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AMENDMENT 1
2010-08-15

Petroleum and natural gas industries — Design and operation of subsea production systems —

Part 1: General requirements and recommendations

AMENDMENT 1: Revised Clause 6

Industries du pétrole et du gaz naturel — Conception et exploitation des systèmes de production immergés —

Partie 1: Exigences générales et recommandations

AMENDEMENT 1: Révision de l'Article 6

Reference number
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Foreword

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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.

Amendment 1 to ISO 13628-1:2005 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 4, *Drilling and production equipment*. The changes are made mainly to Clause 6, which has been amended with a revised set of provisions that includes the general material design requirements and recommendations applicable to the complete subsea production system.

Introduction

This amendment is based on ISO 13628-1:2005, Clause 6; EEMUA Publication 194:2004; several NORSOK standards and many oil company and supplier material specifications.

This revised Clause 6 does not include detailed material requirements and recommendations, e.g. for manufacturing and testing. Such information is included in the product-specific parts of this part of ISO 13628. It is intended that there not be any duplication of this part of ISO 13628 with the other parts of ISO 13628, whereas there can be overlap of material requirements between product-specific parts. In case of conflict between this part of ISO 13628 and product specific parts, it is intended that the latter take precedence.

Petroleum and natural gas industries — Design and operation of subsea production systems —

Part 1:
General requirements and recommendations

AMENDMENT 1: Revised Clause 6

Page iii, Contents:

Replace the list of subclauses for Clause 6 with the following.

Page 1, Clause 2:

Add the following normative references:

ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings. Informative supplement to part 1: Representative photographic examples of the change of appearance imparted to steel when blast-cleaned with different abrasives*

ISO 8503 (all parts), *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates*

ISO 9588, *Metallic and other inorganic coatings — Post-coating treatments of iron or steel to reduce the risk of hydrogen embrittlement*

ISO 12944 (all parts), *Paints and varnishes — Corrosion protection of steel structures by protective paint systems*

ISO 15156 (all parts)[1)], *Petroleum and natural gas industries — Materials for use in H_2S-containing environments in oil and gas production*

1) ISO 15156 (all parts) was adopted by NACE as NACE MR0175/ISO 15156[41].

ISO 23936-1, *Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 1: Thermoplastics*

Page 3, 3.1:

Add the following terms and definitions after 3.1.12.

3.1.13
carbon steel
alloy of carbon and iron containing up to 2 % mass fraction carbon, up to 1,65 % mass fraction manganese and residual quantities of other elements, except those intentionally added in specific quantities for deoxidation (usually silicon and/or aluminium)

NOTE Carbon steels used in the petroleum industry usually contain less than 0,8 % mass fraction carbon.

[ISO 15156-1:2009, 3.3]

3.1.14
corrosion-resistant alloys
CRAs
alloys that are intended to be resistant to general and localized corrosion in oilfield environments that are corrosive to carbon steels

NOTE This definition is in accordance with ISO 15156-1 and is intended to include materials such as stainless steels with minimum 11,5 % mass fraction Cr, and nickel, cobalt and titanium base alloys. Other ISO documents can have other definitions.

3.1.15
low-alloy steel
steels containing a total alloying element content of less than 5 % mass fraction, but more than that for carbon steel

EXAMPLES AISI 4130, AISI 8630, ASTM A182 Grade F22[12] are examples of low alloy steels.

3.1.16
pitting resistance equivalent number
PREN
number developed to reflect and predict the pitting resistance of a stainless steel, based on the proportions of Cr, Mo, W and N in the chemical composition of the alloy

NOTE This number is based on observed resistance to pitting of CRAs in the presence of chlorides and oxygen, e.g. seawater, and is not directly indicative of the resistance to produced oil and gas environments.

$$F_{\mathrm{PREW}} = w_{\mathrm{Cr}} + 3{,}3(w_{\mathrm{Mo}} + 0{,}5w_{\mathrm{W}}) + 16w_{\mathrm{N}}$$

where

w_{Cr} is the mass fraction of chromium in the alloy, expressed as a percentage of the total composition;

w_{Mo} is the mass fraction of molybdenum in the alloy, expressed as a percentage of the total composition;

w_{W} is the mass fraction of tungsten in the alloy, expressed as a percentage of the total composition;

w_{N} is the mass fraction of nitrogen in the alloy, expressed as a percentage of the total composition.

3.1.17
sour service
service in an H_2S-containing (sour) fluid

NOTE In this part of ISO 13628, “sour service” refers to conditions where the H_2S content is such that restrictions as specified by ISO 15156 (all parts) apply.

3.1.18
sweet service
service in an H_2S-free (sweet) fluid

3.1.19
type 316
austenitic stainless steel alloys of type UNS S31600/S31603

3.1.20
type 6Mo
austenitic stainless steel alloys with PREN ⩾ 40 and Mo alloying ⩾ 6,0 % mass fraction, and nickel alloys with Mo content in the range 6 % mass fraction to 8 % mass fraction

EXAMPLES UNS S31254, N08367 and N08926 alloys.

3.1.21
type 22Cr duplex
ferritic/austenitic stainless steel alloys with 30 ⩽ PREN ⩽ 40 and Mo ⩽ 2,0 % mass fraction

EXAMPLES UNS S31803 and S32205 steels.

3.1.22
type 25Cr duplex
ferritic/austenitic stainless steel alloys with 40 ⩽ PREN ⩽ 45

EXAMPLES UNS S32750 and S32760 steels.

Page 3, 3.2:

Add the following abbreviated terms.

CRA corrosion-resistant alloy

HB Brinell hardness

HIC hydrogen induced cracking

HRC Rockwell hardness C scale

MIC microbiologically influenced corrosion

SWC stepwise cracking

Page 42:

Replace Clause 6 with the following.

6 Materials selection and corrosion protection

6.1 General principles

The materials selection process shall take into account all statutory and regulatory requirements. The project design criteria (e.g. design lifetime, inspection and maintenance philosophy, safety and environmental profiles, operational reliability and specific project requirements), should be considered.

Robust materials selection should be made to ensure operation reliability throughout the design life as the access for the purposes of maintenance and repair is limited and costly.

Materials selection should be based on an evaluation of corrosion and erosion as described within this clause. All internal and external media should be considered for the entire design life. Degradation mechanisms not specially covered in this part of ISO 13628 (e.g. fatigue, corrosion-fatigue, wear and galling), should be considered for relevant components and conditions.

Mechanical properties and usage limitations for different material grades shall comply with applicable design code requirements and guidelines given in 6.5. The material weldability should also be considered to avoid fabrication defects.

Cost and material availability have a significant influence on materials selection, and evaluations should be made to support the final selection.

NOTE If life-cycle cost evaluations are considered appropriate, then the methodology described in ISO 15663-2[43] can be helpful.

The end user shall specify how to implement the requirements and guidelines of Clause 6, and specify the design conditions. The scope of work in relevant contracts defines the responsible party for materials selection for the facility and/or equipment. Alternatives to the requirements in Clause 6 may be utilized when agreed between the user/purchaser and the supplier/manufacturer to suit specific field requirements. The intention is to facilitate and complement the material selection process rather than to replace individual engineering judgment and, where requirements are non-mandatory, to provide positive guidance for the selection of an optimal solution.

Similarly, the normative references in this part of ISO 13628 may be replaced by other recognized equivalent standards when agreed between the user/purchaser and the supplier/manufacturer.

Some common oilfield alloys are described in Table 1. This is, however, not meant to be an all-inclusive list and other alloys may be used.

6.2 Corrosivity evaluation

6.2.1 Design premise

The corrosivity evaluation shall consider all media exposed to the system components including the stages of transportation, storage, installation, testing and preservation. This typically includes

- seawater,
- produced fluids,
- drilling and completion fluids,
- hydraulic control fluid,
- chemicals such as inhibitors, well stimulation fluids, etc.

It is recommended that a compatibility matrix be developed showing to which media all components are exposed.

6.2.2 Internal corrosion

6.2.2.1 Hydrocarbon systems

A corrosion evaluation should be carried out to determine the general corrosivity of the internal fluids for the materials under consideration.

The corrosion evaluation should be based on a corrosion prediction model, or on relevant test or field corrosion data agreed with the end user. General and localized corrosion of carbon steel takes place over time, and the anticipated corrosion rate should be calculated for the operating conditions.

For wet hydrocarbon systems made of carbon and low-alloy steel or CRA, the corrosion mechanisms indicated in Table 1 should be evaluated. Details on mechanisms and parameters for consideration are given in ISO 21457[38].

Table 1 — Materials prone to corrosion mechanisms in hydrocarbon systems

Corrosion mechanism	Carbon and low-alloy steel	CRA
CO_2 and H_2S corrosion	Yes	Yes[a]
MIC	Yes	Yes
SSC/SCC caused by H_2S	Yes	Yes
HIC/SWC	Yes	No

[a] The presence of H_2S in combination with CO_2 can also lead to a localized attack of CRAs. The critical parameters are temperature, chloride content, pH and partial pressure of H_2S. There are no generally accepted limits and the limits vary with type of CRA.

In cases where the potential exists for significant sand production, a sand-erosion evaluation should be carried out. The evaluation should include sand-prediction studies in the reservoir to provide information regarding reservoir sanding potential, as well as an evaluation of possible erosion damage. Erosion-prediction models can be used to evaluate the likelihood of erosion damage; the model used should be specified by, or agreed with, the end user. Even where the predicted erosion rate is low, the potential for synergistic erosion-corrosion should be considered.

Chemicals for scale inhibition, scale removal and well stimulation may be corrosive and shall be considered in the corrosion evaluation.

6.2.2.2 Injection systems

Injection systems involve injection of water or gas into the sub-surface for disposal or stimulation purposes.

Water-injection systems include injection of de-aerated seawater, untreated seawater, chlorinated seawater, produced water, aquifer water and combinations and mixing of different waters.

NOTE Aquifer water comes from an underground layer of water-bearing, permeable rock from which ground water can be extracted. This water can be used for injection into oil-bearing reservoirs.

The most relevant corrosion mechanisms for injection of gas, produced water and aquifer water are as for the hydrocarbon carrying systems covered in 6.2.2.1 and the corrosion evaluation should be made accordingly. Details on mechanisms and parameters to consider are given in ISO 21457[38].

All components that can contact injection water should be resistant to well-treatment chemicals or well-stimulation chemicals if back-flow situations can occur.

6.2.3 External corrosion

External corrosion evaluations shall consider all of the following:

— atmospheric corrosion during transport;

— storage and construction;

— seawater corrosion during and after installation;

— availability of cathodic protection.