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Full ring ovalization test for determining the susceptibility to cracking of linepipe steels in sour service – Test method

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Summary of pages

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 June 2016. It was prepared by Technical Committee PSE/17, *Materials and equipment for petroleum, petrochemical and natural gas industries*. A list of organizations represented on this committee can be obtained on request to its secretary.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Introduction

Sour service cracking problems in susceptible pipeline steels are caused by the various forms of hydrogen damage due to the presence of wet hydrogen sulfide (H_2S). The main mechanisms are hydrogen pressure induced cracking (HPIC) [also called hydrogen induced cracking (HIC) or stepwise cracking (SWC)], sulfide stress corrosion (SSC) and stress oriented hydrogen induced cracking (SOHIC). An industry proven technique for assessing pipeline steels is to stress a full ring specimen in a sour environment.

The advantage of the full ring test specified in this British Standard is that it is not necessary to pressurize the linepipe full ring specimen to achieve the required stress loading and residual stresses are retained. Equivalent stresses can be produced using mechanical means to deform the pipe by ovalization. Additional advantages are representative sample and single sided exposure.

This test uses well tried experimental procedures to exert a known stress level at two regions on a full ring section of pipe steel. The pipe specimen is then exposed internally to the sour test solution, although some cases require the sour media externally. Ultrasonic monitoring and hydrogen permeation measurements are conducted regularly during the exposure period. Both crack initiation and propagation can therefore be monitored. Finally, a metallographic study of indications is undertaken to classify any defects found by the ultrasonic survey.

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 pipeline steels, 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 forms the basis of this British Standard.

1 Scope

This British Standard gives a method for determining the susceptibility to cracking of steel pipes in sour service.

This British Standard utilizes a tubular specimen comprising a full circumferential ring. The test method applies to any pipe with or without seam (longitudinal or spiral) or girth weld (with or without filler).

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.

This British Standard provides guidance on determination of specimen size to ensure it retains residual stresses from manufacture and welding.

*NOTE 2 See Clause **7** for specimen sizes.*

The method utilizes ovalization to simulate hoop stress, using mechanical loading on a tubular form. The specimen is subjected to single sided exposure to the sour test environment.

NOTE 3 The test also allows measurement of hydrogen permeation rates which can provide useful information, such as highlighting the effects of galvanic coupling between materials of apparent compatibility.