

**AISI 1040 CARBON STEEL FORGED OR WROUGHT**  
**60,000 MINIMUM YIELD**

Rev	Reason of Change	Date	Prepared By	Reviewed By	Approved By	Status
1	Quenching media temperature requirements as per API 6A 21 <sup>st</sup> edition.	24-09-2019	MN	USR	AS	Released

## **1.0 SCOPE**

- 1.1** AISI 1040 carbon steel forgings and wrought shapes heat-treated to 60,000 PSI minimum yield strength for standard service.
- 1.2** Product forms covered by this specification are closed die, Open die and ring forgings bar and mill shapes.

## **2.0 REQUIREMENTS**

- 2.1** The requirements of specification SES 26-590, SES 26-740 & SES 26-744 shall apply in addition to the following specific requirements.
- 2.2** It is the responsibility of raw material/metal supplier/machined parts supplier of carbon, low alloy and martensitic stainless steel to have practices and procedures in place to assure that raw materials/parts delivered do not have excessive amounts of residual magnetism. Excessive residual magnetism is defined as greater than 3 gauss. Residual magnetism can occur due to factors such as lifting with magnets, magnetic particle inspection or stray welding current. The supplier's procedures/testing methods will be subject to verification during supplier audits.
- 2.3** The raw material supplier shall assure that material with greater than background level of radioactivity.

**3.0 CHEMICAL COMPOSITION:** Chemical composition limits are listed below. An analysis of each heat of steel be made by the manufacturer, preferably from a ladle sample taken at or near the time of pouring. The listed elements shall be reported in weight percent. Reporting of residual element is not required, but total residual must not exceed 1%.

<b>ELEMENTS</b>	<b>COMPOSITION RANGE (%)</b>
Carbon (C)	0.37-0.44
Manganese (Mn)	0.60-0.90
Sulphur (S)	0.05 (max.)
Phosphorus (P)	0.04 (max.)

**3.1** Elements that are not included in the application material specification but that may have been intentionally added by the mill shall be reported and are limited as follows.

<b>ELEMENTS</b>	<b>COMPOSITION RANGE (%)</b>
Vanadium (V)	0.08 (max.)
Aluminum (Al)	0.055 (max.)
Nitrogen (N)	0.010 (max.)
Hydrogen (H)	0.010 (max.)
Niobium(Columbium)+Titanium +Vanadium	0.12 (max.)
Boron	0.0005 (max.)

**4.0 MECHANICAL PROPERTIES:** Mechanical property requirements are listed below. Each heat shall be tested and the listed mechanical properties shall be reported.

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MECHANICAL PROPERTIES	RANGE
TENSILE STRENGTH	85,000 PSI (586 MPa) Min.
YIELD STRENGTH	60,000 PSI (414 MPa) Min.
ELONGATION IN 2" Gage Length	18% Min.
REDUCTION IN AREA	35% Min.
BRINELL HARDNESS	187-237 BHN(10-22 HRC)

## **5.0 HEAT TREATMENT:**

PROCESS	ATMOSPHERE/MEDIA	TEMPERATURE	TIME AT TEMPERATURE
Austenitizing (See note)	Air or Nitrogen	1550 °F (843 °C) minimum.	½ hour per inch maximum of through thickness. One hour minimum.
Quench	Water	The temperature of quenching medium shall not exceed 100 °F (38 °C) at the start of the quench nor exceed 49°C (120°F) at any time during the quench cycle.	
	Polymer	50 °F (10 °C) minimum before quenching	
	Oil	-----	
Temper	Air or Nitrogen	1150 °F (621 °C) Minimum.	3/4 hour per inch of maximum through thickness. One hour minimum.
Slow cool to room temperature			

**Note 1:** The minimum start temperature of 50 °F (10 °C) for oil and polymer Quenchants shall be followed except when a lower minimum start temperature is permitted for a specific quenchant by the quenchant manufacturer. The start temperature shall be documented for all products.

**Note 2: Maximum holding time shall not exceed Five times (5X) the minimum holding time.**  
**In all case, holding time shall not start until parts or materials have reached specified heat treatment temperature. The 5X rule does not apply to the separate QTC (e.g. ER 5")**

## **6.0 DOCUMENTATION REQUIRED**

- 6.1 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.
- 6.2 Certification of heat treatment including cycle time, temperature, cooling media, hardness and graphs.
- 6.3 Calibration certificate of furnace.
- 6.4 At the time of lifting forgings re-verification of chemical properties.
- 6.5 Recheck of tensile strength, yield strength, elongation, reduction in area, hardness, impact testing and UT testing.

**7.0 TESTING TO BE CARRIED OUT BY SARA SAE**

**7.1** At the time of lifting forgings reverification of chemical properties.

**7.2** Recheck of tensile strength, yield strength, elongation, reduction in area, hardness, impact and UT testing.