Materials Selection for Bolting

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Introduction

Fasteners are manufactured to a variety of standards covering dimensions, tolerances, materials, mechanical properties, testing procedures, coating, and other manufacturing processes. This document is intended to provide guidance for the proper selection of materials and manufacturing processes for the oil and gas industry where materials selection and key manufacturing processes are critical barriers to the failure of fasteners. Understanding the failure modes and their associated barriers is critical to the proper selection of fasteners for the specific environmental conditions where they will be installed.

"Bolting" and "bolt" are terms used in this document to collectively describe fasteners, including screws, nuts, bolts, washers, and studs. The use of the terms "bolt" or "bolting" includes all of the fasteners listed above, unless otherwise specifically noted herein.

Materials Selection for Bolting

1 Scope

This document provides guidance for the selection of materials and manufacturing processes for low-alloy steel bolting manufactured in accordance with API Specification 20E and nickel-based and stainless alloys manufactured in accordance with API Specification 20F. Table 2 and Table 3 are provided as guidance for the material selection of fasteners.

2 Normative References

There are no referenced documents that are indispensable for the application of this document.

3 Terms, Definitions, Acronyms, Abbreviations, and Symbols

3.1 Terms and Definitions

3.1.1
aging
A thermal cycle that usually follows solution annealing in precipitation hardening materials.

NOTE Aging can be performed at different temperatures and times to strengthen precipitation hardening materials, such as some stainless steel grades and nickel-based alloys.

3.1.2
annealing
A thermal cycle involving heating and holding material at or above its solutionizing temperature, and then cooling at a slow rate, for such purposes as reducing hardness, improving machinability, facilitating cold working, producing a desired microstructure, or obtaining desired mechanical or other properties.

3.1.3
austenitize, quench, and temper
A heat treatment process commonly associated with steels that strengthens by martensitic transformation, then restores toughness.

NOTE The process consists of heating the material to its solutionizing temperature and holding, followed by rapid cooling (commonly in water, polymer, or oil media). When martensitic structure is obtained, the material is very strong, but extremely brittle. The tempering process reduces stresses and changes the microstructure to tempered martensite, which gives a very desirable combination of high strength and toughness.

3.1.4
banding
The microstructural manifestation of segregated alloy elements.

3.1.5
barrier coating
A coating that is not anodic to the base metal in the intended service environment and that provides protection by isolating the base metal from the environment.

3.1.6
bolt
A type of fastener with a head on one end of a shank or body and a thread on the other end designed for insertion through holes in assembly parts; it is mated with a tapped nut (see Figure 1).