Design of Subsea Well Intervention Systems Using Non-ferrous Alloys

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Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, Suite 1100, Washington, DC 20001, standards@api.org.

Contents

Introduction

This document is not intended to be a standalone document from API 17G, rather a complement to current engineering practices set forth by API 17G with the inclusion of titanium and aluminum alloys.

It is important to note that certain design guidelines will supersede some API 17G requirements due to the material properties of titanium and aluminum. These guidelines will be noted and emphasized for clarity and to resolve conflicting design and test procedures between the API 17G3 and the parent document.

It is necessary that users of this recommended practice be aware that additional or different requirements that can better suit the demands of a particular service environment, the regulations of a jurisdictional authority, or other scenarios not specifically addressed in this recommended practice may be applied as required. This document is a recommended practice and it is not intended to replace sound engineering judgment.

One of the drivers for using titanium for the riser is the natural flexibility of titanium over traditional materials such as steel.

As demonstrated in Figure 1, from this side-by-side analysis of using steel vs titanium to construct a tapered stress joint above the well control package, you find the titanium stress joint provides a 50 % improvement in both wave height capacity (Hs) and vessel watch circle radius (vessel offset).

This analysis was based on an alloyed titanium stress joint example in simulated North Sea currents and wave conditions, along with a water depth of 80 m. All loads to the stress joint remain within the normal design limits.

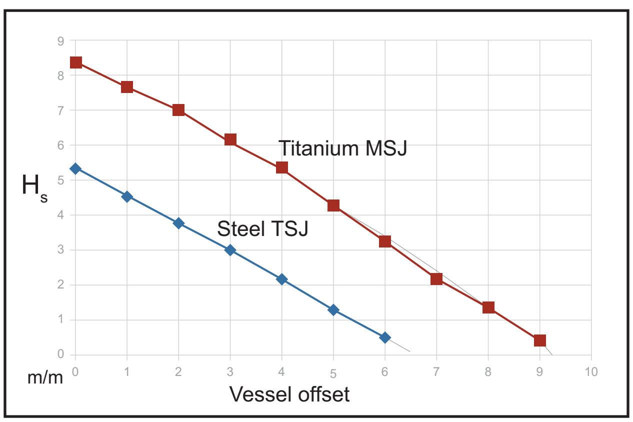

Figure 1—Steel and Titanium Stress Joints

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1 Scope

This recommended practice provides design guidelines for the use of non-ferrous materials in subsea intervention systems and components.

2 Normative References

The following referenced documents are indispensable for the application 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.

API Specification 17D, *Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment*

API Standard 17G, *Design and Manufacture of Subsea Well Intervention Equipment*

API Technical Report 17TR8, *High-Pressure High-Temperature Design Guidelines*

API Specification 20F, *Corrosion-resistant Bolting for Use in the Petroleum and Natural Gas Industries*

API 579-1, *Fitness-for-Service*

ANSI [1]/NACE MR0175 [2]/ISO 15156 [3] (all parts), *Petroleum and natural gas industries—Materials for use in H_2S-containing environments in oil and gas production*

ASME *Boiler and Pressure Vessel Code (BPVC)* [4], *Section VIII: Pressure Vessels; Division 2*: *Alternative Rules*, 2019 Edition

ASME *Boiler and Pressure Vessel Code (BPVC)*, *Section VIII: Pressure Vessels; Division 3: Alternative Rules for Construction of High Pressure Vessels,* 2019 Edition

ASME FFS-1, *Fitness-for-Service*

ASTM [5] E399, *Standard Test Method for Linear-Elastic Plane-Strain Fracture Toughness of Metallic Materials*

ASTM E647, *Standard Test Method for Measurement of Fatigue Crack Growth Rates*

ASTM E992, *Practice of Determination for Fracture Toughness of Steels Using Equivalent Energy Methodology*

ASTM E1290, *Standard Test Method for Crack-Tip Opening Displacement (CTOD) Fracture Toughness Measurement*

ASTM E1820, *Standard Test Method for Measurement of Fracture Toughness*

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3 International Organization for Standardization, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, www.iso.org.
4 ASME International, 2 Park Avenue, New York, NY 10016-5990, www.asme.org.
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