

Petroleum and natural gas industries - Specific requirements for offshore structures - Part 4: Geotechnical and foundation design considerations (ISO 19901-4:2016)

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN ISO 19901-4:2016 sisaldab Euroopa standardi EN ISO 19901-4:2016 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 19901-4:2016 consists of the English text of the European standard EN ISO 19901-4:2016.
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English Version

**Petroleum and natural gas industries - Specific
requirements for offshore structures - Part 4: Geotechnical
and foundation design considerations (ISO 19901-4:2016)**

Industries du pétrole et du gaz naturel - Exigences
spécifiques relatives aux structures en mer - Partie 4:
Bases conceptuelles des fondations (ISO 19901-
4:2016)

Erdöl- und Erdgasindustrie - Besondere
Anforderungen an Offshore-Bauwerke - Teil 4:
Geotechnische und Fundament-Auslegungsmerkmale
(ISO 19901-4:2016)

This European Standard was approved by CEN on 2 July 2016.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

This document (EN ISO 19901-4:2016) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical 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 NEN

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of an identical text or by endorsement, at the latest by February 2017, and conflicting national standards shall be withdrawn at the latest by February 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 19901-4:2003.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 19901-4:2016 has been approved by CEN as EN ISO 19901-4:2016 without any modification.

Contents

Page

Foreword	v
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Symbols and abbreviated terms	4
4.1 General	4
4.2 Symbols for shallow foundations design	4
4.3 Symbols for pile foundations design	7
4.4 Symbols for soil-structure interaction for auxiliary subsea structures, risers and flowlines	10
4.5 Symbols for design of anchors for stationkeeping systems	11
4.6 Abbreviated terms	12
5 General requirements	13
5.1 General	13
5.2 Design cases and safety factors	14
5.3 Characteristic values of soil properties	14
5.4 Testing and instrumentation	15
6 Geotechnical data acquisition and identification of hazards	16
6.1 General	16
6.2 Shallow geophysical investigation	16
6.3 Geological modelling and identification of hazards	17
6.3.1 General	17
6.3.2 Earthquakes	17
6.3.3 Fault planes	17
6.3.4 Seafloor instability	17
6.3.5 Scour and sediment mobility	18
6.3.6 Shallow gas	18
6.3.7 Seabed subsidence	18
6.4 Carbonate soils	19
7 Design of shallow foundations	19
7.1 General	19
7.2 Principles	20
7.2.1 General principles	20
7.2.2 Sign conventions, nomenclature and action reference point	21
7.2.3 Action transfer	21
7.2.4 Idealization of foundation area and the effective area concept	21
7.3 Acceptance criteria and design considerations	22
7.3.1 Action and material factors	22
7.3.2 Use in design	22
7.3.3 Special cases	23
7.3.4 Additional design considerations	24
7.3.5 Alternative method of design based on yield surfaces	26
7.3.6 Selection of soil parameter values for design	27
7.4 Stability of shallow foundations	27
7.4.1 Assessment of bearing capacity	27
7.4.2 Assessment of sliding capacity	29
7.4.3 Assessment of torsional capacity	31
7.5 Serviceability (displacements and rotations)	31
7.5.1 General	31
7.5.2 Displacement under static loading	31
7.5.3 Displacement under dynamic and cyclic actions	34

7.5.4	Other contributors to foundation settlement	34
7.6	Other design considerations	34
7.6.1	Hydraulic stability	34
7.6.2	Installation, retrieval and removal	34
8	Pile foundation design	35
8.1	Pile capacity for axial compression	35
8.1.1	General	35
8.1.2	Axial pile capacity	36
8.1.3	Skin friction and end bearing in cohesive soils	37
8.1.4	Skin friction and end bearing in cohesionless soils	38
8.1.5	Skin friction and end bearing of grouted piles in rock	40
8.2	Pile capacity for axial tension	41
8.3	Axial pile performance	41
8.3.1	Static axial behaviour of piles	41
8.3.2	Cyclic axial behaviour of piles	41
8.4	Soil reaction for piles under axial compression	41
8.4.1	Axial shear transfer t - z curves	41
8.4.2	End bearing resistance–displacement, Q - z , curve	42
8.5	Soil reaction for piles under lateral actions	44
8.5.1	General	44
8.5.2	Lateral capacity for soft clay	45
8.5.3	Lateral soil resistance–displacement p - y curves for soft clay	45
8.5.4	Lateral capacity for stiff clay	45
8.5.5	Lateral soil resistance–displacement p - y curves for stiff clay	46
8.5.6	Lateral capacity for sand	47
8.5.7	Lateral soil resistance – displacement p - y curves for sand	48
8.6	Pile group behaviour	49
8.6.1	General	49
8.6.2	Axial behaviour	49
8.6.3	Lateral behaviour	50
9	Pile installation assessment	50
9.1	General	50
9.2	Drivability studies	51
9.3	Obtaining required pile penetration	51
9.4	Driven pile refusal	52
9.5	Pile refusal remedial measures	52
9.5.1	Review of hammer performance	52
9.5.2	Re-evaluation of design penetration	52
9.5.3	Modifications to piling procedures	52
9.6	Selection of pile hammer and stresses during driving	53
9.7	Use of hydraulic hammers	53
9.8	Drilled and grouted piles	54
9.9	Belled piles	55
9.10	Grouting pile-to-sleeve connections	55
9.11	Pile installation data	55
9.12	Installation of conductors and shallow well drilling	55
10	Soil-structure interaction for auxiliary subsea structures, risers and flowlines	56
11	Design of anchors for floating structures	56
Annex A (informative) Additional information and guidance		57
Bibliography		175

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 on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 67, *Materials, equipment and offshore structures for the petroleum, petrochemical and natural gas industries*, Subcommittee SC 7, *Offshore structures*.

This second edition cancels and replaces the first edition (ISO 19901-4:2003), 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*

The following part is under preparation:

- *Part 9: Structural integrity management*

ISO 19901 is one of a series of standards for offshore structures. The full series consists of the following International Standards which are relevant to offshore structures for the petroleum and natural gas industries:

- 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, *Petroleum and natural gas industries — Floating offshore structures*
- 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 19905-3, *Petroleum and natural gas industries — Site specific assessment of mobile offshore units — Part 3: Floating units (under preparation)*
- ISO 19906, *Petroleum and natural gas industries — Arctic offshore structures*

Other ISO standards can have implications for the geotechnical design of foundations for offshore structures, in particular:

- ISO 13623 (all parts), *Petroleum and natural gas industries — Pipeline transportation systems*
- ISO 13628 (all parts), *Petroleum and natural gas industries — Design and operation of subsea production systems*

Introduction

The International Standards for offshore structures, ISO 19900 to 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 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.

For foundations, some additional considerations apply. These include the time, frequency and rate at which actions are applied, the method of foundation installation, the properties of the surrounding soil, the overall behaviour of the seabed, effects from adjacent structures and the results of drilling into the seabed. All of these, and any other relevant information, need to be considered in relation to the overall reliability of the foundation.

These International Standards are intended to provide wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. The design practice for the foundations of offshore structures has proved to be an innovative and evolving process over the years. This evolution is expected to continue and is encouraged. Therefore, circumstances can arise when the procedures described herein or in ISO 19900 to ISO 19906 (or elsewhere) are insufficient on their own to ensure that a safe and economical foundation design is achieved.

Seabed soils vary. Experience gained at one location is not necessarily applicable at another, and extra caution is necessary when dealing with unconventional soils or unfamiliar foundation concepts. Sound engineering judgment is therefore necessary in the use of this part of ISO 19901.

For an offshore structure, the action effects at the interface between the structure's subsystem and the foundation's subsystem(s) are internal forces, moments and deformations. When addressing the foundation's subsystem(s) in isolation, these internal forces, moments and deformations can be considered as actions on the foundation's subsystem(s) and this approach is followed in this part of ISO 19901.

Some background to and guidance on the use of this part of ISO 19901 is provided for information in [Annex A](#). Guidance on foundations in carbonate soils is provided for information in [A.6.4](#), but there is, as yet, insufficient knowledge and understanding of such soils to produce normative requirements.

In this part of ISO 19901, in accordance with the latest edition of the ISO/IEC Directives, Part 2, the following verbal forms are used:

- 'shall' and 'shall not' are used to indicate requirements strictly to be followed in order to comply with 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' and 'need not' are 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 4: Geotechnical and foundation design considerations

1 Scope

This part of ISO 19901 contains provisions for those aspects of geoscience and foundation engineering that are applicable to a broad range of offshore structures, rather than to a particular structure type. Such aspects are:

- site and soil characterization;
- identification of hazards;
- design and installation of shallow foundations supported by the seabed;
- design and installation of pile foundations;
- soil-structure interaction for auxiliary structures, e.g. subsea production systems, risers and flowlines (guidance given in [A.10](#));
- design of anchors for the stationkeeping systems of floating structures (guidance given in [A.11](#)).

Particular requirements for marine soil investigations are detailed in ISO 19901-8.

Aspects of soil mechanics and foundation engineering that apply equally to offshore and onshore structures are not addressed. The user of this part of ISO 19901 is expected to be familiar with such aspects.

ISO 19901-4 outlines methods developed primarily for the design of shallow foundations with an embedded length (L) to diameter (D) ratio $L/D < 1$ ([Clause 7](#)) and relatively long and flexible pile foundations with $L/D > 10$ ([Clause 8](#)). This part of ISO 19901 does not apply to intermediate foundations with $1 < L/D < 10$. Such intermediate foundations, often known as 'caisson foundations', comprise either shallow foundations with skirts penetrating deeper into the seabed than the width of the foundation, or shorter, more rigid and larger diameter piles than those traditionally used for founding offshore structures. The design of such foundations can require specific analysis methods; it is important that any extrapolation from the design methods described in this part of ISO 19901 to intermediate foundations be treated with care and assessed by a geotechnical specialist.

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 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*