

Section: SES 26 – 740

Issue: "A"

Rev. No.: "3"

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SPECIFICATION FOR GENTRAL REQUIREMENTS OF HEAT TREATMENT OF ALLOY STEELS FOR USE IN WELL HEAED, TREE, MANIFOLD AND RELATED EQUIPMENT

Rev	Reason of Change	Date	Made By	Reviewed By	Approved By	Status
1		20-10-2011	USR	J Gulati	KKD	Released
2	Re-Complied to 6A 20 th Edn.	12/12/2015	KKM	AS	KKD	Released
3	Calibration of heat treat equipment & document retention period amended as per API 6A 21 st edi.	07-10-2019	MN	USR	AS	Released



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1.0 PURPOSE

- 1.1 It is the purpose of the specification to list in a concise form the Heat Treatment of alloy Steels used in well head, Tree, Manifold and related equipment used oil field services.
- 1.2 This material specification is intended to aid the PPC / Product Manager / Purchasing department in our sourcing and the vendor to comply the requirements of heat treatment of a material which needs to meet its intended use, and the quality control department in the inspection and release of incoming material.

2.0 SCOPE

- 2.1 This specification covers requirement of heat treatment of alloy steels used for well Head, Christmas Tree, Manifold and related equipment / die-forgings and ring rolling (where applicable) to meet requirement of the relevant specification.

3.0 APPLICABLE DOCUMENTS :

- Sara Sae QA Sampling Plan
- SES/QAD/MT-1/97 Test Method of MPI
- SES-26-701 Test Method of Liquid Penetrant Test
- SES-26-702/ 761 Ultra Sonic inspection, Steel, General.
- Material Spec as per Purchase Order
- Relevant Drawings / Specs.

4.0 CONDITION

- 4.1 Heat Treated products shall be supplied clean, free from scale meeting the requirement of this specification, the purchase order and the relevant forging drawing.

5.0 HEAT TREATMENT:

- 5.1 Prior to outsourcing the process, prospective vendors shall be assessed for their capabilities for heat treatment.
- 5.2 Prior to HT of bulk the prospective vendor shall submit first off sample of the product duly Heat treated as per procedure for evaluation & approval.
- 5.3 After approval vendor shall make no changes in process without the written permission of Sara Sae and re-approval of first article sample, if desired by Sara Sae.



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6.0 GENERAL REQUIREMENTS

- 6.1 **Spacing** : Material to be heat treated should be racked / stacked such to allow circulation of heating and quenching media, to ensure all surfaces of the product are exposed to heating & quenching media and to minimize war page during heating & quenching.
- 6.2 **Carburization and Nitriding** : The heating media in furnaces used for heating material shall be controlled to preclude carburization & nitriding.
- 6.3 **Heat Treating Equipment** – The design and construction of the furnace (heat treatment equipment) shall be such that the temperature at any point in the furnace working zone or work load shall comply requirements of Annex 'M' of the 21st Edi. of API 6A or AMSH – 6875 and AMS2750E.

6.4 Equipment Calibration-

- 6.4.1 Furnaces shall meet the calibration and survey frequency requirements of Annex M of the 21st edition of API 6A.
- 6.4.2 Uniformity surveys shall be made once per year minimum and shall be made at temperatures that are representative of the operations intended for the furnace. For solution annealing, annealing, austenitizing and normalizing, the uniformity shall be +/- 25°F (14°C) or better. For tempering, stress relieving and aging the uniformity shall be +/- 15°F (8°C) or better. Furnace survey records shall be available to SARA SAE upon request.
- 6.4.3 Temperature controlling and recording instruments used for the heat-treatment processes shall be calibrated at least once in three months with $\pm 1\%$ accuracy of their full-scale range.
- 6.4.4 Equipment used to calibrate the production equipment shall be accurate to $\pm 0.25\%$ of full-scale range.

7.0 HOLDING TIME

Table – 1 : Holding Time for Annealing / Austenizing / Normalizing and tempering of Class A, B, C, and D Steels.



Material	Annealing / Austenizing / Normalizing		Tempering & Aging Furnace or Contact Thermocouples
	Furnace Thermocouples	Contact Thermocouples	
Class A & B Steels	30 minutes / inch of T + one hour : 1 hour min	15 minutes / inch of T 15 minutes min	Matl upto 8" thickness - 1 hr / inch min. + 30 min / inch for additional T
Class C Steels	As per table -1C, AMSH-6875		
Class D Steels	As per table -1D, AMSH-6875		
1. These times are suitable for the simple solid shapes heated from –all surfaces 2. For simple shapes, thickness 'T' shall be defined as follows :			

Billets for forgings may be heated by induction or electric or oil fired furnace

- 7.1.1 Heating shall not produce internal oxidation, sigma phase or grain growth exceeding Grain Size of 5 as per ASTM E112.
- 7.1.2 Billet pre-heat temperature shall depend upon the material used.
- 7.1.3 forgings shall be struck / rolled so that the longitudinal axis of the starting billet coincides with the centerline of the forging / ring.
- 7.1.4 Finished forging / ring shall be hot trimmed.
- 7.1.5 A min forging ratio of 3:1 shall be maintained for all die/free forgings and rings produced from bar/billets with predetermined forging ratio of min 3:1.

8.0 When specified on the PO, forgings shall be supplied in normalized or normalized and tempered condition as required.

9.0 FINISHED FORGING REQUIREMENTS

- 9.1 forgings shall conform to the dimensions and tolerances specified on the relevant drawing referenced on the purchase order.
- 9.2 Finished forgings shall be clean, scale free, free of laps, seams, cracks, fins, scabs excessive flash or other surface / injurious defects.
- 9.3 Forging surface shall be capable of meeting the requirements of MPT/LPT as applicable.

10.0 ACCEPTANCE

- 10.1 A lot shall consist of one part number forgings produced from one heat of respective material and forged (heat treated, if require) in identical conditions.
- 10.2 Sara Sae may inspect random samples from each lot to verify may any or all the above requirements



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10.3 An AQL of 4 with an acceptance / rejection number as per Sara Sae QA Plan shall be used for lot acceptance. Any non-conforming lot shall be rejected.

10.4 Individual forgings may also be rejected for non-conformance if any.

11.0 PACKING

11.1 Forgings shall be supplied in packages that protect against damages during shipment.

12.0 DOCUMENTATION REQUIRED

12.1 Each shipment shall be accompanied by material certifications for each lot of material, the certifications must be positively relatable to the lot of material represented.

- a) Mill certificate of raw material.
- b) Chemical certificate for each lot of forging.

12.2 Mechanical properties certification as per spec.

12.3 Impact testing certification

12.4 Certification of heat treatment including cycle time, temperature, cooling media, hardness and graphs.

12.5 Calibration certificate of furnace.

12.6 Ultrasonic test report – certification of raw material.

12.7 Suppliers shall retain heat treat charts in a secure area for a period of no less than 10 years (e.g. electronic or paper).

13. TESTING TO BE CARRIED OUT BY SARA SAE

13.1 At the time of lifting forgings re-verification of chemical properties.

13.2 Recheck of tensile strength, yield strength, elongation, reduction in area, hardness, impact testing and UT testing as per applicable spec.

