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| S P E C | DEPARTMENT ENGINEERING SPECIFICATION | | A P P R O V E D | WRITTEN BY | |
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H-SERIES® PLUS DRILL PIPE SPECIFICATION

1.0 SCOPE

This specification establishes the requirements for H-SERIES® PLUS drill pipe manufactured by Grant Prideco and its licensees. The requirements defined herein are in addition to those specified in the latest editions of the American Petroleum Institutes Specifications 7 and 5D. These specifications should be consulted for the base requirements for a particular element. Requirements in bold, italicized print are *Supplementary Requirements* and must be specified at the time of order entry. Additionally, the Grant Prideco Standard Products Catalog should be consulted for approved specific connection types, OD and ID combinations, and pipe size, weight, and grade.

2.0 REFERENCES

- 2.1 The latest edition or revision of the following specifications and standards shall form part of this specification:
 - 2.1.1 API Specification 5D
 - 2.1.2 API Specification Spec 7

3.0 TOOL JOINTS

- 3.1 Heat Treatment. Tool joints shall be heat-treated utilizing the quench and temper process.
- 3.2 Mechanical Properties. OD hardness shall be limited to 293 to 331 BHN. Testing shall be conducted at a 100% frequency.

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- 3.3 Charpy V-Notch Impact values for full sized specimens at -4°F shall be a minimum of 41 ft-lbs. for a single reading and a minimum of 52 ft-lbs. for the average of three readings. One hardness reading shall be taken at the OD, mid-wall and ID in each quadrant of a ring taken at least one radius from the end of the tool joint or blank. ***(Supplemental Requirement 1. Through wall hardness traverse throughout the area of the threads at the OD, mid-wall and ID shall be conducted on both pin and box tool joints .)*** Minimum hardness readings shall be 30 HRC with a maximum variation of 6 HRC.
- 3.4 All mechanical testing (yield, tensile, hardness and impact strength) shall be conducted on 1 joint per pin and box / heat / heat treat lot. ***(Supplemental Requirement 2. Testing shall be conducted on 1 pin and box per 100 / heat treat lot.)***
- 3.5 Non-Destructive Flaw Detection. Each joint shall be tested utilizing the Magnetic Particle Inspection method for longitudinal and transverse defects after final machining and, when applicable, after hardbanding.
- 3.6 Microstructure evaluation to determine proper metallurgical structure shall be conducted at the same frequency as the mechanical testing.
- 3.7 Box and pin tool joints shall have the H-SERIES® refacing benchmark.
- 3.8 ***Supplemental Requirement 3. Thread element inspection shall be recorded for the elements of Standoff, Lead, Taper and Thread Height. Records shall be provided to the purchaser and shall be traceable to the tool joint serial number.***
- 3.9 Tool joints shall be pre-broken (make and break). Joints shall be torqued to 60% of the torsional yield strength for the connection, three times, and examined visually after breaking out after the final makeup.
- 3.10 Hardbanding shall be applied, if specified, on the box or pin (or both) tool joints. When specified the standard application on the box tool joint is 4, ¾" wide bands on the OD and 1, ¾" band extending down the 18 degree taper. The standard application on the pin tool joint is 2, ¾" wide bands on the OD, starting ½" from the 35 (or 18) degree taper. Three equally spaced longitudinal fingers are applied below the box hardband on the 18-degree taper when tungsten carbide applications are selected. For chromium based (casing friendly) applications, no fingers are applied.
- 3.11 Box and pin tool joint threads will be cold rolled.

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3.12 Each tool joint shall have a unique serial number applied prior to Brinell hardness testing and the final assembly serial number shall be traceable to the tool joint serial number.

4.0 DRILL PIPE BODY

4.1 Internal Upset Transition. The length of the transition or Miu for IEU and IU upsets shall be 4" minimum including an 8" minimum radius. This length is measured in the "as forged" condition, prior to any machining operations.

4.2 Upset dimensions shall be appropriate for the weld neck configuration of the tool joint being attached.

4.3 The minimum acceptable wall thickness shall be 95% of nominal wall.

4.4 Minimum joint length prior to welding shall be 28'6" to 30'0".

4.5 Tube bodies will be full length Ultrasonically inspected. Reference standard shall contain longitudinal, transverse and oblique (11°, 22°, 45° left and right hand) OD and ID notches. Notch depth shall be 5% of nominal specified pipe body wall thickness.

4.6 Tube body impact values for a ¾ size specimen at -4°F shall be 48 ft-lbs minimum single reading and 59 ft-lbs minimum average.

4.7 Each tube shall have a sequence number applied prior to heat treatment and the final assembly serial number shall be traceable to this sequence number.

4.8 All mechanical testing shall be conducted at a frequency of 1 joint / 100 / heat treat lot.

5.0 FINISHED DRILL PIPE ASSEMBLY

5.1 Tool joints shall be attached to the drill pipe body utilizing either the continuous drive or inertia friction welding method.

5.2 The weld zone shall be heat treated by the quench and temper method.

5.3 Hardness for the weld zone after heat treatment shall be a maximum of 37 HRc.

5.4 The weld zone strength (calculated according to API Spec 7) shall exceed the nominal strength of the pipe body by a minimum of 10%.

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- 5.5 Marking. The finished assembly shall be serialized with a unique number traceable to the heat numbers for the individual drill pipe body, box tool joint, and pin tool joint components.
- 5.6 Finishing. The tool joint threads shall have a 50% zinc tool joint thread compound and pressed steel thread protectors applied. The assembly shall be painted along its length with a black paint and the stenciling applied shall be in white.
- 5.7 Weld zone Charpy V-Notch impact values shall be 31 ft.-lbs. minimum average, no single value less than 24 ft.-lbs., full size specimen at -4 degrees F.
- 5.8 Weld zone mechanical testing will be done at a frequency of 1 weld/100 welds/welder.
- 5.9 Drill pipe assemblies shall be full length demagnetized (max 25 gauss) after completion of all operations.

6.0 CERTIFICATION:

- 6.1 Each drill pipe order shall have a certification package assembled containing the following:
 - 6.1.1 Steel chemistries by heat number.
 - 6.1.2 Mechanical test results following heat treatment.
 - 6.1.3 Serialization log tracing each unique assembly number to the corresponding serial number and heat number for each component and overall assembly tally length.
 - 6.1.4 Product performance sheet.
 - 6.1.5 Certification of compliance to specification(s).
 - 6.1.6 Drill pipe body inspection certification.