

## Stainless Steel Grade 3CR12, UNS S40977, WNR 1.4003, Grade 3CR12

### Introduction :

Grade 3CR12 stainless steel is manufactured by changing the properties of grade 409 steel which makes it low cost grade chromium. It resists wet abrasion and mild corrosion. Grade 3CR12 stainless steels can be used in applications for which carbon steel, aluminium, or galvanized provide unwanted results, owing to its resistance to strong acids and alkalis, and cracking outcome from chloride stress corrosion. Grade 3CR12 has improved resistance to water and chloride substances, under ambient conditions. As the corrosivity of chloride contents will be mitigated by the nitrate and sulphate ions. The surface of the material is subjected to mild corrosion when exposed to any type of environment and hence it is one of the major drawbacks of grade 3CR12. Due to this the material is in short supply to decorative applications. In the presence of air, and between 450 and 600°C under stress environments it exhibits scaling resistance between 600 and 750°C. Under prolonged exposure to temperatures between 450 and 550°C this material tends to become fragile. However, at this temperature range the material does not lose its impact resistance. The machinability of grade 3CR12 stainless steels is around 60% of that of mild steel. They do not require special machining methods due to the work-hardening rate lesser than that of austenitic steels.

### Chemical Composition

	SS Grade 3CR12	UNS S40977	WNR 1.4003	GRADE 3CR12
Carbon	0.030 max	0.030 max	0.030 max	0.030 max
Manganese	1.50 max	1.50 max	1.50 max	1.50 max
Phosphorus	0.040 max	0.040 max	0.040 max	0.040 max
Sulfur	0.015 max	0.015 max	0.015 max	0.015 max
Silicon	1.00 max	1.00 max	1.00 max	1.00 max
Chromium	10.5-12.5	10.5-12.5	10.5-12.5	10.5-12.5
Nickel	0.30-1.00	0.30-1.00	0.30-1.00	0.30-1.00
Nitrogen*	0.030 max	0.030 max	0.030 max	0.030 max

### Mechanical Properties

	SS Grade 3CR12	UNS S40977	WNR 1.4003	GRADE 3CR12
Ultimate Tensile Strength, ksi	65 min	65 min	65 min	65 min
0.2% Offset Yield Strength, ksi	41 min	41 min	41 min	41 min
Elongation in 2 inches, %	18 min	18 min	18 min	18 min
0.2% Offset Yield Strength, ksi	-	-	-	-
Elongation in 2 inches, %	88 max	88 max	88 max	88 max

## Products Available in forms :

- Stainless Steel Grade 3CR12, UNS S40977 Plates
- Stainless Steel Grade 3CR12, UNS S40977 Pipes
- Stainless Steel Grade 3CR12, UNS S40977 Round Bar
- Stainless Steel Grade 3CR12, UNS S40977 Tube
- Stainless Steel Grade 3CR12, UNS S40977 Flanges
- Stainless Steel Grade 3CR12, UNS S40977 Wire
- Stainless Steel Grade 3CR12, UNS S40977 Fittings

## Standard Available in forms :

- ASTM A182/ ASME SA182 Stainless 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

## Heat Resistance

- Grade 3CR12 stainless steels exhibit scaling resistance between 600 and 750°C in the presence of air, and between 450 and 600°C under stress environments.
- The material tends to become fragile upon prolonged exposure to temperatures between 450 and 550°C.
- However, the material does not lose its impact resistance at this temperature range.

## Corrosion Resistance

- Grade 3CR12 stainless steels can be employed in applications for which aluminium, galvanized or carbon steels provide undesirable results, owing to its resistance to strong acids and alkalis, and cracking resulted from chloride stress corrosion.
- However, unlike grade 304, grade 3CR12 has minimal resistance to crevice and pitting corrosion in the presence of chloride.
- Under ambient conditions, grade 3CR12 has improved resistance to water and chloride substances, as the corrosivity of chloride contents will be mitigated by the nitrate and sulphate ions.
- One of the major drawbacks of grade 3CR12 is that the surface of the material is subjected to mild corrosion when exposed to any type of environment.
- It is due to this reason the material is limited to decorative applications.

## Heat Treatment

- Grade 3CR12 stainless steels are annealed at temperatures ranging from 700 to 750°C, divided into 25 mm section, and each section is soaked for 1½ h.
- The material is then allowed to cool.
- Care should be taken to prevent hardening during heat treatment.
- The mechanical properties and corrosion resistance characteristics of this grade can be affected by quenching treatments.
- Once the material is annealed, processes such as pickling and passivating are performed.

## Welding

- Welding methods used for austenitic stainless steels can be applied to grade 3CR12 stainless steels.
- Low heat input techniques, such as GMAW (MIG) and GTAW (TIG), can be considered.
- During welding, grade 309 filler wire, pre-qualified by AS 1554.6, is preferred. However, grade 308L, 316L, 309Mo and 309L wires have also been employed in many cases.
- Any discoloration in the welded product can be removed using backing gases, or techniques such as purging and pickling.

## Machining

- Machinability of grade 3CR12 stainless steels is around 60% of that of mild steel.
- They have a work-hardening rate lesser than that of austenitic steels, and, hence, they do not require special machining methods.

## Finishes

- Grade 3CR12 stainless steel plates can be obtained in standard, hot-rolled annealed and pickled (HRAP) finish, and coils are available in 2B or 2D finish.
- Black finish can also be produced by hot-rolling the material, leaving behind a dark oxidized surface on the steel.
- Grade 3CR12 with black finish has a good corrosion resistance and low friction and, hence, it is suitable for different wear applications.

## Applications

- Sugar processing industries
- Transport equipment, such as rail wagons carrying iron ores and coal
- Mining and mineral processing
- Oven and furnaces



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