
**Petroleum and natural gas
industries — Floating offshore
structures —**

**Part 1:
Ship-shaped, semi-submersible,
spar and shallow-draught cylindrical
structures**

*Industries du pétrole et du gaz naturel — Structures en mer
flottantes*

Partie 1: Unités monocoques, unités semi-submersibles et unités spars



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ISO 19904-1:2019

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Published in Switzerland

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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.

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document 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 19904-1:2006), which has been technically revised. The main changes compared to the previous edition are as follows:

- title has been modified by replacing 'monohulls' with 'ship-shaped' and adding 'shallow-draft cylindrical structures';
- list of normative references ([Clause 2](#)) has been expanded;
- some definitions have changed and some new terms and definitions ([Clause 3](#)) have been added;
- subclause on planning requirements ([5.3](#)) has been expanded by addressing inspection and maintenance philosophy ([5.3.5](#)), documentation ([5.3.6](#)), extreme weather preparedness ([5.3.7](#)), and disconnectible floating platforms ([5.3.8](#));
- subclause on use for project application ([5.4.2](#)) has been expanded with a paragraph regarding documentation for disconnectable floating platforms;
- new subclause on topsides arrangement and layout ([5.5.9](#)) has been added;
- subclause on air gap ([8.10](#)) has been renamed to air gap and wave crest assessment, and a new subclause addressing wave crest effects ([8.10.2](#)) has been added;
- subclause on material ([9.9](#)) has been expanded by addressing cement grout ([9.9.5](#)) and elastomeric materials ([9.9.6](#));
- subclause on corrosion protection of steel ([9.10](#)) has been rewritten substantially;
- subclause on fabrication and constructions ([9.11](#)) has been expanded by addressing fabrication details ([9.11.3](#)) and welding ([9.11.4](#));

- subclause on general aspects of fatigue analysis and design (10.1) has been expanded by adding a discussion on fatigue strength and actions;
- subclause on general aspects of ship-shaped structures (11.1) has been expanded;
- subclause on sloshing (11.2.3) has been expanded by addressing general configuration of tanks and resonance due to sloshing;
- subclause on green water (11.2.4) has been expanded;
- subclause on structural strength (11.3) has been expanded by elaborating on the evaluation of hull girder strength (11.3.1) and local strength and details (11.3.4);
- subclause on general design criteria for semi-submersibles (12.2) has been expanded;
- new clause addressing shallow-draft cylindrical structures (Clause 14) has been added;
- subclause on watertight and weathertight appliances (16.4) has been expanded;
- subclause on hull systems (17.2) has been expanded by addressing atmospheric tanks (17.2.5.2) and water displaced tanks (17.2.5.3), elaborating on inert gas systems (17.2.6) and addressing production vent/flare system (17.2.8) and electrical systems (17.2.9);
- subclause on import and export systems (17.3) has been expanded by elaborating on general aspects (17.3.1), alongside transfer (17.3.3.3.3) and tandem transfer (17.3.3.3.4) and addressing direct transfer (17.3.3.3.5);
- clause on stationkeeping systems (18) has been expanded by addressing disconnectable structures (18.4);
- subclause on structural integrity management system philosophies (19.2) has been expanded by elaborating on general aspects, including the addition of a figure (19.2.1);
- new clause addressing assessment of existing floating structures (Clause 20) has been added;
- additional information and guidance (Annex A) has been modified with additions and changes in line with modifications to the main text;
- the list of informative references (Bibliography) has been updated and expanded as needed.

A list of all parts in the ISO 19904 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, the ISO 19905 series and ISO 19906) constitute a common basis covering those aspects that address design requirements and assessments of all offshore structures used by the petroleum, petrochemical 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 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 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 documents.

This document was developed in response to the offshore industry's demand for a coherent and consistent definition of methodologies to design, analyse and assess floating offshore structures of the class described in [Clause 1](#). Further applicable requirements are found in national and international codes and standards, and RCS rules.

Some background to, and guidance on, the use of this document is provided in informative [Annex A](#). The clause numbering in [Annex A](#) is the same as in the normative text to facilitate cross-referencing.

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Petroleum and natural gas industries — Floating offshore structures —

Part 1:

Ship-shaped, semi-submersible, spar and shallow-draught cylindrical structures

1 Scope

This document provides requirements and guidance for the structural design and/or assessment of floating offshore platforms used by the petroleum and natural gas industries to support the following functions:

- production;
- storage and/or offloading;
- drilling and production;
- production, storage and offloading;
- drilling, production, storage and offloading.

NOTE 1 Floating offshore platforms are often referred to using a variety of abbreviations, e.g. FPS, FSU, FPSO (see [Clauses 3](#) and [4](#)), in accordance with their intended mission.

NOTE 2 In this document, the term “floating structure”, sometimes shortened to “structure”, is used as a generic term to indicate the structural systems of any member of the classes of platforms defined above.

NOTE 3 In some cases, floating platforms are designated as “early production platforms”. This term relates merely to an asset development strategy. For the purposes of this document, the term “production” includes “early production”.

This document is not applicable to the structural systems of mobile offshore units (MOUs). These include, among others, the following:

- floating structures intended primarily to perform drilling and/or well intervention operations (often referred to as MODUs), even when used for extended well test operations;
- floating structures used for offshore construction operations (e.g. crane barges or pipelay barges), for temporary or permanent offshore living quarters (floatels), or for transport of equipment or products (e.g. transportation barges, cargo barges), for which structures reference is made to relevant recognized classification society (RCS) rules.

This document is applicable to all possible life-cycle stages of the structures defined above, such as:

- design, construction and installation of new structures, including requirements for inspection, integrity management and future removal,
- structural integrity management covering inspection and assessment of structures in-service, and
- conversion of structures for different use (e.g. a tanker converted to a production platform) or re-use at different locations.

The following types of floating structure are explicitly considered within the context of this document:

- a) ship-shaped structures and barges;
- b) semi-submersibles;
- c) spars;
- d) shallow-draught cylindrical structures.

In addition to the structural types listed above, this document covers other floating platforms intended to perform the above functions, consisting of partially submerged buoyant hulls made up of any combination of plated and space frame components. These other structures can have a great range of variability in geometry and structural forms (e.g. tension leg platforms) and, therefore, can be only partly covered by the requirements of this document. In other cases, specific requirements stated in this document can be found not to apply to all or part of a structure under consideration.

NOTE 4 Requirements for topsides structures are presented in ISO 19901-3.

In the above cases, conformity with this document requires the design to be based upon its underpinning principles and to achieve a level of safety equivalent, or superior, to the level implicit in it.

NOTE 5 The speed of evolution of offshore technology often far exceeds the pace at which the industry achieves substantial agreement on innovation in structural concepts, structural shapes or forms, structural components and associated analysis and design practices, which are continuously refined and enhanced. On the other hand, International Standards can only capture explicit industry consensus, which requires maturation and acceptance of new ideas. Consequently, advanced structural concepts can, in some cases, only be partly covered by the requirements of this document.

This document is applicable to steel floating structures. The principles documented herein are, however, considered to be generally applicable to structures fabricated in materials other than steel.

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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.

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 19901-3, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 3: Topsides structure*

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

ISO 19901-7, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units*

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

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

INTERNATIONAL MARITIME ORGANIZATION. IMO MARPOL, International Convention for the Prevention of Pollution from Ships

International Maritime Organization. IMO International Code on Intact Stability

INTERNATIONAL MARITIME ORGANIZATION. IMO International Convention on Load Lines

International Maritime Organization. IMO Crude Oil Washing Systems

IMO MEPC/Circ. 406, Guidelines for application of MARPOL Annex 1 requirements to FPSOs and FSUs as modified by Resolutions MEPC.139(53) and MEPC.142(54)

3 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 <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

abnormal value

value of an environmental parameter used in accidental limit state verification in which a *structure* (3.59) is not expected to suffer significant loss of integrity

Note 1 to entry: Abnormal situations are used to provide robustness against events with an annual probability of exceedance typically between 10^{-3} and 10^{-4} to avoid, for example, excessive deformations.

Note 2 to entry: In ALS verification, all the partial factors are set to 1.0.

[SOURCE: ISO 19901-1:2015, 3.1, modified]

3.2

accidental event

event involving exceptional conditions of the *structure* (3.59) or its exposure

EXAMPLE Impact, fire, explosion, local failure or loss of intended differential pressure (e.g. buoyancy).

3.3

action

external load applied to the *structure* (3.59) (direct action) or an imposed deformation or acceleration (indirect action)

EXAMPLE An imposed deformation can be caused by fabrication tolerances, differential settlement, temperature change or moisture variation.

Note 1 to entry: An earthquake typically generates imposed accelerations.

[SOURCE: ISO 19900:2013, 3.3]

3.4

action combination

values of different *actions* (3.3) considered simultaneously in *verification* (3.61) of the *structure* (3.59)

3.5

action effect

effect of *actions* (3.3) on a *structure* (3.59) or on *structural components* (3.57)

EXAMPLE Internal force, moment, stress, strain, rigid body motion or elastic deformation.

[SOURCE: ISO 19900:2013, 3.4, modified — "on a structure or" has been added to the definition and examples have been added.]

Note 1 to entry: Can be used interchangeably with the word "response".