Sara Sae

Engineering Standards/Specifications

Procedure No.

SES 26-708

Title

MATERIAL SPEC, ALLOY STEEL FORGINGS, RINGS AND BARS, AISI 4130 FOR LOW TEMPERATURE SERVICE FOR API SPEC DESIGNATION SS-122 DNV 75K, STANDARD AND H_2S SERVICE (HB 197-237)

V.P. of Manufacturing	V.P. of Engineering	V.P. of QA/QC	V.P. of Sales/ Marketing	Revision Description	Release Date	Rev. Ltr

Written By	Revised By	

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Title

MATERIAL SPEC, ALLOY STEEL FORGINGS, RINGS AND BARS, AISI 4130 FOR LOW TEMPERATURE SERVICE FOR API SPEC DESIGNATION SS-122 DNV 75K, STANDARD AND H_2S SERVICE (HB 197-237)

1.0 SCOPE

1.1 This Specification covers low alloy forgings, cogged bars (forged bars), and forged rings suitable for pressure containing parts for low temperature, standard and H_2S service in conformance with NACE MR-01-75 and for assembly with other wrought steel parts and castings by fusion welding. This material shall be used for low temperature service specified by API Spec 6A or 16A material designations 75K. This material may have third party inspection requirements.

1.2 The material manufacturer or the forging supplier shall document the hot working process, the heat treating procedure, the qualification of heat treating equipment, and shall maintain material traceability. Heat treatment certification shall be provided for time and temperature of the heat treated lot.

2.0 APPLICABLE REQUIREMENTS AND SPECIFICATIONS

2.1 Applicable Specifications

2.1.1 UNS G41300
2.1.2 AISI 4130
2.1.3 API Spec 6A and 16A
2.1.4 ASTM A-29
2.1.5 NACE MR-01-75

3.0 BASIS OF PURCHASE

3.1 The material chemistry shall meet the requirements of Paragraph 4.1.

3.2 Purchase Order shall include the following:

3.2.1 NOV Sara Engineering Material Specification, revision, and date of issue.

3.2.2 NOV Sara part number

3.2.3 Dimensions: OD x L or OD/ID x L

3.2.4 Material grade designation (e.g. 4130). The NOV Sara material specification number is not acceptable.

3.2.5 Heat Treating Condition Required:

a. Forged rings shall be purchased in the normalized condition. Rings shall be later water quenched and tempered to **HB 207-237** by NOV Sara after rough machining.

b. Other forgings that are in the near net or rough machined dimensions, may be purchased water quenched & tempered to **HB 207-237** per paragraph 6.0 when specified in the purchase order.

c. Forged bars may be purchased in the slow cool condition. NOV Sara will normalize them prior to rough machining.

d. **Final hardness readings of finished components shall meet HB 197-237.**

3.2.6 Certification requirements specified in Section 10.0.

3.2.7 Test temperature and V-notch Charpy values when different from this specification requirement.

3.2.8 If part is to be polymer quenched the PO shall state that the part is to be polymer quenched.

4.0 CHEMISTRY REQUIREMENTS

4.1 The AISI 4130 parts must conform to the requirements for the chemical composition for each grade specified and shall be within the limits specified **below** for each grade:

AISI Grade	4130
Carbon, %	.28 to .33
Manganese, %	.40 to .60
*Phosphorous, %	.025 max.
*Sulfur, %	.025 max.
Silicon, %	.15 to .35
Chromium, %	.80 to 1.10
Molybdenum, %	.15 to .25
Nickel, %	.50 max.
Copper, % Residual	.30 max.

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* Phosphorous and sulfur have maximum limitations which are different from the typical AISI chemistry.

5.0 MECHANICAL PROPERTIES

5.1 Mechanical properties can be obtained from a prolongation coupon or a test block which will represent the API QTC. This coupon or test block shall be from the same heat of steel, receive the same type of hot work and the same reduction or less, and shall have the equivalent heat treat cycle as the product. Two hardness tests shall be performed on the QTC after the final heat treat cycle.

Tensile Strength, psi (min.)	95,000
Yield Strength, psi (min.)	75,000
Elongation, 2" gauge length, % (min.)	18
Reduction in area, % (min.)	35
Brinell Hardness Before Final Machining, HB	207-237
Brinell Hardness After Final Machining, HB	197-237

5.1.1 For material thicknesses equal to or greater than 4", the size of the API QTC shall be 4" x 4" x 8", representing an ER = 5.

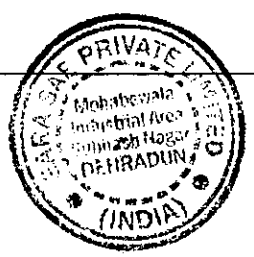
5.1.2 For material thicknesses less than 4", the size of the API QTC shall be T" x T" x 6", where T is the maximum wall thickness of the forging or customer requirement.

5.1.3 The test specimens shall be sampled from a t/4 location where "t" is the thickness of the test coupon.

5.2 Impact Properties

5.2.1 Test temperature, V-notch Charpy values, and lateral expansion requirements shall be:

Temperature	Charpy V-Notch (Avg. of 3 Specimens)	Min. Requirements for One Specimen Only	Lateral Expansion Min.
-32°C	31 ft.-lbs.	24 ft.-lbs.	0.015"



5.2.2 The test specimens should be sampled from a t/4 location where "t" is the thickness of the test coupon.

5.2.3 Unless otherwise specified, the Charpy V-Notch specimens are to be oriented in the longitudinal direction, with the notch machined such that it is perpendicular to the material surface (from which t/4 is measured).

5.3 Chemical and mechanical properties obtained from a mill qualification report representing the same heat, reduction, and heat treating are acceptable.

5.4 Chemical, mechanical and impact testing may be conducted on pieces cut from the forging and subjected to the equivalent heat treatment as the component.

6.0 HEAT TREATMENT

6.1 Wrought products shall be supplied in the normalized (1650 - 1700°F) condition unless specified otherwise in the Purchase Order.

6.1.1 After rough machining, the material shall be fully austenitized 1650 to 1700°F, water quenched and tempered to meet the minimum properties of paragraph 5.0. The minimum tempering temperature shall be 1200°F.

6.1.2 The test coupon (QTC) shall be austenitized 1675°F, water quenched and tempered. The minimum tempering temperature shall be 1200°F.

6.1.3 The parts may be polymer quenched provided the following criteria are meet.

6.1.3.1 If polymer quenching is performed the PO shall state that the part and test coupon are to be polymer quenched. If polymer quenching is performed the vendor shall state the percent polymer for the test coupon and the part on the material certification.

6.1.3.2 The concentration of polymer in the quench media used to quench the part and the test coupon shall not exceed 16%.

6.1.3.3 The temperature requirements for heat treatment shall meet section 6.1.1 and 6.1.2 of this document.

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6.1.3.4 When the part and test coupon are heat treated and quenched by the same vendor they shall be quenched in the same polymer quench media containing the same percent polymer. The concentration of polymer in the quench media used to quench both the part and the test coupon shall not exceed 16%.

6.1.3.5 If the part and test coupon are heat treated and quenched by different vendors the difference in percent polymer between the two vendors shall not vary by more than ±2%. The concentration of polymer in the quench media used to quench the part and the test coupon shall not exceed 16%.

7.0 MARKINGS

7.1 The wrought products shall be marked by steel stamping with the Purchase Order number, the alloy, mill heat number, and part number.

8.0 INSPECTION

8.1 The product shall be inspected for laps, seams, folds, and re-entry grains, and those defects shall be ground out.

8.2 When surface defects are removed by grinding and the thickness is not reduced below that specified on the Purchase Order, the defective areas may be blended smooth. Care should be taken to assure that all the defects have been removed by reinspecting the zone after grinding.

8.3 When surface grinding reduces the thickness below the specified minimum, the material shall be rejected. No welding is permitted for materials required by this Specification.

9.0 SPECIAL REQUIREMENTS

9.1 Cleanliness

9.1.1 NOV Sara has the option to perform a macro analysis of the forged bars, rings, and other forgings to reveal the presence of segregation and non-metallic inclusions. The material shall show freedom from pipe, segregation, flaking, and injurious non-metallic inclusions.

9.2 Wroughtness

9.2.1 The forged bars or rings shall be mechanically hot worked by a press or hammer to work the metal to produce uniform wroughtness throughout the section thickness. The minimum reduction that the forging is subjected to shall exceed 3.5 to 1. The reduction can be calculated based on the original area to the final area of the part.

9.3 Melting Process

9.3.1 The steel shall be made by the basic electric furnace process in which the molten metal may be vacuum or AOD treated prior to or during the pouring of the ingot in order to remove objectionable gases, particularly hydrogen. Vacuum-arc remelting and electroslag remelting are also permissible melting processes. The material shall be treated to fine grain melting practice.

9.4 Large Cross Section Forgings

9.4.1 In forgings with large cross sections the possibility of hydrogen flakes (cracks) shall be considered by the forge vendor. Appropriate action shall be taken by the forge vendor to prevent deleterious hydrogen flakes (cracks).

10.0 CERTIFICATION

10.1 A certification shall be provided to NOV Sara with each shipment. In addition, the original and a copy will be provided to the NOV Sara Purchasing Department.

10.2 The following information is mandatory on the certified record:

10.2.1 Purchase Order Number

10.2.2 Mill chemical analysis and heat number

10.2.3 Statement of actual values of the mechanical properties to include Charpy V-Notch values, of the forged coupon or test block for each heat treatment specified in Section 5.0.

10.2.4 Certification of heat treatment to include time/temperature cycle and the two surface hardnesses of the test block (API QTC).

10.2.5 If material was purchased in the normalized, slow cooled or Q&T condition, it must be reflected on the certification.

10.2.6 If polymer quenching is performed the vendor shall also state the percent polymer concentration in the bath on the heat treatment certification. This information is required for both the QTC and the heat treated part.

10.3 In the event of partial shipment or billing, each shipment shall be accompanied by a certification. Traceability of components is required as to heat lot, heat treatment, and mechanical properties.

11.0 DIMENSIONS

11.1 The wrought products shall conform to the dimensions and tolerances specified on the NOV Sara drawing and/or Purchase Order.

12.0 DEVIATION

12.1 Any deviation from this Specification shall be permitted only upon prior written approval from NOV Sara. NOV Sara Engineering shall be the final authority on any deviations.

12.2 Qualified suppliers will be notified of their acceptability to this Specification and any deviations will be so noted.

13.0 LOT NUMBER

13.1 Materials/parts ordered to this NOV Sara Specification must have Lot # assigned by NOV Sara Quality Control.