INTERNATIONAL STANDARD

ISO 19906

First edition
2010-12-15

Petroleum and natural gas industries — Arctic offshore structures

Industries du pétrole et du gaz naturel — Structures arctiques en mer

Reference number
ISO 19906:2010(E)

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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.

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 19906 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 19906 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*[1)]

— 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 (all parts), *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units*[2)]

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

1) ISO 19901-3, *Topsides structure,* to be published.

2) All parts are under preparation.

Introduction

The series of International Standards ISO 19900 to ISO 19906 addresses design requirements and assessments for 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, regardless of 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 the various types of offshore structure is intended to provide wide latitude in the choice of structural configurations, materials and techniques without hindering innovation. Sound engineering judgment is, therefore, necessary in the use of these International Standards.

This International Standard was developed in response to the offshore industry's demand for a coherent and consistent definition of methodologies to design, analyse and assess arctic and cold region offshore structures of the class described in Clause 1.

Structures capable of resisting ice have been in use in temperate regions for well over a century. These include bridge piers and navigation aids in ice-covered rivers and estuaries. In fact, bridge codes in cold countries have included methods for ice loads dating back many decades. In more severe arctic and cold regions, ice resistant structures are more recent. But much experience has been gained commencing in the 1960s, and this knowledge is incorporated into this International Standard. Where uncertainties still exist, conservative approaches and methods have been recommended.

This International Standard also addresses issues such as topsides winterization, and escape, evacuation and rescue that go beyond what is strictly necessary for the design, construction, transportation, installation and decommissioning of the structure. These issues are essential for offshore operations in arctic and cold region conditions and they are not covered in other International Standards. When future editions of ISO 19906 and other International Standards are prepared, efforts will be made to avoid duplication of scope.

Annex A provides background to and guidance on the use of this International Standard and it is intended that it be read in conjunction with the main body of this International Standard. The clause numbering in Annex A is the same as in the normative text to facilitate cross-referencing.

Annex B provides regional information on the physical environment of specific offshore areas in arctic and cold regions.

To meet certain needs of industry for linking software to specific elements in this International Standard, a special numbering system has been permitted for figures, tables, equations and bibliographic references.

Petroleum and natural gas industries — Arctic offshore structures

1 Scope

This International Standard specifies requirements and provides recommendations and guidance for the design, construction, transportation, installation and removal of offshore structures, related to the activities of the petroleum and natural gas industries in arctic and cold regions. Reference to arctic and cold regions in this International Standard is deemed to include both the Arctic and other cold regions that are subject to similar sea ice, iceberg and icing conditions. The objective of this International Standard is to ensure that offshore structures in arctic and cold regions provide an appropriate level of reliability with respect to personnel safety, environmental protection and asset value to the owner, to the industry and to society in general.

This International Standard does not contain requirements for the operation, maintenance, service-life inspection or repair of arctic and cold region offshore structures, except where the design strategy imposes specific requirements (e.g. 17.2.2).

While this International Standard does not apply specifically to mobile offshore drilling units (see ISO 19905-1), the procedures relating to ice actions and ice management contained herein are applicable to the assessment of such units.

This International Standard does not apply to mechanical, process and electrical equipment or any specialized process equipment associated with arctic and cold region offshore operations except in so far as it is necessary for the structure to sustain safely the actions imposed by the installation, housing and operation of such equipment.

2 Normative references

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

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

3) To be published.

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 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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19900, ISO 19901-1, ISO 19901-2 and ISO 19901-4 and the following apply.

3.1
abrasion
effect of ice grinding against the surface of a structure removing paint, surface protrusions and coatings, oxidized material, or concrete particles and aggregate

3.2
accidental situation
exceptional condition of use or exposure for the structure

NOTE Exceptional conditions include fire, explosion, impact or local failure.

3.3
action
external load applied to the structure (direct action) or an imposed deformation or acceleration (indirect action)

3.4
action combination
design values of the different actions considered simultaneously in the verification of a specific limit state

3.5
action effect
effect of actions on the structure or its components

3.6
adfreeze
freezing of ice to the surface of a structure

3.7
alert
prescribed reaction to specific ice conditions, which in time can become hazardous to the operation of a structure

NOTE Several different levels associated with the time proximity of the hazard are normally recognized.

3.8
aspect ratio
ratio of structure diameter or width to ice thickness

3.9
broken ice
loose ice consisting of small floes, broken up as a result of natural processes, or active or passive intervention

3.10
characteristic value
value assigned to a basic variable associated with a prescribed probability of being exceeded by unfavourable values during some reference period

NOTE For actions, the characteristic value is the main representative value. In some design situations, a variable can have two characteristic values, an upper and a lower value.

3.11
companion environmental action
environmental action applied simultaneously with the principal environmental action

3.12
consequence category
classification system for identifying the environmental, economic and indirect personnel safety consequences of failure of a platform

NOTE For offshore structures, three consequence categories are defined; see 7.1.3:

— C1: high consequences;

— C2: medium consequences;

— C3: low consequences.

3.13
consolidation
process of freezing of pore water in voids within ice rubble, between floes, or between soil particles

NOTE For soils, this involves drainage of pore fluid as a result of overburden pressures.

3.14
consolidated layer
portion of an ice ridge keel, rubble pile, rubble field or stamukha below the waterline formed by the ice consolidation process

3.15
design action
action combination resulting from factored representative actions associated with an AL or EL event

3.16
design resistance
resistance calculated from factored characteristic material properties or from factored resistance based on unfactored characteristic material properties

3.17
design service life
assumed period for which a structure or a structural component will be used for its intended purpose with anticipated maintenance but without substantial repair being necessary

3.18
design value
value derived from the representative value for use in the design verification procedure

3.19
disconnection
planned separation of the risers (and mooring, if applicable) from a floating structure

3.20
ductility
ability of a material to deform and absorb energy beyond its elastic limit or ability of a component to sustain load beyond yield

NOTE See also **system ductility** (3.79).

3.21
dynamic action
action that induces acceleration of a structure or a structural component of a magnitude sufficient to require specific consideration

3.22
dynamic positioning
technique of automatically maintaining the position of a floating vessel within a specified tolerance by controlling onboard thrusters to counter the wind, wave, current and ice actions

3.23
emergency disconnection
planned separation of the risers (and mooring, if applicable) from a floating structure, without depressurization of the risers

3.24
escape
act of personnel moving away from a hazardous event to a place on the installation where its effects are reduced or removed

3.25
evacuation
planned precautionary and emergency method of moving personnel from the installation (muster station or TR) to a safe distance beyond the immediate or potential hazard zone

3.26
exposure level
classification system used to define the requirements for a structure based on consideration of life-safety and of environmental and economic consequences of failure

For offshore structures, three exposure-level categories are defined; see 7.1.4:

— L1: highest exposure level;

— L2: intermediate exposure level;

— L3: lowest exposure level.

3.27
first-year ice
FY
sea ice formed during the current or prior winter that has not survived one summer melt season

3.28
floe
relatively flat piece of sea ice greater than 20 m across

NOTE There are typically sub-categories: small (20 m to 100 m across), medium (100 m to 500 m across), big (500 m to 2 000 m across), vast (2 km to 10 km across) and giant (greater than 10 km across).

3.29
flowline
piping on the sea floor linking one or more subsea wells to the production system

NOTE Functions may include production, injection, subsea systems control and export of produced fluids.

3.30 Freeboard

3.30.1
freeboard
vertical distance from the water surface to the top of the ice

3.30.2
freeboard
vertical distance from the mean water surface at a given draught to the deck level, measured at the lowest point where water can enter the structure or ship

3.31
freeze-thaw
possible degrading effect on concrete of repeated temperature changes causing frost cycles at the surface

3.32
glory hole
man-made areal excavation in the seabed used to protect a subsea installation or its components from ice damage

3.33
ice alert
alert related to encroaching hazardous ice features or conditions, generally requiring specific changes to production operations

3.34
iceberg
glacial or shelf ice (greater than 5 m freeboard) that has broken (calved) away from its source

NOTE Icebergs can be freely floating or grounded, and are sometimes defined as tabular, dome, pinnacle, wedge or block shaped.

3.35
ice detection
discrimination of ice features or associated conditions from the surrounding environment

3.36
ice gouge
ice scour
incision made by an ice feature in the seabed, having the form of either an areal incision (i.e. pit) or a linear incision (i.e. furrow)

3.37
ice island
large tabular shaped ice feature that has calved from an ice shelf or glacier

3.38
ice management
active processes used to alter the ice environment with the intent of reducing the frequency, severity or uncertainty of ice actions

3.39
ice management plan
detailed plan outlining the objectives, active procedures involved and individual responsibilities for the implementation of the ice management system

3.40
ice management system
ice management, and associated ice detection and threat evaluation tools used for its implementation

3.41
ice ridge
linear feature formed of ice blocks created by the relative motion between ice sheets

NOTE A pressure ice ridge is formed when ice sheets are pushed together and a shear ice ridge is formed when ice sheets slide along a common boundary.

3.42
ice scenario
combination of circumstances involving the presence of ice, resulting in actions or action combinations on a structure

3.43
infill
material deposited in an ice gouge, excavation or trench through natural processes

3.44
landfast ice
fast ice
ice that remains attached to a shoreline, island or grounded ice feature

3.45
level ice
sheet ice
region of ice with relatively uniform thickness

3.46
life-safety category
classification system for identifying the applicable level of life-safety for a platform

NOTE For offshore structures, three life-safety categories are defined; see 7.1.2:

— S1: manned non-evacuated;

— S2: manned evacuated;

— S3: unmanned.

3.47
local failure
localized damage to the structure with the potential for escalating to partial or complete failure

3.48
lowest anticipated service temperature
LAST
minimum hourly average extreme-level (EL) air temperature

NOTE The EL temperature is described in 7.2.2.6.

3.49
mat
man-made weighted sheet used for the stabilization of soils or subsea components

3.50
material factor
partial safety factor applied to the characteristic value of a material property

3.51
multi-year ice
MYI
MY
sea ice that has survived at least one summer melt season

NOTE When the term “multi-year ice” is used in conjunction with the term “second-year ice”, the former should be interpreted as ice that has survived at least two summer melt seasons.

3.52
offshore installation manager
OIM
person responsible for the installation and all operations on and around a structure

3.53
owner
representative of the company or companies that own, hold a licence for or hold a lease for the development

3.54
pack ice
sea ice consisting of discrete floes that is not landfast

3.55
pack ice driving actions
actions exerted by the surrounding sea ice on the structure or to an ice feature in contact with it

3.56
permafrost
ground (soil or rock) remaining at or below 0 °C for at least two consecutive years

3.57
place of safety
area outside the hazard zone in which personnel safety is no longer at risk due to the installation hazard

3.58
polynya
area of open water surrounded by sea ice, caused by persistent winds, currents or upwelling of warm water

3.59
rafted ice
ice feature formed from the superposition of two or more ice sheet layers