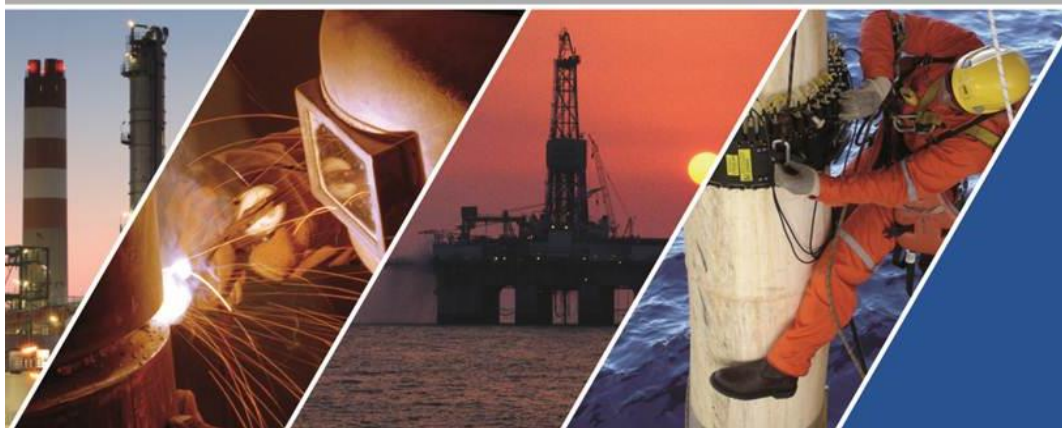




## Definition of Sour Service Limits for Welded Type 316L and Other Cost Effective CRAs



**PUBLISHABLE  
SUMMARY**

**16170**

### Background

Many applications in sour service require use of general grade corrosion resistant alloy (CRA) materials such as Type 316L stainless steel and alloy 825, in the form of solid homogenous material, metallurgically clad lining or weld overlay, but the environmental limits of application are not well defined. To allow less conservative material selection and to ensure safe application of these cost effective CRAs in the welded condition and as cladding, data are required on the application envelope which may be adopted subsequently by ISO15156-3 / MR0175.

Following discussion with industry, the alloy of highest importance is Type 316L material in both solid (homogeneous) and metallurgically-bonded cladding forms, and this will be addressed via the work which is described in this proposal. The solid form is typically dual certified to the composition of 316L and the strength of 316. It is anticipated that the work scope described in this proposal may form the first of a series of phases to address the pressing needs for data to support optimised cost effective material selection for sour operating conditions. Further phases of work will be discussed during progress of the programme presented herein.

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## Objectives

- Define accurate sour service application limits for the cracking resistance of solid (homogeneous) type 316L stainless steel for a range of chloride concentrations, eg 50ppm to 100,000ppm, and temperature, e.g. 60-120° C.
- Define whether the sour service application limits for the cracking resistance of type 316L stainless steel in the form of metallurgically-bonded cladding differ from the limits for solid material.
- Provide guidance on application envelope restrictions based on environmental data.
- If the Sponsor Group so desire, submit data to ISO15156 / MR0175 to ballot for changes to this international standard.

## Benefits

- Provision of an accurate application envelope ensures optimised cost effective material selection to avoid over-design and lead to savings in materials costs.
- Defined limits also avoid the project delays inherent when material testing is required to demonstrate acceptability on a case-by-case basis.
- Refined application limits ensure cost effective safe operation of facilities using such material grades in solid, lining and weld overlay forms, thus avoiding costly failures impacting upon production efficiency, personnel safety and the environment.

## Participants

The sponsor group comprised:

- BP
- Chevron
- ConocoPhillips
- ENI
- Petrobras
- Statoil
- Saudi Arabian Oil Co

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## Scope of Work

The following work was performed:

- Literature Review
- Four-point bend stress corrosion cracking testing under various conditions of temperature (71-140°C), partial pressure of H<sub>2</sub>S (0.01-10 bar), chloride content (50mg/l, 1000mg/l, 50,000mg/l and 100,000mg/l) and nominal pH (3.5, 4.5 and 5.0). All environments were beyond the ISO15156-3 limits for 316L at the time of the project. Tests were performed on the following materials:
  - ☐ Homogenous 316/316L pipe material
  - ☐ Welded 316/316L pipe material
  - ☐ 316L cladding from welded clad pipe material
- Mechanical tests and metallurgical examinations to support the SCC tests
- Ballot to ISO to expand the sour service limits in ISO15156-3 for 316L based on the results for the homogenous and welded solid 316/316L SCC test results.

## Price and Duration

The project had a duration of 2 years and a budget of £350,000. It was funded by 7 Sponsors each making a contribution of £50,000. The fee for additional companies buying-back into the project results is £50,000.

## Further Information

For further information on Joint Industry Projects (JIP) and their operation, please visit:

<http://www.twi.co.uk/services/research-and-consultancy/joint-industry-projects/>

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