on a floating structure that do not contribute to the overall integrity of the floating structural system.

This part of ISO 19901 is not applicable to the structure of hulls of mobile offshore units.

This part of ISO 19901 does not apply to those parts of floating offshore structures and mobile offshore units that are governed by the rules of a recognized certifying authority and which are wholly within the class rules.

Some aspects of this part of ISO 19901 are also applicable to those parts of the hulls of floating offshore structures and mobile offshore units that contain hydrocarbon processing, piping or storage.

This part of ISO 19901 contains requirements for, and guidance and information on, the following aspects of topsides structures:

— design, fabrication, installation and modification;

— in-service inspection and structural integrity management;

— assessment of existing topsides structures;

— reuse;

— decommissioning, removal and disposal;

— prevention, control and assessment of fire, explosions and other accidental events.

This part of ISO 19901 applies to structural components including the following:

— primary and secondary structure in decks, module support frames and modules;

— flare structures;

— crane pedestal and other crane support arrangements;

— helicopter landing decks (helidecks);

— permanent bridges between separate offshore structures;

— masts, towers and booms on offshore structures.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2631-1, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1: General requirements*

ISO 2631-2, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 2: Vibration in buildings (1 Hz to 80 Hz)*

ISO 13702, *Petroleum and natural gas industries — Control and mitigation of fires and explosions on offshore production installations — Requirements and guidelines*

ISO 19900, *Petroleum and natural gas industries — General requirements for offshore structures*

ISO 19901-1, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating considerations*

ISO 19901-2, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 2: Seismic design procedures and criteria*

ISO 19901-6, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 6: Marine operations*

ISO 19902, *Petroleum and natural gas industries — Fixed steel offshore structures*

ISO 19903, *Petroleum and natural gas industries — Fixed concrete offshore structures*

ISO 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars*

ISO 19905-1, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 1: Jack-ups*

ISO 19906, *Petroleum and natural gas industries — Arctic offshore structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19900, ISO 19902 and the following apply.

3.1
abnormal value
design value of a parameter of abnormal severity used in accidental limit state checks in which a structure is intended not to suffer complete loss of integrity

Note 1 to entry: Abnormal events are typically accidental and environmental (including seismic) events having probabilities of exceedance of the order of 10^{-3} to 10^{-4} per annum.

[SOURCE: ISO 19900:2013, definition 3.1]

3.2
accidental situation
design situation involving exceptional conditions of the structure or its exposure

EXAMPLE Impact, fire, explosion, loss of intended differential pressure.

[SOURCE: ISO 19900:2013, definition 3.2]

3.3
active fire protection
system of fire protection that reacts to a fire by discharging water or an inert or reactive substance in the vicinity of the fire to extinguish it

Note 1 to entry: There is a possibility that such a system fails to operate as designed.

3.4
caisson
appurtenance used for abstracting water from the sea or as a drain

3.5
conductor
tubular pipe extending upward from or beneath the sea floor containing pipes that extend into the petroleum reservoir

[SOURCE: ISO 19900:2013, definition 3.12]

Note 1 to entry: A conductor is generally vertical, and is continuous from below the sea floor to the wellbay in the topsides and can be laterally supported in both the support structure and topsides structure. The vertical support is in the seabed.

Note 2 to entry: In a few cases, conductors are rigidly attached to the topsides or to the support structure above sea level. In these cases, the conductor's axial stiffness can affect the load distribution within the overall structure.

3.6
critical component
structural component, failure of which would cause failure of the whole structure, or a significant part of it

Note 1 to entry: A critical component is part of the primary structure.

[SOURCE: ISO 19902:2007, definition 3.12]

3.7
design accidental action
accidental action with a probability of occurrence greater than 10^{-3} to 10^{-4} per year

3.8
design service life
assumed period for which a structure is used for its intended purpose with anticipated maintenance, but without substantial repair being necessary

[SOURCE: ISO 19900:2013, definition 3.16]

3.9
design situation
set of physical conditions representing real conditions during a certain time interval, for which the design demonstrates that relevant limit states are not exceeded

[SOURCE: ISO 19900:2013, definition 3.17]

3.10
design value
value derived from the representative value for use in the design verification procedure

[SOURCE: ISO 19900:2013, definition 3.18]

3.11
explosion
rapid chemical reaction of gas or dust in air

Note 1 to entry: An explosion results in increased temperatures and pressure impulses. A gas explosion on an offshore platform is usually a deflagration in which flame speeds remain subsonic.

[SOURCE: ISO 19902:2007, definition 3.17]

3.12
exposure level
classification system used to define the requirements for a structure based on consideration of life safety and consequences of failure

Note 1 to entry: An exposure level 1 platform is the most critical and exposure level 3 the least. A normally manned platform which cannot be reliably evacuated before a design event will be an exposure level 1 platform.

[SOURCE: ISO 19900:2013, definition 3.20]

3.13
extreme value
value of a parameter used in ultimate limit state checks, in which a structure's global behaviour is intended to stay in the elastic range

Note 1 to entry: Extreme values and events have probabilities of exceedance of the order of 10^{-2} per annum.

[SOURCE: ISO 19902:2007, definition 3.19]

3.14
load case
compatible load arrangements, sets of deformations and imperfections considered simultaneously with permanent actions and fixed variable actions for a particular design or verification

[SOURCE: ISO 19902:2007, definition 3.29]

Note 1 to entry: Load arrangements are the identification of the position, magnitude and direction of a free action.

3.15
mitigation
action taken to reduce the consequences of a hazardous event

EXAMPLE Provision of fire or explosion walls; use of water deluge on gas detection; structural strengthening.

3.16
nominal value
value assigned to a basic variable determined on a non-statistical basis, typically from acquired experience or physical conditions

[SOURCE: ISO 19900:2013, definition 3.29]

3.17
owner
representative of the company or companies owning or leasing a development

[SOURCE: ISO 19900:2013, definition 3.34]

3.18
passive fire protection
PFP
coating on the surface of a structural component that improves the structural component's resistance to fire

Note 1 to entry: Some PFP can produce toxic fumes in fires.

3.19
platform
complete assembly including structure, topsides, foundations and stationkeeping systems

[SOURCE: ISO 19900:2013, definition 3.35]

3.20
regulator
authority established by a national governmental administration to oversee the activities of the offshore oil and natural gas industries within its jurisdiction, with respect to the overall safety to life and protection of the environment

Note 1 to entry: The term *regulator* can encompass more than one agency in any particular territorial waters.

Note 2 to entry: The regulator can appoint other agencies, such as marine classification societies, to act on its behalf, and in such cases, *regulator* as it is used in this International Standard includes such agencies.

Note 3 to entry: In this International Standard, the term *regulator* does not include any agency responsible for approvals to extract hydrocarbons, unless such agency also has responsibility for safety and environmental protection.

[SOURCE: ISO 19902:2007, definition 3.40]

3.21
representative value
value assigned to a basic variable for verification of a limit state

[SOURCE: ISO 19900:2013, definition 3.38]

3.22
return period
average period between occurrences of an event or of a particular value being exceeded

Note 1 to entry: The offshore industry commonly uses a return period measured in years for environmental events. The return period in years is equal to the reciprocal of the annual probability of exceedance of the event.

[SOURCE: ISO 19900:2013, definition 3.40]

3.23
riser
tubular used for the transport of fluids between the sea floor and a termination point on the platform

Note 1 to entry: For a fixed structure the termination point is usually the topsides. For floating structures, the riser can terminate at other locations of the platform.

[SOURCE: ISO 19900:2013, definition 3.41]

Note 2 to entry: A riser can be supported both laterally and vertically in the topsides structure and transmit actions from thermal effects, wave action, permanent and variable actions and variations in fluid flow to the topsides structure.

3.24
robustness
ability of a structure to withstand accidental and abnormal events without being damaged to an extent disproportionate to the cause

[SOURCE: ISO 19900:2013, definition 3.42]

3.25
safety-critical element
SCE
item of structure, piping or equipment, the failure of which can result in major accidents or which is provided to prevent or mitigate against them

EXAMPLE Primary structure, pressure-containing equipment, blow-down and other safety systems, vessels and pipework containing hazardous materials, fire and gas detection systems, supports for SCE.

3.26
structural component
physically distinguishable part of a structure

EXAMPLE Column, beam, stiffened plate, tubular joint, or foundation pile.

[SOURCE: ISO 19900:2013, definition 3.46]

3.27
support structure
structure supporting the topsides

Note 1 to entry: The support structure can take many forms including fixed steel (see ISO 19902), fixed concrete (see ISO 19903), floating (see ISO 19904-1), mobile offshore units (see ISO 19905-1), or the various forms of arctic structures (see ISO 19906).

3.28
topsides
structures and equipment placed on a supporting structure (fixed or floating) to provide some or all of a platform's functions

Note 1 to entry: For a ship-shaped floating structure, the deck is not part of the topsides.

Note 2 to entry: For a jack-up, the hull is not part of the topsides.

Note 3 to entry: A separate fabricated deck or module support frame is part of the topsides.

[SOURCE: ISO 19900:2013, definition 3.52]

4 Symbols and abbreviated terms

4.1 Symbols

a acceleration

A accidental action

b spacing of stiffeners

D_e equivalent quasi-static action representing dynamic response effects to the extreme environmental action, E_e

D_o equivalent quasi-static action representing dynamic response effects to the operating environmental action, E_o

E quasi-static environmental action

E_e extreme quasi-static environmental action due to wind, waves and current

E_o quasi-static environmental action due to wind, waves and current for an operating condition under consideration (see 7.3.4)

F_d design action

F_G vertical action due to self-weight of a crane

F_H horizontal action due to off-lead and side-lead on a crane

F_r representative action

F_{rhl} representative hook load of a crane

F_W maximum operating wind action on a crane

$F_{W,ext}$ extreme wind action on a crane

g acceleration due to gravity

G permanent action

I explosion impulse

l span or length

K_c building code correspondence factor

p instantaneous explosion overpressure

p(t) variation of overpressure with time

P probability

Q variable action

R resistance

R_D design resistance

R_K representative resistance

S internal force or moment

S_d design internal force or moment

t time from ignition of an explosion

t_d duration of explosion pressure pulse

T fundamental period of vibration of a component or structure