

DEP SPECIFICATION

**MATERIALS FOR USE IN H₂S-CONTAINING
ENVIRONMENTS IN OIL AND GAS PRODUCTION
(AMENDMENTS AND SUPPLEMENTS TO ISO 15156:2009)**

DEP 30.10.02.15-Gen.

February 2012

DESIGN AND ENGINEERING PRACTICE

DEM1



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TABLE OF CONTENTS

PART I	INTRODUCTION AND GENERAL	4
1.	INTRODUCTION	4
1.1	SCOPE.....	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	4
1.3	DEFINITIONS	5
1.4	CROSS-REFERENCES	5
1.5	SUMMARY OF MAIN CHANGES.....	5
1.6	COMMENTS ON THIS DEP	6
1.7	DUAL UNITS.....	6
PART II	GENERAL	7
PART III	AMENDMENTS AND SUPPLEMENTS TO ISO 15156-1	8
1	Scope	8
6	Evaluation and definition of service conditions to enable material selection	8
7	Selection of materials, resistant to SSC/SCC in the presence of sulphides, from existing lists and tables	8
PART IV	AMENDMENTS AND SUPPLEMENTS TO ISO 15156-2	9
1	Scope	9
7	Qualification and selection of carbon and low-alloy steels with resistance to SSC, SOHIC and SZC	9
8	Evaluation of carbon and low alloy steels for their resistance to HIC/SWC	9
Annex A	SSC-resistant carbon and low alloy steels (and requirements and recommendations for the use of cast irons)	9
Annex B	Qualification of carbon and low alloy steels for H₂S service by laboratory testing	10
PART V	AMENDMENTS AND SUPPLEMENTS TO ISO 15156-3	11
1	Scope	11
Annex A	Environmental cracking-resistant CRAs and other alloys (including Table A.1 – Guidance on the use of the materials selection tables)	11
Annex B	Qualification of CRAs for H₂S-service by laboratory testing	24
PART VI	REFERENCES	29

PART I INTRODUCTION AND GENERAL

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the selection and qualification of cracking resistant metallic materials for service in H₂S containing environments in oil and gas production.

This DEP addresses all mechanisms of cracking that can be caused by H₂S, including sulphide stress cracking, stress corrosion cracking, hydrogen induced cracking and stepwise cracking, stress-oriented hydrogen induced cracking, soft zone cracking and galvanically induced hydrogen stress cracking. Loss of material by general (mass loss) corrosion or localised corrosion is not addressed.

This DEP is based on ISO 15156:2009, which is divided into three parts: ISO 15156-1:2009, ISO 15156-2:2009 AND ISO 15156-3:2009.

- Part III gives amends, supplements and deletes various clauses of ISO 15156-1:2009.
- Part IV gives amends, supplements and deletes various clauses of ISO 15156-2:2009.
- Part V gives amends, supplements and deletes various clauses of ISO 15156-3:2009

Parts III, IV and V follow the clause numbering of ISO 15156:2009 for easy reference. All clauses of ISO 15156:2009 not modified by this DEP remain valid as written.

This DEP may be applied to gas handling, oil refining, chemical processing or gasification equipment at the discretion of the Principal. See also DEP 30.10.02.17-Gen.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards.

This DEP is a revision of the DEP of the same number dated February 2011; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier/Vendor** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The **Equipment user**, who may or may not be the **Principal** as defined above, is the party responsible, during operation, for the health and safety of the public and personnel and the environment.

The lower-case word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced in this DEP are listed in (Part VI).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2011.

ISO 15156-2-2009 Technical Circular 1 2010-06-14 and ISO 15156-3-2009 Technical Circular 1 2010-06-20, updating the ISO 15156:2009 standard, did not require amendments of this DEP with the exception of Part IV Table A.24 (see below).

The main, non-editorial changes are summarised in the table below.

Section	Paragraph	Change
Part III 6.1	2	SHALL [PS] changed to shall
Part IV B.5	1	SHALL [PS] changed to shall
Part IV Table A.6		Added caution not to apply this table for compressor pressure containing barriers
Part V Table A.13	Footnote 3	SHALL [PS] changed to shall
Part V A.6.2, Table A.19		Guidance for use of martensitic stainless steels downhole aligned with latest version of WS 39.01.20.12-Gen. (Casing and Tubing Design Manual, Volume 1: Mandatory Requirements)
Part V Table A.23		Error in H ₂ S and pH level corrected.
Part V Table A.24	NOTE and Footnote c)	Requirement for liquid quenching/ rapid cooling of duplex stainless steel updated following ISO 15156-3-2009 Technical Circular 1 2010-06-20
Part V Table A.31	Footnote f)	SHALL [PS] changed to shall
Part V Table A.31	Footnote e)	SHALL [PS] changed to shall

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of “DEPs on the Web”, available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

PART II GENERAL

Parts III, IV and V of this DEP are written as amendments and supplements to the following ISO Standards:

Part	ISO Standard
III	ISO 15156-1:2009
IV	ISO 15156-2:2009
V ⁽¹⁾	ISO 15156-3:2009

NOTE 1. This DEP is intended to be used in conjunction with DEP 39.01.10.12-Gen.; additional requirements were added to the tables in this part of the DEP to achieve consistency. It should be recognised that in the ISO standard and in this DEP, concentrations of sodium chloride in the corrosive phases are expressed as chloride concentrations [Cl⁻] in mg/l, whereas in DEP 39.01.10.12-Gen., they are expressed as sodium chloride concentrations [NaCl] in g/l. Thus, when conversions are made, the atomic weights of sodium and chloride shall be taken into consideration (Cl⁻ amounts to 61% by mass of NaCl).

Wherever reference is made to the above ISO Standards, it shall be understood to mean the ISO 15156-1:2009, ISO 15156-2:2009 and ISO 15156-3:2009 as amended/supplemented by this DEP.

For ease of reference, the clause numbering of the above-mentioned standards have been used throughout Parts III, IV and V of this DEP.

Clauses in the ISO 15156:2009 which are not mentioned in this DEP shall remain valid as written.

Information concerning the latest edition of the above ISO Standards and any associated Technical Corrigenda and Technical Circulars can be obtained at www.nace.org/mr0175links or www.iso.org/iso15156maintenance.

PART III AMENDMENTS AND SUPPLEMENTS TO ISO 15156-1

1 Scope

Replace the fifth paragraph as follows:

DEP 30.10.02.17-Gen. shall apply for refining and downstream processes and equipment. This DEP (30.10.02.15-Gen.) may be applied to refining and downstream equipment at the discretion of the Principal.

6 Evaluation and definition of service conditions to enable material selection

Add the following paragraphs to 6.1:

6.1 Definition of service conditions is the responsibility of the Materials and Corrosion Engineer and shall be based on information from the Process Engineer. For testing purposes, the chemical environment, in particular, the pH, partial pressure and salinity the Materials and Corrosion Engineer should request input from the Production Chemist.

The Materials and Corrosion Engineer shall consult with the Wells Engineer and/or vice versa to achieve consensus that all downhole casing and tubing materials and accessories are selected in compliance with WS 39.01.20.12-Gen (Casing and Tubing Design Manual, Vol.1, Mandatory Requirements)

7 Selection of materials, resistant to SSC/SCC in the presence of sulphides, from existing lists and tables

Replace the last sentence of the third paragraph with the following sentence:

The equipment user shall give consideration to specific testing of materials for applications where they consider the probability and potential consequences of failure make this justifiable (see Clause 1, **WARNING**).

PART IV AMENDMENTS AND SUPPLEMENTS TO ISO 15156-2

1 Scope

Replace the final paragraph as follows:

DEP 30.10.02.17-Gen. shall apply for refining and downstream processes and equipment. This DEP (30.10.02.15-Gen.) may be applied to refining and downstream equipment at the discretion of the Principal.

7 Qualification and selection of carbon and low-alloy steels with resistance to SSC, SOHIC and SZC

7.3 Hardness requirements

7.3.2 Parent metals

Remove NOTE and add the following paragraph:

Hardness measurements on parent metals SHALL [PS] include tests made on a specimen cut as a cross-section through the thickness of the test piece and prepared for metallographic examination. Vickers hardness readings shall be made using a 10 kgf load. Nine readings shall be taken in total, 3 each from the middle of the plate and 2 mm (0.08 in) below each outer edge. The distance between each measurement shall be approximately 5 mm (0.20 in). No hardness value should exceed 220 HV 10. The highest value measured shall be reported on the test certificate.

8 Evaluation of carbon and low alloy steels for their resistance to HIC/SWC

In the second paragraph replace the second sentence with:

The level of sulfur in the steel is of particular importance. The maximum acceptable levels for flat-rolled and seamless products shall be 0.003 % and 0.01 %, respectively.

Add the following paragraph after the second paragraph:

The evaluation of the risk associated with HIC damage to materials shall be documented.

Annex A SSC-resistant carbon and low alloy steels (and requirements and recommendations for the use of cast irons)

A.2 SSC-resistant carbon and low alloy steels and the use of cast irons

A.2.1 General requirements for carbon and low alloy steels

A.2.1.4 Welding

Delete the last sentence of paragraph four.

A.2.2 Application to product forms

A.2.2.2 Pipe, plate and fittings

Add the following remark:

As a best practice, it is recommended to perform ultrasonic testing on carbon steel plate materials according to ASTM A 578, Supplementary requirements S2.2, maximum defect area 100 mm² (0.15 in²) to avoid the presence of delaminations that may initiate HIC and increase inspection scope and cost.