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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: Structures Top Sides

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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, Subcommittee SC 7, *Offshore structures,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Oil and gas industries including lower carbon energy,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 19901-3:2014), which has been technically revised.

The main changes are as follows:

— alignment of terminology with that of ISO 19900;

— a rational re-arrangement of the clauses content and numbering;

— adoption with modifications of IOGP supplementary requirements (S-631-04);

— ‘national or regional codes’ and ‘national or regional building codes’ have been replaced by ‘national building standards’ throughout the whole document;

— ‘supporting structure’ has been replaced by ‘substructure’ and definition of ‘substructure’ has been added to Clause 3;

— ‘wave, wind and current’ has been replaced by ‘metocean’;

— ‘design assessment/situations’ has replaced ‘design situations’ according to ISO 19900;

— 5.2.1 has been updated distinguishing between ASD (Allowable strength design) associated to ANSI/AISC 360-22 and WSD (Working stress design) associated to AISC 335-89 and API RP 2A-WSD.

Further guidance is provided for floating structures where the hull is typically designed using the WSD method. In 5.2.2 guidance on the application of K_c is given in case of WSD method.

— subclause 5.7 on critical structures has been added;

— in 6.5.2.4 the frequency range to avoid structural resonance has been changed according to NORSOK N-004:2022, F-2-9-6;

— Table 2 has been updated with the introduction of 'restricted access for inspection, maintenance and repair' partial damage factors and reduction in case of full accessibility (with reference to ISO 19904-1, NORSOK N-004,[32] Reference [30] and DNVGL-OS-C101[31]). Guidance in case of dissimilar materials has been added;

— subclause 6.8.2 on ductility has been introduced, adapted from NORSOK N-004:2022, 7.2;

— addition of Table A.1 with typical minimum values for local, primary and global design of operational actions (Q);

— subclause 7.3 has been re-ordered and updated;

— subclause 7.5 has been renamed 'Indirect actions and resulting forces' and updated according to the modifications and assumptions in 10.1 and 10.2;

— wind actions, 7.6.2 and A.7.6.2, introduction of national building standards for the evaluation of the representative wind actions; alignment with ISO 19900 and ISO 19901-1 and addition of more guidance;

— alignment of minimum lateral acceleration for seismic (7.7.2 and A.7.7.2) with ANSI/API RP 2TOP[82].

— all sources of topsides accelerations collected (7.9.9 and A.7.9.9) and aligned;

— technical review of the accidental events (7.9 and A.7.9), with introduction of risk-informed and reliability-based approaches for fire and explosion in addition to the default semi-probabilistic approach;

— K_c correspondence factor (8.1 and A.8.1) defined according to an equivalent reliability procedure for ANSI/AISC 360-22,[12] CSA-S16:19[14] and EN 1993-1-1[13];

— bolted connection (8.4.3 and A.8.4.3) have been modified according to IOGP supplementary specification S-631-04;

— 8.5 has been renamed as 'Castings and forgings', adding references to forgings;

— addition of 8.6 and A.8.6 on design for structural stability in alignment with ANSI/API RP 2TOP[82] and based on ANSI/AISC 360-22[12] and EN 1993-1-1[13] criteria;

— addition of Clause 9 dedicated to the description of the limit state verification approaches including risk-informed and reliability-based approaches for fire and explosion (9.2, 9.3, A.9.2 and A.9.3) in addition to the default semi-probabilistic approach;

— in 10.2.1, an alternative method (method b) for the analysis of the topsides structures has been introduced with further guidance in A.10.2.1. The associated 6.4, 7.5, 7.8 and 10.1 and A.6.4, A.7.5, A.7.8 and A.10.1 have been updated accordingly;

— helicopter landing facilities (10.5) updated according to CAP 437[21] for emergency landing and addition of design load combinations (Table 7) adapted from NORSOK N-004:2022, Table F.5.[32] Deletion of the previous Table A.5;

— crane support structure clauses, 10.6 and A.10.6 have been reviewed. Crane support structure is to be designed according to API Spec 2C or EN 13852-1 and additional provisions reported. The simplified fatigue method has been aligned with ANSI/API RP 2TOP[82];

— Table 9 adapted with modifications from NORSOK N-004:2022, Table F.1[32] and addition of some example figures for DC;

— former 12.1 to 12.3.5 have been deleted and moved to ISO 19902:2020, Clause 18.

— in 12.2 Welding requirements have been reviewed;

— in 12.5 provisions for dissimilar materials have been added, adapted from NORSOK N-004:2022, F.4.4;

— addition of clauses on reduction or removal of the structural integrity (12.5, Clause 14, A.12.5 and A.14) in accordance with ISO 19901-9 and ISO 19902;

— in Annex B, updated example of K_c calculations by utilization ratio for ISO 19902 and ANSI/AISC 360-22[12].

— removal of former Annex C. K_c is now reported as normative value in Table 4 for ANSI/AISC 360-22[12], CSA-S16:19[14] and EN 1993-1-1[13].

A list of all parts in the ISO 19901 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The International Standards on offshore structures prepared by TC 67 (i.e. ISO 19900, the ISO 19901 series, ISO 19902, ISO 19903, ISO 19904-1, ISO 19905-1, ISO 19905-3 and ISO 19906) constitute 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 International Standards on offshore structures prepared by TC 67 are 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 document has been prepared for those structural components of offshore platforms which are above the wave zone and are not part of the substructure or of the hull.

Historically, the design of structural components in topsides has been performed to national building standards for onshore structures, modified in accordance with experience within the offshore industry, or to relevant parts of classification society rules. While this document permits use of national building standards, 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 substructures 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 document.

Annex B provides an example of the use of national building standards for onshore structures in conjunction with this document.

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

Part 3: Topsides structure

1 Scope

This document provides requirements, guidance and information for the design and fabrication of topsides structure for offshore structures, including in-service, pre-service and post-service conditions.

The actions on topsides structure and the action effects in structural components are derived from this document, where necessary in combination with other International Standards in the ISO 19901 series (e.g. ISO 19901-1 for wind actions - see 7.6.2, ISO 19901-2 for seismic actions - see 7.7, ISO 19902 for Fatigue design - see 6.7).

This document is applicable to the following:

— topsides of fixed offshore structures;

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

— topsides of arctic offshore structures, excluding winterization (see ISO 19906).

If any part of the topsides structure forms part of the primary structure of the overall structural system which resists global platform actions, the requirements of this document are supplemented with applicable requirements in ISO 19902, ISO 19903, ISO 19904-1, ISO 19905-1, ISO 19905-3 and ISO 19906.

For those parts of floating offshore structures and mobile offshore units that are chosen to be governed by the rules of a recognized classification society, the corresponding class rules supersede the associated requirements of this document.

This document also addresses prevention, control and assessment of fire, explosions and other accidental events.

The fire and explosion provisions of this document can be applied to those parts of the hulls of floating structures and mobile offshore units that contain hydrocarbon processing, piping or storage.

NOTE Requirements for structural integrity management are presented in ISO 19901-9.

This document 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.

This document provides requirements for selecting and using a national building standard with a correspondence factor for determining the resistance of rolled and welded non-circular prismatic components and their connections.

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.

API Spec 2C, *Offshore Pedestal-mounted Cranes*

API Spec 2SC, *Manufacture of Structural Steel Castings for Primary Offshore Applications*

API Spec 2SF, *Manufacturer of Structural Steel Forgings for Primary Offshore Applications, 1 edition, August 2013, reaffirmed 2020*

ASTM F2329/F2329M, *Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners*

ASTM F3125/F3125M, *Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 Mpa and 1 040 Mpa Minimum Tensile Strength*

EEMUA PUB NO 176, *Specification for structural castings for use offshore*

EN 13852-1, *Cranes — Offshore cranes — Part 1: General-purpose offshore cranes*

EN 1993-1-8, *Eurocode 3: Design of steel structures – Part 1-8: Design of joints*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*

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 10684, *Fasteners — Hot dip galvanized coatings*

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

ISO 17776, *Petroleum and natural gas industries — Offshore production installations — Major accident hazard management during the design of new installations*

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 19901-9, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 9: Structural integrity management*

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

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

ISO 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Ship-shaped, semi-submersible, spar and shallow-draught cylindrical structures*

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

ISO 19905-3, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 3: Floating units*

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

ISO 20088-1, *Determination of the resistance to cryogenic spillage of insulation materials — Part 1: Liquid phase*

ISO 20088-2, *Determination of the resistance to cryogenic spill of insulation materials — Part 2: Vapour exposure*

ISO 20088-3, *Determination of the resistance to cryogenic spillage of insulation materials — Part 3: Jet release*

ISO 22899-1, *Determination of the resistance to jet fires of passive fire protection materials — Part 1: General requirements*

ISO 834-1, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

NORSOK M-122, *Cast structural steel, rev. 2, October 2012*

NORSOK M-123, *Forged structural steel, rev. 2, October 2012*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
active fire protection
equipment, systems, and methods which, following initiation, can be used to control, mitigate, and extinguish fires

[SOURCE: ISO 13702:2015, 3.1.3]

3.2
caisson
appurtenance used for abstracting water from the sea or as a drain

3.3
critical structure
structural components, forming parts of the topsides structure, that provide support to safety and environmental critical elements (SECE), loss of which can cause specific life-safety, environmental or business consequences

Note 1 to entry: Subclause 5.7 provides details and examples.

Note 2 to entry: Critical structure also includes structures which support safety and environmental critical elements (SECE) previously termed safety-critical elements (SCE), see ISO 19901-9:2019, 9.4 and A.9.4.

Note 3 to entry: SECE includes all relevant equipment and systems.

3.4
endurance period
time estimated for evacuation as defined by the Emergency Evacuation Rescue Analysis (EERA)

Note 1 to entry: The endurance period is specified in the basis of design.

3.5
major accident
MA
hazardous event that results in

— multiple fatalities or severe injuries; or

— extensive damage to structure, installation or plant; or

— large-scale impact on the environment (e.g. persistent and severe environmental damage that can lead to loss of commercial or recreational use, loss of natural resources over a wide area or severe environmental damage that will require extensive measures to restore beneficial uses of the environment)

Note 1 to entry: In this document, a major accident is the realization of a major accident hazard.

[SOURCE: ISO 17776:2016, 3.1.12, modified — Note 2 to entry deleted.]

3.6
passive fire protection
PFP
coating or cladding arrangement or free-standing system which, in the event of fire, provides thermal protection to restrict the rate at which heat is transmitted to the object or area being protected

[SOURCE: ISO 13702:2015, 3.1.36]

3.7
risk curve
probability of consequences exceeding a defined limit during a reference period

3.8
substructure
structure supporting the topsides

Note 1 to entry: The substructure can take many forms including fixed steel (see ISO 19902), concrete (see ISO 19903), floating (see ISO 19904-1 and ISO 19905-3), jack-up (see ISO 19905-1), or the various forms of arctic structures (see ISO 19906).

3.9
ideal hinge
pinned connection
idealisation by which no moments are transferred

Note 1 to entry: Plastic strain in an ideal hinge is typically a fraction of a percent.

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	environmental action
E_e	extreme quasi-static environmental action due to metocean and ice
E_o	environmental action due to metocean and ice for the operator defined operating conditions
F_d	design action
F_r	representative action
g	acceleration due to gravity
G	permanent action
I	explosion impulse
l	span or length
K_c	correspondence factor
p	instantaneous explosion overpressure
$p(t)$	variation of overpressure with time
P	probability
Q	operational action
R	resistance
R_d	design value of resistance
R_k	characteristic value of resistance, or value based on characteristic values of material properties
S_d	total design action effect
t	time from ignition of an explosion
t_d	duration of positive explosion pressure pulse
T	fundamental period of vibration of a component or structure
$T_{C,max}$	maximum allowable temperature in a component
δ	thickness of a structural component, plate, or finite element