
Naftna in plinska industrija, vključno z nizkoogljično energijo - Preskusna metoda ovalizacije s polnim obročem za oceno odpornosti jeklenih cevi proti razpokanju v kislem okolju (ISO 3845:2024)

Oil and gas industries including lower carbon energy - Full ring ovalization test method for the evaluation of the cracking resistance of steel line pipe in sour service (ISO 3845:2024)

Öl- und Gasindustrie einschließlich kohlenstoffarmer Energieträger - Vollring-Ovalisierungsprüfverfahren für die Bewertung der Rissbeständigkeit von Stahlleitungsrohren im sauren Betrieb (ISO 3845:2024)

Industries du pétrole et du gaz, y compris les énergies à faible teneur en carbone - Méthode d'essai de déformation du diamètre d'une conduite en acier pour évaluer sa tenue mécanique en environnement corrosif (ISO 3845:2024)

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ICS:

75.200	Oprema za skladiščenje nafte, naftnih proizvodov in zemeljskega plina	Petroleum products and natural gas handling equipment
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February 2026

ICS 75.200

English Version

Oil and gas industries including lower carbon energy - Full
ring ovalization test method for the evaluation of the
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für die Bewertung der Rissbeständigkeit von
Stahlleitungsrohren im sauren Betrieb (ISO
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European foreword

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**International
Standard**

ISO 3845

**Oil and gas industries including
lower carbon energy — Full ring
ovalization test method for the
evaluation of the cracking resistance
of steel line pipe in sour service**

*Industries du pétrole et du gaz, y compris les énergies à
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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 document 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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Sour service cracking problems in susceptible steel line pipe are caused by the various forms of hydrogen damage due to the presence of wet hydrogen sulfide (H_2S). The main mechanisms are hydrogen-induced cracking (HIC) or stepwise cracking (SWC), sulfide stress cracking (SSC) and stress-oriented hydrogen-induced cracking (SOHIC). An industry-proven technique for assessing the cracking resistance of steel line pipe is to stress a full ring pipe specimen in a sour environment.

The advantages of the full ring test specified in this document are that it is not necessary to pressurize the line pipe full ring specimen to achieve the required stress, and residual stresses are retained. Equivalent internal stresses can be produced by ovalization of the pipe using mechanical means.

Additional advantages are more representative samples, when compared to machined four-point bend specimens and single-sided exposure can allow in-situ inspection during test exposure.

A known stress is exerted at two regions on a full ring section of steel pipe. The pipe specimen is then exposed internally to the sour test solution.

Ultrasonic testing can be conducted regularly on internally loaded test specimens during the exposure period to monitor crack initiation and propagation. Hydrogen permeation measurements may also be conducted. Both crack initiation and propagation can therefore be monitored. Finally, a metallurgical examination is undertaken to classify any indications found by non-destructive testing (NDT), such as visual inspection, magnetic particle testing (MT), penetrant testing (PT) or ultrasonic testing (UT).

The method has been in use since 1984, but in 1991 a Joint Industry Sponsored Project was set up with the aim of systematically developing, defining and validating the full ring test. The resultant test method designed to determine the susceptibility of steel line pipe, bends, flanges and fittings, including all associated welds to hydrogen damage caused by exposure to sour environments, was published by the UK HSE as OTI 95 635^[1] and subsequently in 2016 as BS 8701, prior to adoption as ISO 3845.

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WARNING — The use of this document can involve hazardous materials, operations and equipment. It does not purport to address all the safety or environmental problems associated with its use. Attention is drawn to national and health safety practices and regulations regarding the use of hazardous materials prior to use, in particular for hydrogen sulfide.

1 Scope

This document gives a method for determining the resistance to cracking of steel pipes in sour service.

This test method employs a full-scale test specimen consisting of a short length of pipe (a 'full ring'), sealed at each end to contain the sour test environment within. The test method applies to any pipe; seamless, longitudinally welded (with or without filler), helical welded, and to girth welds between pipes.

NOTE 1 The specimen is usually a pipe but can also consist of flange neck or section of a bend, or other tubular component or a combination of the above.

NOTE 2 This test method can also be used for corrosion resistant alloys (CRAs).

The method utilizes ovalization by mechanical loading to produce a circumferential stress, equal to the target hoop stress, at two diametrically opposite locations on the inside surface of the test specimen. The test specimen is then subjected to single sided exposure to the sour test environment.

NOTE 3 The test also allows measurement of hydrogen permeation rates.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 2400, *Non-destructive testing — Ultrasonic testing — Specification for calibration block No. 1*

ISO 3059, *Non-destructive testing — Penetrant testing and magnetic particle testing — Viewing conditions*

ISO 3452 (all parts), *Non-destructive testing – Penetrant testing*

ISO 4787, *Laboratory glass and plastic ware — Volumetric instruments — Methods for testing of capacity and for use*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7963, *Non-destructive testing — Ultrasonic testing — Specification for calibration block No. 2*

ISO 8044, *Corrosion of metals and alloys — Vocabulary*

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*

ISO 9934 (all parts), *Non-destructive testing — Magnetic particle testing*

ISO 11666, *Non-destructive testing of welds — Ultrasonic testing — Acceptance levels*

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ISO 16810, *Non-destructive testing – Ultrasonic testing – General principles*

ISO 17635, *Non-destructive testing of welds — General rules for metallic materials*

ISO 17638, *Non-destructive testing of welds — Magnetic particle testing*

ISO 17640:2018, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment*

ISO 22232 (all parts), *Non-destructive testing — Characterization and verification of ultrasonic test equipment*

ISO 23277, *Non-destructive testing of welds — Penetrant testing — Acceptance levels*

ASTM D1193, *Standard Specification for Reagent Water*

ASTM E1237, *Standard Guide for Installing Bonded Resistance Strain Gages*

ASTM F21, *Standard test method for hydrophobic surface films by the atomizer test*

NACE TM0284:2016, *Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

ancillary components

parts of the apparatus necessary for the test which are not the loading components to impart *stress* (3.26)

3.2

corrosion-resistant alloy

CRA

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

[SOURCE: ISO 15156-1:2020, 3.6]

3.3

imperfection

discontinuity or irregularity in the product wall or on the product surface that is detectable by inspection methods outlined in this document

3.4

indication

evidence obtained by non-destructive inspection

3.5

girth weld

butt weld joining one pipe to another (or bend or flange)

3.6

hardness

resistance of metal to *plastic deformation* (3.16), usually determined by indentation

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3.7

heat-affected zone**HAZ**

portion of base metal not melted during brazing, cutting or *welding* (3.31), but whose *microstructure* (3.14) and properties are altered by the thermal cycle of these processes

3.8

helical weld

DEPRECATED: spiral weld

weld running helically (spirally) around the circumference of a pipe formed from strip

3.9

hydrogen-induced cracking**HIC**

planar cracking that occurs in carbon and *low alloy steels* (3.12) when atomic hydrogen diffuses into the steel and then combines to form molecular hydrogen at trap sites

[SOURCE: ISO 15156-1:2020, 3.12, modified — Note 1 to entry has been removed.]

3.10

hydrogen permeation

process of atomic hydrogen diffusion through a metal

3.11

longitudinal weld

straight weld running along the longitudinal axis of a pipe

3.12

low alloy steel

steel with a total alloying element content of less than about 5 % mass fraction, but more than specified for carbon steel

[SOURCE: ISO 15156-1:2020, 3.15]

3.13

measured strain

$\varepsilon_1, \varepsilon_2, \varepsilon_3$

surface *strain* (3.24) as measured by various techniques in one or more of three known directions at the surface

3.14

microstructure

structure of a metal as revealed by microscopic examination of a suitably prepared specimen

[SOURCE: ISO 15156-1:2020, 3.16]

3.15

modulus of elasticity

Young's modulus

E

ratio of tensile or compressive *stress* (3.26) to corresponding *strain* (3.24) below the elastic limit

3.16

plastic deformation

permanent deformation caused by straining beyond the elastic limit

3.17

Poisson's ratio

ν

dimensionless material constant (approximately constant for steel) given by the ratio of contraction/expansion per unit length tangential to the direction of loading over the expansion/contraction per unit length in the direction of loading