
**Petroleum and natural gas industries —
Materials for use in H₂S-containing
environments in oil and gas production —**

Part 1:

**General principles for selection of cracking-
resistant materials**

iTeh STANDARD REVIEW
(standards.iteh.ai)

*Industries du pétrole et du gaz naturel — Matériaux pour utilisation en
présence de H₂S dans la production de pétrole et de gaz naturel —*

ISO 15156-1:2001

*Partie 1: Principes généraux pour le choix des matériaux résistant au
craquage*



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 15156-1:2001](https://standards.iteh.ai/catalog/standards/sist/ce8b1f6f-bf70-42b3-9ff-f800c3712b56/iso-15156-1-2001)

<https://standards.iteh.ai/catalog/standards/sist/ce8b1f6f-bf70-42b3-9ff-f800c3712b56/iso-15156-1-2001>

© ISO 2001

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

	Page
1 Scope	1
2 Normative references	2
3 Terms and definitions	3
4 Abbreviated terms	5
5 General principles	6
6 Evaluation and definition of service conditions to enable material selection	6
7 Selection of pre-qualified materials resistant to SSC/SCC in the presence of sulfides	7
8 Qualification of materials for H ₂ S service	7
9 Report of the method of selection or qualification	8
Bibliography.....	10

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 15156-1:2001](https://standards.iteh.ai/catalog/standards/sist/ce8b1f6f-bf70-42b3-9ff-f800c3712b56/iso-15156-1-2001)

<https://standards.iteh.ai/catalog/standards/sist/ce8b1f6f-bf70-42b3-9ff-f800c3712b56/iso-15156-1-2001>

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 3.

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 part of ISO 15156 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15156-1 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*.

ISO 15156 consists of the following parts, under the general title *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production*:

- Part 1: *General principles for selection of cracking-resistant materials*
- Part 2: *Cracking-resistant carbon and low alloy steels*
- Part 3: *Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

Introduction

The consequences of sudden failures of metallic components used in the oil and gas field, and associated with their exposure to H₂S-containing production fluids, led to the preparation of the first edition of NACE MR 0175. This standard was published in 1975 by the National Association of Corrosion Engineers, now known as NACE International.

The original and subsequent editions of NACE MR 0175 established limits of H₂S partial pressure above which precautions against sulfide stress cracking (SSC) were always considered necessary. They also provided guidance for the selection and specification of SSC-resistant materials when the H₂S thresholds were exceeded. In more recent editions, NACE MR 0175 has also provided application limits for some corrosion-resistant alloys, in terms of environmental composition and pH, temperature and H₂S partial pressures. NACE MR 0175 is complemented by NACE TM 0177 and NACE M 284.

In separate developments, the European Federation of Corrosion issued EFC Publication 16 in 1995 and EFC Publication 17 in 1996. These documents are generally complementary to those of NACE though they differ in scope and detail.

With the cooperation of NACE and EFC, ISO/TC 67 formed Working Group 7 to prepare ISO 15156. The Working Group are to promote the collection, review and, where appropriate, publication of field experience and laboratory test data related to the cracking resistance of metallic materials in H₂S-containing environments.

This part of ISO 15156 utilises the above sources to provide requirements and recommendations for materials qualification and selection for safe application in environments containing wet H₂S in oil and gas production systems.

[ISO 15156-1:2001](https://standards.iteh.ai/catalog/standards/sist/ce8b1f6f-bf70-42b3-9ff-f800c3712b56/iso-15156-1-2001)

<https://standards.iteh.ai/catalog/standards/sist/ce8b1f6f-bf70-42b3-9ff-f800c3712b56/iso-15156-1-2001>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 15156-1:2001

<https://standards.iteh.ai/catalog/standards/sist/ce8b1f6f-bf70-42b3-9ff-f800c3712b56/iso-15156-1-2001>

Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production —

Part 1:

General principles for selection of cracking-resistant materials

1 Scope

This part of ISO 15156 describes general principles and gives requirements and recommendations for the selection and qualification of metallic materials for service in equipment used in oil and gas production and in natural gas sweetening plants in H₂S-containing environments, where the failure of such equipment could pose a risk to the health and safety of the public and personnel or to the environment. It can be applied to help to avoid costly corrosion damage to the equipment itself. It supplements, but does not replace, the material requirements given in the appropriate design codes, standards or regulations.

This part of ISO 15156 addresses all mechanisms of cracking that can be caused by H₂S, including sulfide 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.

Table 1 provides a non-exhaustive list of equipment to which this part of ISO 15156 is applicable, including permitted exclusions.

This part of ISO 15156 applies to the qualification and selection of materials for equipment designed and constructed using conventional elastic design criteria.

This part of ISO 15156 is not necessarily applicable to equipment used in refining or downstream processes and equipment.

CAUTION — Metallic materials selected or qualified using ISO 15156 are resistant to cracking in defined H₂S-containing environments in oil and gas production, but are not necessarily immune under all service conditions.

Table 1 — List of equipment

ISO 15156-1 is applicable to materials used for the following equipment	Permitted exclusions
Drilling, well construction and well servicing equipment	Equipment only exposed to drilling fluids of controlled composition ^a Drill bits Blowout preventer (BOP) shear blades ^b Drilling riser systems Work strings Wire line and wire line equipment ^c Surface and intermediate casing
Wells, including subsurface equipment, gas lift equipment, wellheads and christmas trees	Sucker rod pumps and sucker rods ^d Electrical submersible pumps Other artificial lift equipment Slips
Flowlines, gathering lines, field facilities and field processing plants	Crude oil storage and handling facilities operating at gauge pressure below 4,3 bar (65 psi)
Sour-water handling equipment	
Natural gas treatment plants	
Transportation pipelines for liquids, gases and multiphase fluids	Lines handling gas prepared for domestic use
<p>^a Given the high strength often needed, drilling equipment may not comply with the requirements of this part of ISO 15156. In such cases the primary means for avoiding SSC is control of the drilling or well-servicing environment. As service stresses and material hardness increase, drilling fluid control becomes increasingly important. Take care to control the drilling environment by maintenance of drilling fluid hydrostatic head and fluid density to minimize formation fluid in-flow and by one or more of the following procedures: 1) maintenance of pH 10 or higher to neutralize H₂S in the drilled formation; 2) use of chemical sulfide scavengers; 3) use of a drilling fluid in which oil is the continuous phase.</p> <p>^b High strength steels used for blowout preventer (BOP) shear blades are highly susceptible to SSC.</p> <p>^c Wireline lubricators and lubricator connecting devices shall comply.</p> <p>^d NACE MR 0176 applies to sucker rod pumps and sucker rods.</p>	

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15156. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15156 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 15156-2, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 2: Cracking-resistant carbon and low alloy steels*

ISO 15156-3, *Petroleum and natural gas industries — Materials for use in H₂S-containing environments in oil and gas production — Part 3: Cracking-resistant CRAs (corrosion-resistant alloys) and other alloys*

3 Terms and definitions

For the purposes of this part of ISO 15156, the following terms and definitions apply.

3.1

blowout preventer

BOP

mechanical device capable of containing pressure, used for control of well fluids and drilling fluids during drilling operations

3.2

braze, verb

join metals by flowing a thin layer (of capillary thickness) of a lower-melting-point non-ferrous filler metal in the space between them

3.3

carbon steel

alloy of carbon and iron containing up to 2 % carbon and up to 1,65 % 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 % carbon.

3.4

christmas tree

equipment at a wellhead for the control of fluid production or injection

3.5

cold work, verb

deform metal plastically under conditions of temperature and strain rate that induce strain hardening, usually, but not necessarily, conducted at room temperature

3.6

corrosion-resistant alloy

CRA

alloy intended to be resistant to general and localized corrosion of oilfield environments that are corrosive to carbon steels

3.7

ferrite

body-centred cubic crystalline phase of iron-based alloys

3.8

ferritic steel

steel whose microstructure at room temperature consists predominantly of ferrite

3.9

hardness

resistance of metal to plastic deformation, usually measured by indentation

3.10

heat-affected zone

HAZ

that portion of the base metal that is not melted during brazing, cutting or welding, but whose microstructure and properties are altered by the heat of these processes