



SLOVENSKI STANDARD
SIST EN ISO 19904-1:2007
01-januar-2007

Ensemble de structures offshore flottantes - Partie 1: Structures mono-coques, unités semi-submersibles et unités spars (ISO 19904-1:2006)

Petroleum and natural gas industries - Floating offshore structures - Part 1: Monohulls, semi-submersibles and spars (ISO 19904-1:2006)

Erdöl- und Erdgasindustrie - Schwimmende Offshore-Anlagen - Teil 1: Produktions- und Lagerungsanlagen außer Tension-Leg-Anlagen (ISO 19904-1:2006)

(standards.iteh.ai)

Industries du pétrole et du gaz naturel - Structures en mer flottantes - Partie 1: Unités monocoques, unités semi-submersibles et unités spars (ISO 19904-1:2006)

<https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>

Ta slovenski standard je istoveten z: EN ISO 19904-1:2006

ICS:

75.180.10	Oprema za raziskovanje in odkopavanje	Exploratory and extraction equipment
-----------	---------------------------------------	--------------------------------------

SIST EN ISO 19904-1:2007

en,fr

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN ISO 19904-1:2007

<https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>

ICS 75.180.10

English Version

Petroleum and natural gas industries - Floating offshore structures - Part 1: Monohulls, semi-submersibles and spars (ISO 19904-1:2006)

Industries du pétrole et du gaz naturel - Structures en mer flottantes - Partie 1: Unités mono-coques, unités semi-submersibles et unités spars (ISO 19904-1:2006)

Erdöl- und Erdgasindustrie - Schwimmende Offshore-Anlagen - Teil 1: Produktions- und Lagerungsanlagen außer Tension-Leg-Anlagen (ISO 19904-1:2006)

This European Standard was approved by CEN on 22 September 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, 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.

<https://standards.iteh.ai/catalog/standards/sist/edee1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Foreword

This document (EN ISO 19904-1:2006) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries", 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 May 2007, and conflicting national standards shall be withdrawn at the latest by May 2007.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, 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.

Endorsement notice

The text of ISO 19904-1:2006 has been approved by CEN as EN ISO 19904-1:2006 without any modifications.

(standards.iteh.ai)

[SIST EN ISO 19904-1:2007](https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>

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

**Part 1:
Monohulls, semi-submersibles and spars**

*Industries du pétrole et du gaz naturel — Structures en mer flottantes —
Partie 1: Unités monocoques, unités semi-submersibles et unités spars*

(standards.iteh.ai)

[SIST EN ISO 19904-1:2007](https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN ISO 19904-1:2007](https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>

© ISO 2006

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	vi
Introduction	viii
1 Scope	1
2 Normative references	2
3 Terms and definitions	3
4 Symbols and abbreviated terms	9
4.1 Symbols	9
4.2 Abbreviated terms	10
5 Overall considerations	12
5.1 Functional requirements	12
5.2 Safety requirements	12
5.3 Planning requirements	13
5.4 Rules and regulations	14
5.5 General requirements	14
5.6 Independent verification	18
5.7 Analytical tools	18
5.8 In-service inspection and maintenance	18
5.9 Assessment of existing floating structures	18
5.10 Reuse of existing floating structures	19
6 Basic design requirements	19
6.1 General	19
6.2 Exposure levels	19
6.3 Limit states	22
6.4 Design situations	23
7 Actions and action effects	25
7.1 General	25
7.2 Permanent actions (<i>G</i>)	25
7.3 Variable actions (<i>Q</i>)	25
7.4 Accidental actions (<i>A</i>)	26
7.5 Environmental actions (<i>E</i>)	27
7.6 Other actions	35
7.7 Repetitive actions	35
7.8 Action combinations	36
8 Global analysis	36
8.1 General	36
8.2 Static and mean response analyses	36
8.3 Global dynamic behaviour	37
8.4 Frequency domain analysis	39
8.5 Time domain analysis	39
8.6 Uncoupled analysis	40
8.7 Coupled analysis	40
8.8 Resonant excitation and response	40
8.9 Platform offset	40
8.10 Air gap	40
8.11 Platform motions and accelerations	41
8.12 Model tests	41
8.13 Design situations for structural analysis	42

9	Structural considerations.....	42
9.1	General.....	42
9.2	Representative values of actions.....	43
9.3	Design scantlings.....	44
9.4	Modelling.....	45
9.5	Structural analysis.....	47
9.6	Structural strength.....	49
9.7	Design checks.....	50
9.8	Special design issues.....	54
9.9	Material.....	55
9.10	Corrosion protection of steel.....	57
9.11	Fabrication and construction.....	57
9.12	Marine operations.....	58
9.13	Topsides/hull interface.....	58
10	Fatigue analysis and design.....	59
10.1	General.....	59
10.2	Fatigue damage design safety factors.....	60
10.3	Outline of approach.....	61
10.4	Environmental data.....	62
10.5	Structural modelling.....	62
10.6	Hydrostatic analyses.....	62
10.7	Response amplitude operators and combinations of actions.....	62
10.8	Stresses and SCFs.....	63
10.9	Stress range counting and distribution.....	63
10.10	Fatigue resistance.....	63
10.11	Damage accumulation.....	63
10.12	Fracture mechanics methods.....	64
10.13	Fatigue-sensitive components and connections.....	64
11	Monohulls.....	65
11.1	General.....	65
11.2	General design criteria.....	65
11.3	Structural strength.....	66
12	Semi-submersibles.....	69
12.1	General.....	69
12.2	General design criteria.....	69
12.3	Structural strength.....	70
13	Spars.....	70
13.1	General.....	70
13.2	General design requirements.....	71
13.3	Structural strength.....	72
14	Conversion and reuse.....	72
14.1	General.....	72
14.2	Minimum design, construction and maintenance standards.....	73
14.3	Pre-conversion structural survey.....	73
14.4	Effects of prior service.....	73
14.5	Corrosion protection and material suitability.....	75
14.6	Inspection and maintenance.....	75
15	Hydrostatic stability and compartmentation.....	75
15.1	General.....	75
15.2	Inclining test.....	76
15.3	Compartmentation.....	76
15.4	Watertight and weathertight appliances.....	76
15.5	Special requirements for monohulls.....	77
16	Mechanical systems.....	77
16.1	General.....	77
16.2	Hull systems.....	77

STANDARD PREVIEW
<http://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>
 (standards.iteh.ai)

16.3	Import and export systems	85
16.4	Fire protection systems	87
17	Stationkeeping systems	88
17.1	General	88
17.2	Mooring equipment.....	89
17.3	Turret.....	90
18	In-service inspection, monitoring and maintenance.....	92
18.1	General.....	92
18.2	Structural integrity management system philosophies.....	92
18.3	Planning considerations	95
18.4	Implementation issues	96
18.5	Minimum requirements	99
Annex A	(informative) Additional information and guidance	104
A.1	Scope	104
A.2	Normative references	106
A.3	Terms and definitions.....	106
A.4	Symbols and abbreviated terms	106
A.5	Overall considerations	107
A.6	Basic design requirements.....	111
A.7	Actions and action effects	113
A.8	Global analysis.....	125
A.9	Structural considerations.....	128
A.10	Fatigue analysis and design.....	134
A.11	Monohulls	137
A.12	Semi-submersibles	141
A.13	Spars	142
A.14	Conversion and reuse	143
A.15	Hydrostatic stability and compartmentation	144
A.16	Mechanical systems	144
A.17	Stationkeeping systems.....	154
A.18	In-service inspection, monitoring and maintenance.....	155
	Bibliography	172

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 19904-1 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*.

ISO 19904 consists of the following parts, under the general title *Petroleum and natural gas industries — Floating offshore structures*:

— *Part 1: Monohulls, semi-submersibles and spars*

Tension leg platforms is to form the subject of a future *Part 2*.

ISO 19904 is one of a series of 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*¹⁾
- ISO 19903, *Petroleum and natural gas industries — Fixed concrete offshore structures*¹⁾
- ISO 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars*
- ISO 19904-2, *Petroleum and natural gas industries — Floating offshore structures — Part 2: Tension leg platforms*²⁾
- ISO 19905-1, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 1: Jack-ups*²⁾

1) To be published.

2) Under preparation.

- ISO/TR 19905-2, *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units — Part 2: Jack-ups commentary*³⁾
- ISO 19906, *Petroleum and natural gas industries — Arctic offshore structures*³⁾

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN ISO 19904-1:2007](https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>

³⁾ Under preparation.

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, 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 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.

International Standard ISO 19904 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. In particular, this part of ISO 19904 addresses monohulls, semi-submersibles and spars.

Some background to, and guidance on, the use of this part of ISO 19904 is provided in informative Annex A. The clause numbering in Annex A is the same as in the normative text to facilitate cross-referencing.

<https://standards.iteh.ai/catalog/standards/sist/edec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>

Petroleum and natural gas industries — Floating offshore structures —

Part 1: Monohulls, semi-submersibles and spars

1 Scope

This part of ISO 19904 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, etc. (see Clauses 3 and 4), in accordance with their intended mission.

NOTE 2 In this part of ISO 19904, 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 International Standard, the term “production” includes “early production”.

Its requirements do not apply to the structural systems of mobile offshore units (MOUs). These include, among others:

- 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.

Its requirements are 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 reuse at different locations.

The following types of floating structure are explicitly considered within the context of this part of ISO 19904:

- a) monohulls (ship-shaped structures and barges);
- b) semi-submersibles;
- c) spars.

In addition to the structural types listed above, this part of ISO 19904 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 and used in conjunction with the stationkeeping systems covered in ISO 19901-7. These other structures can have a great range of variability in geometry and structural forms and, therefore, can be only partly covered by the requirements of this part of ISO 19904. In other cases, specific requirements stated in this part of ISO 19904 can be found not to apply to all or part of a structure under design.

In all the above cases, conformity with this part of ISO 19904 will require that the design is based upon its underpinning principles and achieves a level of safety equivalent, or superior, to the level implicit in it.

NOTE 4 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 provisions of this part of ISO 19904.

This part of ISO 19904 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.

2 Normative references

[SIST EN ISO 19904-1:2007](https://standards.iteh.ai/catalog/standards/sist/edec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

[https://standards.iteh.ai/catalog/standards/sist/edec1c5-cd21-41be-b155-](https://standards.iteh.ai/catalog/standards/sist/edec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

[5d1d539e71dd/sist-en-iso-19904-1-2007](https://standards.iteh.ai/catalog/standards/sist/edec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

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.

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

ISO 19900:2002, *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 19901-7:2005, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units*

ISO 19902:—⁴⁾, *Petroleum and natural gas industries — Fixed steel offshore structures*

⁴⁾ To be published.

3 Terms and definitions

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

3.1

abnormal

condition that exceeds conventionally specified design conditions and which is used to mitigate against very remote events

3.2

accidental design situation

design situation involving exceptional conditions of the structure 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 (direct action) or an imposed deformation or acceleration (indirect action)

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

NOTE An earthquake typically generates imposed accelerations.

[ISO 19900:2002]

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.4

action combination

design values of different actions considered simultaneously in design checks of the structure for a specific limit state

[SIST EN ISO 19904-1:2007](https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007)

<https://standards.iteh.ai/catalog/standards/sist/edeec1c5-cd21-41be-b155-5d1d539e71dd/sist-en-iso-19904-1-2007>

3.5

action effect

effect of actions on structural components

EXAMPLE Internal forces, moments, stresses, strains, rigid body motions or elastic deformations.

[ISO 19900:2002]

3.6

air gap

clearance between the highest water surface that occurs during the extreme environmental conditions and the lowest exposed part not designed to withstand wave impingement

[ISO 19900:2002]

3.7

basic variable

one of a specified set of variables representing physical quantities which characterize actions, environmental influences, geometrical quantities, or material properties, including soil properties

[ISO 19900:2002]

3.8

characteristic value

value of a basic variable, an action or a strength model having a prescribed probability of not being violated by unfavorable values

NOTE 1 In the case of actions and related properties, the characteristic value normally relates to a reference period.

NOTE 2 Adapted from ISO 19900:2002, definition 2.7.