INTERNATIONAL STANDARD

# ISO 19905-1

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# Petroleum and natural gas industries — Site-specific assessment of mobile offshore units —

## Part 1: Jack-ups

*Industries du pétrole et du gaz naturel — Évaluation spécifique au site d'unités mobiles en mer —*

*Partie 1: Plates-formes auto-élévatrices*



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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 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).

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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information



The committee responsible for this document is 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 19905-1:2012), which has been technically revised.

ISO 19905 consists of the following parts, under the general title *Petroleum and natural gas industries — Site-specific assessment of mobile offshore units*:

— *Part 1: Jack-ups*

— *Part 2: Jack-ups commentary and detailed sample calculation* [Technical Report]

The following parts are under preparation:

— *Part 3: Floating units*

ISO 19905 is one of a series of International Standards for offshore structures. The full series comprises the following:

— 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 19904-1, *Petroleum and natural gas industries — Floating offshore structures — Part 1: Monohulls, semi-submersibles and spars*
- 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*
- ISO 19906, *Petroleum and natural gas industries — Arctic offshore structures*

# Introduction

The series of International Standards applicable to types of offshore structure, 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, 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 or assessment rules, safety elements, workmanship, quality control procedures and national requirements, all of which are mutually dependent. The modification of one aspect of design or assessment 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 offshore structural systems.

The series of International Standards applicable to types of offshore structure is intended to provide a 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 part of ISO 19905, which has been developed from the Society of Naval Architects and Marine Engineers (SNAME) Technical & Research Bulletin 5-5A (2002), states the general principles and basic requirements for the site-specific assessment of mobile jack-ups; it is intended to be used for assessment and not for design.



NOTE For the exposure level 1(L1) assessment and, where appropriate, the exposure level 2 (L2) assessment prior to evacuation being effected, this part of ISO 19905 requires the use of 50 year independent or 100 year joint probability metocean extremes, together with associated partial action factors. It is based on extensive benchmarking and best practice in the international community.



Site-specific assessment is normally carried out when an existing jack-up unit is to be installed at a specific site. The assessment is not intended to provide a full evaluation of the jack-up; it assumes that aspects not addressed herein have been addressed using other practices and standards at the design stage. In some instances, the original design of all or part of the structure could be in accordance with other standards in the ISO 19900 series, and in some cases, different practices or standards could have been applied.

The purpose of the site assessment is to demonstrate the adequacy of the jack-up and its foundations for the assessment situations and defined limit states, taking into account the consequences of failure. It is important that the results of a site-specific assessment be appropriately recorded and communicated to those persons required to know or act on the conclusions and recommendations. Alternative approaches to the site-specific assessment can be used, provided that they have been shown to give a level of structural reliability equivalent, or superior, to that implicit in this part of ISO 19905.

Annex A provides background to and guidance on the use of this part of ISO 19905. The clause numbering in Annex A is the same as in the normative text in order to facilitate cross-referencing. ISO/TR 19905-2 provides additional background to some clauses and a detailed sample 'go-by' calculation.

Annex B summarizes the partial factors. Supplementary information is presented in Annexes C to H.

To meet certain needs of industry for linking software to specific elements in this part of ISO 19905, a special numbering system has been permitted for figures, tables, formulae and bibliographic references.

In International Standards, the following verbal forms are used:

- "shall" and "shall not" are used to indicate requirements strictly to be followed in order to conform to 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" is 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 — Site-specific assessment of mobile offshore units — Part 1: Jack-ups

## 1 Scope

This part of ISO 19905 specifies requirements and guidance for the site-specific assessment of independent leg jack-up units for use in the petroleum and natural gas industries. It addresses:

a) manned non-evacuated, manned evacuated and unmanned jack-ups;

b) the installed phase at a specific site.

To ensure acceptable reliability, the provisions of this part of ISO 19905 form an integrated approach, which is used in its entirety for the site-specific assessment of a jack-up.

This part of ISO 19905 does not apply specifically to mobile offshore drilling units operating in regions subject to sea ice and icebergs. When assessing a jack-up operating in such areas, it is intended that the assessor supplement the provisions of this part of ISO 19905 with the provisions relating to ice actions and procedures for ice management contained in ISO 19906.



This part of ISO 19905 does not address design, transportation to and from site, or installation and removal from site. However, it is advisable that the assumptions used in the assessment be checked against the as-installed configuration.



To ensure that the design of the jack-up is sound and the structure is adequately maintained, this part of ISO 19905 is applicable only to independent leg jack-ups that either:

— hold a valid classification society certification from a recognized classification society (RCS) throughout the duration of the operation at the specific site subject to assessment; or

— have been verified by an independent competent body to be structurally fit for purpose for elevated situations and are subject to periodic inspection, both to the standards of an RCS.

NOTE 1 An RCS is an International Association of Classification Societies (IACS) member body, meeting the RCS definition given in 3.52.

Jack-ups that do not comply with this requirement are assessed according to the provisions of ISO 19902, supplemented by methodologies from this part of ISO 19905, where applicable.

NOTE 2 Future revisions of this part of ISO 19905 can be expanded to cover mat-supported jack-ups.

NOTE 3 Well conductors are a safety-critical element for jack-up operations. However, the integrity of well conductors is not part of the site-specific assessment process for jack-ups and is, therefore, not addressed in this part of ISO 19905. Annex A provides references to other publications addressing this topic.

NOTE 4 RCS rules and the IMO MODU code provide guidance for the design of jack-ups.

## 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 19901-1:2015, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating conditions*[1]

ISO 19901-2, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 2: Seismic design procedures and criteria*

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

## 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 19902, and the following apply.

NOTE Other terms and definitions relevant for the use of this part of ISO 19905 are found in ISO 19901-4 and ISO 19906.

**3.1**
**abnormal wave crest**
wave crest with probability of typically $10^{-3}$ to $10^{-4}$ per annum



**3.2**
**accidental situation**
exceptional situation of the structure



EXAMPLES Impact, fire, explosion, local failure, 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 1 to entry: An earthquake typically generates imposed accelerations.

[SOURCE: ISO 19900:2013, 3.3]

**3.4**
**assessment**
**site-specific assessment**
evaluation of the stability and structural integrity of a jack-up and, where applicable, its seabed restraint or support against the actions determined in accordance with the requirements of this part of ISO 19905

Note 1 to entry: An assessment can be limited to an evaluation of the components or members of the structure which, when removed or damaged, could cause failure of the whole structure, or a significant part of it.

[1] To be published. Replaces ISO 19901-1:2005.

 

**3.5**
**assessment situation**
jack-up configuration together with the environmental loading to be assessed

Note 1 to entry: For discussion on configuration, see 5.4.1.

Note 2 to entry: The assessment situations are checked against the acceptance criteria of this part of ISO 19905 to demonstrate that the relevant limit states are not exceeded.

**3.6**
**assessor**
entity performing the site-specific assessment

**3.7**
**backfill**
submerged weight of all of the soil that can be present on top of the spudcan

Note 1 to entry: Backfilling can occur during or after preloading. $W_{BF,o}$ refers to the submerged weight of the backfilling that occurs up to achieving the preload reaction. $W_{BF,A}$ refers to the submerged weight of the backfilling that occurs after the maximum preload has been applied and held. Both $W_{BF,o}$ and $W_{BF,A}$ can comprise backflow and/or infill. For discussion of the effects, see A.9.3.2.1.4.

**3.8**
**backflow**
soil that flows from beneath the spudcan around the sides and onto the top

Note 1 to entry: Backflow is part of *backfill* (3.7).



**3.9**
**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



[SOURCE: ISO 19900:2013, 3.7]

**3.10**
**boundary conditions**
actions and constraints on a (section of a) structural component (or a group of structural components) by other structural components or by the environment surrounding it

Note 1 to entry: Boundary conditions can be used to generate reaction forces at locations of restraint.

[SOURCE: ISO 19902:2007, 3.6]

**3.11**
**chart datum**
local datum used to fix water depths on a chart or tidal heights over an area

Note 1 to entry: Chart datum is usually an approximation to the level of the lowest astronomical tide.

[SOURCE: ISO 19901-1:2015, 3.2]

**3.12**
**consequence category**
classification system for identifying the environmental, economic and indirect personnel safety consequences of failure of a jack-up

Note 1 to entry:Categories for environmental and economic consequences are the following (see 5.3.3):

— C1: high environmental or economic consequence;
— C2: medium environmental or economic consequence;
— C3: low environmental or economic consequence.

[SOURCE: ISO 19902:2007, definition 3.11, modified]

**3.13**
**critical component**
structural component, failure of which could cause failure of the whole structure, or a significant part of it

Note 1 to entry: A critical component is part of the primary structure.

[SOURCE: ISO 19902:2007, 3.12]

**3.14**
**dynamic amplification factor**
**DAF**
ratio of a dynamic action effect to the corresponding static action effect

Note 1 to entry:For a jack-up, the dynamic action effect is best simulated by means of a concentrated or distributed inertial loadset. It is usually not appropriate to factor the static actions to simulate the effects of dynamic actions.

Note 2 to entry:The DAF excluding the mean values, $K_{DAF,\mathrm{SDOF}}$, can typically be obtained from a single degree-of-freedom (SDOF) calculation. In this case, it is defined as the ratio of the amplitude of a dynamic action effect to the amplitude of the corresponding static action effect for periodic excitation of a linear one degree-of-freedom model approximation of jack-up behaviour.



Note 3 to entry:The DAF including the mean values, $K_{DAF,RANDOM}$, can typically be obtained from a random wave calculation. In this case, it is defined as the ratio of the absolute value of a dynamic action effect to the absolute value of the corresponding static action effect, each including their mean value.



[SOURCE: ISO 19902:2007, definition 3.16, modified]

**3.15**
**deterministic analysis**
analysis in which the response is determined from a single combination of actions

**3.16**
**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

Note 1 to entry: An exposure level 1 (L1) jack-up is the most critical and exposure level 3 (L3) the least (see 5.5).

[SOURCE: ISO 19902:2007, definition 3.18, modified]

**3.17**
**extreme storm event**
extreme combination of wind, wave and current conditions to which the structure can be subjected during its deployment

Note 1 to entry: This is the metocean event used for ULS storm assessment (see 5.5.4 and 6.4).

**3.18**
**fixed load**
permanent parts of the jack-up, including hull, legs and spudcans, outfit, stationary and moveable-fixed equipment

Note 1 to entry: Moveable-fixed equipment normally includes the drilling package structure and associated permanently attached equipment.

**3.19**
**footprint**
sea floor depression which remains when a jack-up is removed from a site

**3.20**
**foundation**
soil and spudcan supporting a jack-up leg

**3.21**
**foundation fixity**
rotational restraint offered by the soil to the spudcan

**3.22**
**foundation stability**
ability of the foundation to provide sufficient support to remain stable when subjected to actions and incremental deformation

**3.23**
**global analysis**
determination of a consistent set of internal forces and moments, or stresses, in a structure that are in equilibrium with a defined set of actions on the entire structure

Note 1 to entry: When a global analysis is of a transient situation (e.g. earthquake), the inertial response is part of the equilibrium.



[SOURCE: ISO 19902:2007, definition 3.23, modified]



**3.24**
**independent leg jack-up**
jack-up unit with legs that can be raised and lowered independently

**3.25**
**inertial loadset**
set of actions that approximates the effect of the inertial forces

Note 1 to entry: An inertial loadset is used only in quasi-static analyses.

**3.26**
**infill**
soil above the plan area of the spudcan arising from sediment transport or hole sidewall collapse

Note 1 to entry: Infill is part of *backfill* (3.7).

**3.27**
**intrinsic wave frequency**
wave frequency of a periodic wave in a reference frame that is stationary with respect to the wave

Note 1 to entry: If there is no current, the reference frame is also stationary with respect to the sea floor. If there is a current, the reference frame moves with the same speed and in the same direction as the current.

**3.28**
**jack-up**
mobile offshore unit with a buoyant hull and one or more legs that can be moved up and down relative to the hull

Note 1 to entry:A jack-up reaches its operational mode by lowering the leg(s) to the seabed and then raising the hull to the required elevation. The majority of jack-ups have three or more legs, each of which can be moved independently and which are supported in the seabed by spudcans.

**3.29**
**jack-up owner**
representative of the companies owning or chartering the jack-up

**3.30**
**joint probability metocean data**
combinations of wind, wave and current that produce the action effect that can be expected to occur at a site, on average, once in the return period

**3.31**
**leaning instability**
instability of an independent leg jack-up that can arise when the rate of increase of actions on the foundation with jack-up inclination exceeds the rate of increase of foundation capacity with depth

**3.32**
**life-safety category**
classification system for identifying the applicable level of life-safety of personnel on a jack-up

Note 1 to entry:Categories for life-safety are the following (see 5.5.2):

— S1: manned non-evacuated;

— S2: manned evacuated;

— S3: unmanned.



[SOURCE: ISO 19902:2007, definition 3.27, modified]



**3.33**
**limit state**
state beyond which the structure no longer fulfils the relevant assessment criteria

[SOURCE: ISO 19900:2013, definition 3.28, modified]

**3.34**
**load case**
compatible load arrangements, sets of deformations and imperfections considered simultaneously with permanent actions and fixed variable actions for a particular design or verification

[SOURCE: ISO 19902:2007, 3.29]

**3.35**
**long-term operation**
operation of a jack-up on one particular site for more than the RCS special survey period

**3.36**
**lowest astronomical tide**
**LAT**
level of low tide when all harmonic components causing the tides are in phase

Note 1 to entry: The harmonic components are in phase approximately once every 19 years, but these conditions are approached several times each year.

[SOURCE: ISO 19901-1:2015, 3.17]

**3.37**
**mat-supported jack-up**
jack-up unit with the leg(s) rigidly connected by a foundation structure, such that the leg(s) are raised and lowered in unison

**3.38**
**mean high water spring tidal level**
arithmetic mean of all high water spring tidal sea levels measured over a long period, ideally 19 years

**3.39**
**mean low water spring tidal level**
arithmetic mean of all low water spring tidal sea levels measured over a long period, ideally 19 years

**3.40**
**mean sea level**
**MSL**
arithmetic mean of all sea levels measured at hourly intervals over a long period, ideally 19 years

Note 1 to entry: Seasonal changes in mean level can be expected in some regions and over many years the mean sea level can change.

[SOURCE: ISO 19901-1:2015, 3.20]

**3.41**
**mean zero-upcrossing period**
average intrinsic period of the zero-upcrossing waves in a sea state



Note 1 to entry:In practice, the mean zero-crossing period is often estimated from the zeroth and second moments of the wave spectrum as given by Formula (3.41-1):

$$T_z = T_2 = \sqrt{m_0(f) / m_2(f)} = 2\pi\sqrt{m_0(\omega) / m_2(\omega)} \quad (3.41\text{-}1)$$



where

$f$ is the frequency in cycles per second (hertz);

$m_0$ is the zeroth spectral moment and is equivalent to $\sigma^2$, the variance of the corresponding time series;

$m_2$ is the second spectral moment;

$T_2$ and $T_z$ are the average zero-crossing period of the water surface elevation, defined by the zeroth and second order spectral moments, ($T_2 = T_z$);

$\omega$ is the wave frequency in radians per second.

[SOURCE: ISO 19901-1:2015, definition 3.22, modified]

**3.42**
**most probable maximum extreme**
**MPME**
value of the maximum of a variable with the highest probability of occurring over a defined period of time

Note 1 to entry: A defined period of time can be, for example, *X* hours.

Note 2 to entry: The most probable maximum extreme is the value for which the probability density function of the maxima of the variable has its peak. It is also called the mode or modus of the statistical distribution.

[SOURCE: ISO 19901-1:2015, definition 3.24, modified]