

**ALLOY STEEL (AISI 4140) TUBING/BAR, 100 KSI YIELD,
IMPACT REQUIREMENTS AT -20F**

Rev	Reason of Change	Date	Made By	Reviewed By	Approved By	Status
0	Initial release	09-03-2018	MN	AS	KKD	Released
1	Quenching media temperature requirements amended & retention period added in clause 7.0 added as per API 6A 21st edition	03-10-2019	MN	USR	AS	Released

Summary: This specification covers the requirements for quenched and tempered AISI4140 low alloy steel bars, tubes, and shapes.

 A JOULON COMPANY	SARA SAE ENGINEERING SPECIFICATION		
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1.0 SCOPE

This specification covers the requirements for quenched and tempered AISI 4140 low alloy steel bars, tubes, and shapes. Unless otherwise specified, the maximum size will be limited to 8.5 inches. The material is intended for components in standard service only.

2.0 APPLICABLE SPECIFICATIONS

ASTM A29

3.0 MANUFACTURE

- 3.1 The steel shall be made by electric furnace process and vacuum degassed.
- 3.2 The steel shall be fully killed and made to austenitic grain size 5 or finer.

4.0 CHEMICAL ANALYSIS

- 4.1 The heat analysis of the steel shall conform to the chemical requirements listed below. The product analysis tolerance ranges shall be per ASTM A29.

Carbon.....	0.38-0.43%
Manganese.....	0.75-1.00
Phosphorus.....	0.025 max.
Sulfur.....	0.025 max.
Silicon.....	0.15-0.35
Chromium.....	0.80-1.10
Molybdenum.....	0.15-0.25

5.0 MECHANICAL PROPERTIES

5.1

- Tensile strength, min.....120 ksi
- Yield strength (0.2% offset), min... 100 ksi
- Elongation in 2" or 4D, min..... 16%
- Reduction of area, min..... 25% (Not required for tubing wall thicknesses of less than 7/8")

Charpy V-notch Impact Energy Values (10mm x 10mm specimens) at test temperature of -20°F (-29°C):

Longitudinal

- Min. average for a set of 3 specimens.....31 ft-lbf (42J)
- Min. for each individual specimen.....23.6 ft-lbf (32J)
- Lateral expansion, min.....0.015 inches
- Percent shear.....Report actual values

- 5.2 Hardness241-321 HB (22-34 HRC)

6.0 HEAT TREATMENT

PROCESS	ATMOSPHERE/MEDIA	TEMPERATURE	TIME AT TEMPERATURE
Normalized	Air	1600 °F – 1700 ° (870 °C – 925 °C)	30 Minutes/inch of thickness. Minimum time 30 minute.
Still air cool to below 400 °F (204 °C) before further processing.			
Austenitize	Air	1550 °F - 1650 °F (840 °C – 900 °C)	30 Minutes/inch of thickness. Minimum time 30 minute.
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.			
Quench	Water	50 °F (10 °C) minimum before quenching	
	Polymer	-----	
Temper	Air	1000 °F – 1300 °F (540 °C – 700 °C)	1 hour per inch of maximum through thickness. One hour minimum.

Cooling after tempering shall be air cooling or faster (By Water). Furnace cooling is not permitted. For heavy cross sections, rapid cooling after tempering may improve impact properties. The minimum tempering temperatures must be met in all cases to ensure that later steps of manufacturing.

Note: 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").

Note 1: The short blasting shall be carried out after normalizing & Tempering if applicable.

Note 2: The austenitizing temperature shall be less than the normalizing temperature.

2.1 Continuous Heat Treatment

Screw, walking-beam, pusher furnaces, mesh or cast link type furnaces utilized for continuous heat treatment are permitted. Continuous induction, electrical resistance or infra-red heat treatment is not permitted. Times outside the specified ranges may be used, as long as the minimum time at temperature is 15 minutes per inch of thickness. Tempering temperature minimum shall be met. Other thermal operations may use temperatures outside the ranges specified. Mechanical properties shall be met on a prolongation or sacrificial part.

7.0 WORKMANSHIP

Material shall be inspected in accordance with part report (DBI). Material shall be free of injurious defects that are detrimental to the integrity of the final product, such as laps, scabs, cracks and exogenous inclusions.

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