Round Robin Test Program for Development of Hardness Conversions for Precipitation Hardened Nickel Alloys and Martensitic Stainless Steels

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Introduction

This API Technical Report documents the results of a round robin test program conducted jointly by API and ASTM. An API task group operating under API Subcommittee 21 provided coordination on behalf of API, and ASTM Committee E28.06.02 provided coordination on behalf of ASTM. Additionally, The API Committee for Standardization of Oilfield Equipment and Materials (CSOEM) provided financial support to the program to facilitate preparation of the test samples and procurement of certified hardness test calibration blocks.

The objective of the test program was to develop two independent sets of hardness conversions, one for precipitation hardened nickel alloys and the other for martensitic stainless steels, which could be used to ballot two new hardness conversion tables with corresponding hardness conversion equations for ASTM Standard E140.

The results of the round robin hardness test program indicated that existing hardness conversions in ASTM E140-12bE1 Table 1 for non-austenitic steels are not appropriate for martensitic stainless steels, such as those included in NACE MR0175/ISO 15156.

Round Robin Test Program for Development of Hardness Conversions for Precipitation Hardened Nickel Alloys and Martensitic Stainless Steels

1 Scope

This test program was designed to provide the data necessary to develop two independent sets of hardness conversions, one for precipitation hardened nickel alloys (PHNA) and the other for martensitic stainless steels (MSS), that could be used to ballot two new hardness conversion tables with corresponding hardness conversion equations for ASTM Standard E140.

The members of ASTM Committee E28.06.02 recommended the round robin hardness tests be performed at six different companies. The members of API Subcommittee 21 Task Group recommended the various alloys to test, and the desired hardness ranges for the test specimens.

2 Normative References

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

3 Raw Material for Test Specimens

3.1 Raw Material for Martensitic Stainless Steel Test Specimens

The test specimens for the MSS portion of this test program were made from three different alloys. They were only tested in the 1st round robin (RR1) test.

— UNS S41000

— UNS S42400

— UNS J91540

Annex A.1 provides the information from the material certification for the martensitic stainless steels UNS S41000, UNS S42400, and UNS J91540. The test specimens from UNS S41000 were heat treated to four different target hardness values, while UNS S42400 and UNS J91540 were heat treated to five different target hardness values each.

3.2 Raw Material for Precipitation Hardened Nickel Alloy Test Specimens

The test specimens for the precipitation hardened nickel alloy portion of this test program were made from four different alloys. These alloys were supplied in the solution annealed and precipitation hardened condition, with each alloy having a different hardness level. They were tested in the 1st (RR1) and the 2nd (RR2) round robin tests. The alloys are as follows:

— UNS N09925 (ANSI/NACE MR0175)

— UNS N07718 Oil Patch Grade (API 6A718)

— UNS N07716 (ANSI/NACE MR0175)

— UNS N07718 Aerospace Grade (Similar to ASTM B637, AMS 5663)

The information from the material certification for the precipitation hardened nickel alloy test specimens is provided in Annex A.2.