SS316, 60 KSI (414 MPA) COLD WORKED BAR/SHEET/PLATE/TUBE/PIPE/MILL SHAPES, SUBSEA COMPATIBLE, WITH QUALITY REQUIREMENTS INCLUDED

Rev	Reason of Change	Date	Made By	Reviewed By	Approved By	Status
0	Initial release	12-01-2017	MN	AS	KKD	Released

1.0 Scope

PRODUCT FORM: Bar, Sheet, Plate, Strip, Tube, Pipe, Mill Shapes.

This specification covers cold worked, high strength 316 stainless steels bar, Sheet/Plate/strip, tube, pipe, and mill shapes for structural applications. This material is subsea compatible, but is not suitable for H_2S service. Caution should be exercised when used in surface applications in a marine environment, as there is an increased risk of Chloride-Induced Stress Corrosion Cracking. In any case, this material is not suitable for service where chlorides are present at temperatures above 140°F (60°C) without material engineering approval.

Welding of this material will result in a reduction in strength, as cold-worked strengthening will no longer be present.

Where conflict exists between this specification and other specifications, this specification shall take precedence.

2.0 Melting

The material shall be made by one of the following practices: electric-arc, electric-induction, or other suitable processes.

3.0 Chemistry Requirements

The chemistry shall meet the requirements listed in Table 1[1].

Table 1: Chemical Requirements. (All are maximums unless otherwise noted)

Elements	Wt. Percentage (%)
Carbon	0.08
Manganese	2.00
Chromium	16.00 – 18.00
Molybdenum	2.00 – 3.00
Phosphorus	0.045
Sulfur	0.030
Silicon[2]	1.00
Nickel	10.00 – 14.00
[1]N = 0.10% max for plate (A240) [2]Si = 0.75% max for plate (A240)	

4.0 Heat Treatment

Material shall be in the solution annealed and quenched condition.

PROCESS	ATMOSPHERE/MEDIA	TEMPERATURE	TIME AT TEMPERATURE
Normalizing	Air	1900-2050 ^{o}F (1040-1120 ^{o}C)	1/2 hour per inch of maximum through Thickness. One hour minimum
Quenching	Water	100 ^{o}F (38 ^{o}C) max at the start of quench	120^{0}F Max. at the completion of the quench

Note: Maximum holding time shall not exceed Five times (5X) the maximum 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")

5.0 Metallurgical Testing

Properties shall be tested on a prolongation of the product or using a sacrificial part. Samples for production testing shall realistically reflect the properties in the actual component.

5.1 Mechanical Properties

The material shall meet the mechanical properties of Table 2.

Table 2: Mechanical Requirements. (All are minimums unless otherwise noted)

Tensile Strength	100.0 ksi (689 Mpa)
Yield Strength	60.0 ksi (414 Mpa)
Elongation in 2", 4D or 5D	12%
Rockwell Hardness (max.)	35 HRC

6.0 Non Destructive Evaluation

The following NDE methods are required by the associated ASTM specifications, and are required to be present on the material test report prior to cold-working. If additional NDE is needed after cold-working, it must be specified on the FMC part report.

Table 3: NDE specified by the various ASTMs for each product form

ASTM	Product Form	NDE required
A358	Welded Pipe	RT or Spot RT
A312	Pipe (Welded, SMLS, or CW)	Nondestructive Electric Test[1] or Hydrostatic Test
A240	Plate	None
A269	Tube	Nondestructive Electric Test[1]
A479	Bar and Shapes	None
[1]ASTM A999 defines this as UT (E213), Eddy Current (E309 or E426), or Flux Leakage (E570, not applicable for non-ferromagnetic)		

7.0 Repair

Repair by welding is not acceptable.

8.0 Documentation required:-

Each shipment shall be accompanied by material certifications for each lot of material, certifications must be positively relatable to the lot of material represented. Recheck of Chemical properties to be carried out by Sara Sae.