Four-Point Bend Testing of Materials for Oil and Gas Applications

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Document History:

2023-09: Revised by AMPP Standards Committee (SC) 08, “Metallic Material Selection & Testing”

2015-12-03: Approved by NACE Task Group (TG) 494, “Four-Point Bend Test Method”

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Foreword

Four-point bend testing is used extensively in the oil and gas industry to evaluate resistance of metals to sulfide stress cracking and stress corrosion cracking. The face of the specimen to be tested is stressed in tension and the reverse face in compression. The test is carried out for a specified exposure period with the specimen held under constant displacement using compact loading jigs. The compact nature of the jigs enables testing of several specimens in the test vessel simultaneously. Despite the apparent simplicity of the test, there are many factors that can influence the test results. The purpose of this standard is to establish a reliable methodology for conducting the tests to enhance repeatability and reproducibility of test data. The results of the tests can then be used with greater confidence to rank the performance of metals, the relative aggressiveness of environments, and to provide a basis for qualifying metals for service application. As such, the standard will be of particular benefit to materials and corrosion engineers in the oil and gas sector and to test laboratories providing critical data.

Scope

This document provides technical requirements for the use of four-point bend testing to evaluate the resistance of metals, including carbon steels, low alloy steels, and corrosion resistant alloys (CRAs), to stress corrosion cracking (SCC) and sulfide stress cracking (SSC). The test is carried out for a specified exposure period with the specimen held under constant displacement using compact loading jigs.

Rationale

The standard is revised as required by the AMPP 5-year review policy. Revisions are mainly focused on specimen loading by Deflection and Strain Gauge Methods. The revisions provide more clarifications and specifications on how to load a four-point bend specimen to the target stress level.

In AMPP standards, the terms *shall* and *must* are used to state requirements and are considered mandatory. The term *should* is used to state something that is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.

Section 1: General

This document provides technical requirements for the use of four-point bend testing to evaluate the resistance of metals, including carbon steels, low alloy steels, and corrosion resistant alloys (CRAs), to stress corrosion cracking (SCC) and sulfide stress cracking (SSC). The emphasis in this document is on the methodology of the four-point bend test. The context of the test results for service application and applicability of ANSI[1]/NACE MR0175/ISO[2] 15156[1-3] is the responsibility of the service purchaser/end-user.

Although this test method is intended for SCC or SSC testing, other types of cracking, e.g., hydrogen-induced cracking (HIC), stepwise cracking (SWC), stress-oriented hydrogen-induced cracking (SOHIC), may also be observed.

The default parameters defined by this document are standard requirements.

Section 2: Terms, Definitions and Abbreviations

For the purposes of this document, the following terms, definitions, and abbreviated terms apply.

As-received Parent Material Specimen: The specimen taken from the part of a material sample in the original condition of interest (manufacturing form, post-service, etc.).

[1] American National Standards Institute (ANSI), 25 West 43rd St., 4th Floor, New York, NY 10036, www.ansi.org.
[2] International Organization for Standardization (ISO), Chemin de Blandonnet 8. Case Postale 401, 1214 Vernier, Geneva, Switzerland, www.iso.org.