SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416, ASTM A416, Grade 416, AFNOR Z12CF13

Introduction :

Stainless Steel 416 has a machinability of 85% and it is a free-machining stainless steel. The machinability of most of the free-machining stainless steels can be improved by adding sulphur, which leads to the development of manganese sulphide inclusions. It also reduces the weld ability, formability and corrosion resistance of stainless steel 416 to below that of stainless steel 410. This steel is available in highly tempered, hardened or unhardened forms due to its high machinability and low cost. It is highly resistant to acids, alkalis, fresh water and dry air. 416 stainless steel can be hardened to obtain maximum smooth surface and corrosion resistance. It is in appropriate for chloride and marine environment due to its higher sulphur content. Under intermittent conditions the scaling resistance can be extended up to 760°C and upto 675°C under continuous operation. Grade 416 should not be used at temperature greater than the typical tempering temperatures by considering the sustainability of mechanical properties. It can be annealed at temperature of 815 to 900°C for ½ h and the process can be followed by cooling at 30°C for an hour and air cooling.

Chemical Composition

	SS 416	TYPE 416	WNR 1.4005	UNS S41600	AISI 416	ASTM A416	GRADE 416	AFNOR Z12CF13
Carbon	0.15 max	0.15 max	0.15 max	0.15 max	0.15 max	0.15 max	0.15 max	0.15 max
Manganese	1.25 max	1.25 max	1.25 max	1.25 max	1.25 max	1.25 max	1.25 max	1.25 max
Phosphorus	0.06 max	0.06 max	0.06 max	0.06 max	0.06 max	0.06 max	0.06 max	0.06 max
Sulfur	0.15 min	0.15 min	0.15 min	0.15 min	0.15 min	0.15 min	0.15 min	0.15 min
Silicon	1.00 max	1.00 max	1.00 max	1.00 max	1.00 max	1.00 max	1.00 max	1.00 max
Chromium	12.0-14.0	12.0-14.0	12.0-14.0	12.0-14.0	12.0-14.0	12.0-14.0	12.0-14.0	12.0-14.0
Nickel	-	-	-	-	-	-	-	-

Mechanical Properties

	SS 416	TYPE 416	WNR 1.4005	UNS S41600	AISI 416	ASTM A416	GRADE 416	AFNOR Z12CF13
Tensile Strength, Mpa	550-700	550-700	550-700	550-700	550-700	550-700	550-700	550-700
0.2% Yield Strength, Mpa	340min	340min	340min	340min	340min	340min	340min	340min
Elongation % 2" (50.8mm)	15 min	15 min	15 min	15 min	15 min	15 min	15 min	15 min
Reduction in Area, %	-	-	-	-	-	-	-	-
Hardness, HB	207max	207max	207max	207max	207max	207max	207max	207max

Standard Available in forms :

- ASTM A182/ ASME SA182 Stainlees Steel Pipe Fittings
- ASTM A213 / ASME SA213 Seamless Stainless Steel Pipes
- ASTM A240/ ASME SA240 Stainless Steels Sheets / Plates
- ASTM A249/ ASME SA249 Stainless Steel Welded Tubes
- ASTM A269/ ASME SA269 Stainless Steel Tubes
- ASTM A270/ ASME SA270 Stainless Steel Sanitary Tubes
- ASTM A312/ ASME SA312 Stainless Steel Pipes
- ASTM A403/ ASME SA403 Stainless Steel Pipe Fittings
- ASTM A554/ ASME SA554 Stainless Steel Welded Tubes
- ASTM A731/ ASME SA731 Stainless Steel Pipes
- ASTM A789/ ASME SA789 Stainless Steel Tubes
- ASTM A790/ ASME SA790 Stainless Steel Pipes
- ASTM A791/ ASME SA791 Stainless Steel Tubes

Products Available in forms :

- SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416 Plates
- SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416 Pipes
- SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416 Round Bar
- SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416 Tube
- SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416 Flanges
- SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416 Wire
- SS 416, Type 416, WNR 1.4005, UNS S41600, AISI 416 Fittings

Corrosion Resistance

- Grade 416 steels are highly resistant to acids, alkalis, fresh water and dry air.
- However, they are less corrosion resistant than non-free-machining steels, austenitic grades and grade 430 Ferritic alloys with 17% chromium.
- These steels are hardened to obtain maximum corrosion resistance and smooth surface.
- 416 free-machining grades with high sulphur content are inappropriate for chloride and marine environments.

Heat Resistance

- Scaling resistance of grade 416 steels under intermittent conditions can be extended up to 760°C, and up to 675°C under continuous operations.
- Considering the sustainability of mechanical properties, 416 steels should not be employed at temperatures greater than the standard tempering temperatures.

Heat Treatment

Full Annealing -

- Grade 416 steel can be annealed at temperatures of 815 to 900°C for ½ h.
- This process is followed by cooling at 30°C for an hour and air-cooling.

Sub-Critical Annealing -

- Grade 416 steel is heated to 650 to 760°C and air-cooled.

Hardening –

- This process involves heating grade 416 steels to 925 to 1010°C, oil quenching and tempering to improve mechanical properties.
- Tempering should not be carried out at temperatures ranging from 400 to 580°C, owing to poor ductility of grade 416.

Welding

- Grade 416 steel exhibits poor weldability.
- Welding can be carried by pre-heating 416 steels to 200 to 300°C, followed by re-hardening, annealing or stress relieving at 650 to 675°C.
- Grade 410 low hydrogen electrodes can be used for welding purposes.
- Grade 309 filler rods can also be used for materials that require moderate hardening.

Machining

- Grade 416 steels offer the highest machinability of any stainless steel in their sub-critical annealed condition.

Applications

Some of the major applications of grade 416 stainless steels are listed below:

- Valves, pump shafts and motor shafts
- Parts of washing machines
- Gears, bolts, nuts and studs
- Automatic screw-machined components

**9/A, 9th Floor, Mehta Mehal,
15th Mathew Road, Opera House,
Charni Road, Mumbai - 400 004, India.**

**web: www.aesteiron.com
email: info@aesteiron.com
Tel: +91-22-67776700 - 6799 - 6777**

AESTEIRON
STEELS LLP