

STABILIZED FERRITIC STAINLESS STEEL

General Characteristics:

Grade 409L is titanium stabilized ferritic stainless steel containing about 11% chromium conforming to UNS S40910. The presence of chromium leads to the formation of a passive surface film which provides corrosion resistance. The addition of titanium prevents formation of harmful chromium carbides which can lead to inter granular corrosion in service. Titanium being a ferrite former also helps in avoiding hardening on cooling after welding. Furthermore, titanium also ties up with sulphur, leading to improved resistance to pitting corrosion. Atmospheric corrosion resistance of this grade is nearly 250 times that of mild steel. This grade is well suited for such mildly corrosive environments where good formability and weldability are required.

409L stainless steel is especially suitable for the manufacture of automotive exhaustive systems on account of:

- Good cold workability similar to that of low alloy steels.
- Good corrosion resistance in natural atmospheres and in contact with moderately corrosive media.
- Good oxidation resistance up to 800 °C.
- Good weldability.

Chemical Composition:

Designation	%C	%Mn	%S	%P	%Si	%Ni	%Cr	%N	%Ti
UNS S40910	Min	--	--	--	--	--	10.5	-	6*(%C+%N)
	Max	0.030	1.00	0.020	0.040	1.00	0.50	11.7	0.030

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 - UNS S40910	380 min	170 min	20 min	88 HRB max

Physical Properties:

Young's Modulus in tension GPa	Density gm/cm ³	Specific Heat at 23-100°C J/Kg-K	Electrical resistivity μΩ-m	Thermal conductivity W/m. K(100°C)	Mean Co-efficient of Thermal Expansion (25°C-100°C) (/°C)
200	7.8	458	590	25.4	11.2 x 10 ⁻⁶

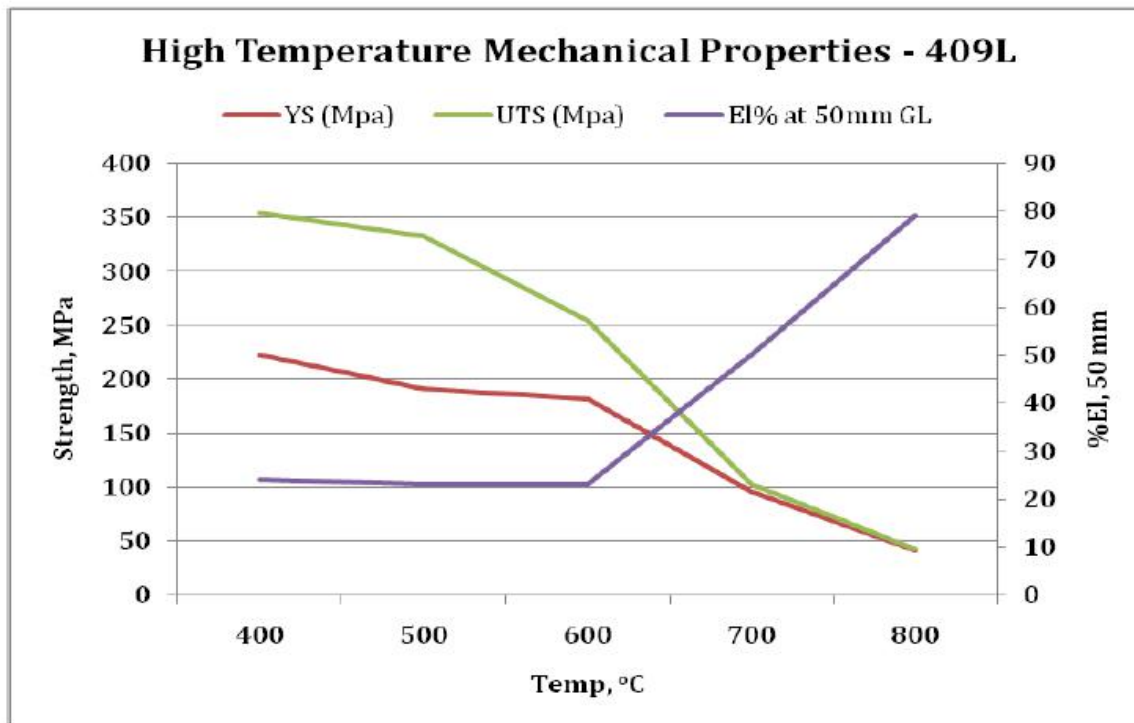
Products available:

Hot Rolled Plates & Coil, Cold Rolled Coil & Sheets

Applications:

409L is primarily suited for the manufacture of car exhaust systems, and particularly of those components that are exposed to working temperatures up to 750-800°C such as

- Manifolds
- Front pipes
- Catalytic shells
- Mufflers



Corrosion Resistance:

This alloy is effective in many applications where carbon steel, galvanized, aluminized or painted steel or aluminum give unsatisfactory life. The stabilization of carbon and nitrogen with titanium exhibits good resistance to intergranular corrosion. In addition, stabilization of the sulphur by titanium increases the resistance to pitting corrosion. Being ferritic, 409L is relatively insensitive to stress corrosion cracking. This alloy resists thickness loss in many environments such as brick kiln atmospheres, automotive exhaust acids; but may form a light surface rust film. It should not be used in decorative applications unless painted.

Oxidation Resistance:

409L exhibits good oxidation resistance in normal combustion atmospheres up to approximately 800°C. It provides sufficient oxidation resistance in exhaust systems. It forms a thin tenacious oxide film on the surface which withstands peeling under such thermal cycles.

Formability:

This stainless steel can be welded, drawn, bent, folded, blanked and fabricated into a variety of exhaustive system components without any difficulty. All welding processes must be carried out with minimum heat input to reduce grain growth effects. Conventional welding such as gas tungsten arc, electrical resistance or gas metal-arc can be used. Automotive exhaust tubing is easily welded without any filler metal. When weld filler is required, AWS ER309 is recommended.

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General Characteristics:

Grade 409Ni is titanium stabilized ferritic stainless steel containing about 11% chromium with 0.75%Ni conforming to UNS S40975. Addition of Nickel provides high strength and toughness. The presence of chromium leads to the formation of a passive surface film which provides corrosion resistance. The addition of titanium prevents formation of harmful chromium carbides which can lead to inter granular corrosion in service. This grade is well suited for mildly corrosive environments where good formability and weldability are required.

Benefits of 409Ni

- 250 times greater corrosion resistance than mild steel
- Outstanding corrosion/abrasion resistance
- Economy-low cost, low maintenance
- High strength-offers low weight design options
- Excellent impact resistance
- Good weldability by conventional methods
- Can eliminate need for coatings and corrosion allowances
- Good performance at elevated temperatures

Chemical Composition:

Designation	%C	%Mn	%S	%P	%Si	%Ni	%Cr	%N	%Ti
UNS S40975	Min	--	--	--	--	0.50	10.5	-	6*(%C+%N)
	Max	0.030	1.00	0.030	0.040	1.00	11.7	0.030	0.75

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 - UNS S40975	415 min	275 min	20 min	92 HRB max

Products available:

Hot Rolled Plates & Coil, Cold Rolled Coil & Sheets

Applications:

- *Bulk wet materials handling*
- *Vehicle frame/chassis*
- *Rail car hoppers*
- *Conveyors, chutes, screens, troughs*
- *Bunkers, hoppers*
- *Tanks and containers*
- *Chimneys, ducting*
- *Enclosures, cabinets*
- *Walkways, stairs, railings*

Corrosion Resistance:

This alloy is effective in many applications where carbon steel, galvanized, aluminized or painted steel or aluminum give unsatisfactory life. The stabilization of carbon and nitrogen with titanium exhibits good resistance to inter-granular corrosion. Atmospheric corrosion resistance of this grade is nearly 250 times that of mild steel.

Formability & Weldability:

Fabrication of 409Ni Stainless Steel should be limited to moderate roll forming and blanking operations due to higher mechanical properties. All welding processes must be carried out with minimum heat input to reduce grain growth effects. Conventional welding such as gas tungsten arc, electrical resistance or gas metal-arc can be used. When weld filler is required, AWS ER309 is recommended.

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FERRITIC STAINLESS STEEL

General Characteristics:

410S is a ferritic stainless steel with higher Chromium content compared to 409 grade to impart better corrosion resistance.

Chemical Composition:

Grade		%C	%Mn	%S	%P	%Si	%Ni	%Cr
UNS S41008	Min	--	--	--	--	--	--	11.5
	Max	0.08	1.00	0.030	0.040	1.00	0.60	13.5

Mechanical Properties:

Grade	UTS (MPa)	YS (MPa)	%EL	Hardness
UNS S41008	415 min	205 min	22 min	89 HRB max

Physical Properties:

Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion (μm/m/°C)	Thermal Conductivity (W/m °C)	Specific Heat (J/Kg °K)	Electrical Resistivity (μΩm)
7700	200	10.3	25.9	460	600

Products available:

Hot Rolled Plates & Coil, Cold Rolled Coil & Sheets

Applications:

Furnace parts and burners operating at lower temperatures, tray supports, bubbles caps and internals in petroleum fractionating towers.

Corrosion Resistance:

410S is better than 409M ferritic stainless steel due to higher chromium content and control over carbon content.

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FERRITIC STAINLESS STEEL

General Characteristics:

430L alloy is a low carbon ferritic stainless steel containing minimum 16% Chromium. The high chromium content provides good corrosion resistance in mildly corrosive environments and good oxidation resistance at elevated temperatures. 430L alloy is ductile in annealed condition, does not work harden excessively during cold working, and can be formed using a variety of roll forming or mild stretch bending operations as well as the more common drawing and bending processes. Because of low carbon content, this alloy replaces ASTM 430 when a better performance in inter-granular corrosion is required. 430L has no nickel, copper and very low manganese. So it costs low, is stable in price and yet boasts of impressive technical characteristics. This means you can plan better, price better and profit better. 430L is a bright stainless steel which needs less polishing as compared to AISI 304 and 200 series. These properties make it a suitable material for Mint applications.

This alloy is used in a variety of interior and exterior trim applications where economy plus corrosion resistance is more important than high strength. It exhibits excellent polishing characteristics and is therefore used in applications such as architectural trim. It is endowed with good formability and corrosion resistance.

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Ni	%Cr
UNS S43000	Min	--	--	--	--	--	--	16.0
	Max	0.12	1.00	0.030	0.040	1.00	0.75	18.0

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 – UNS S43000	450 min	205 min	22 min	89 HRB max

Physical Properties:

Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion(μm/m/°C)	Thermal Conductivity (W/m °C)	Specific Heat (J/Kg °K)	Electrical Resistivity (μΩm)
7700	200	10.3	25.9	460	600

Products available:

Hot Rolled Plates & Coil, Cold Rolled Coil & Sheets

Applications:

- *Coin Minting*
- *Decorative Panels*
- *Home appliances: Dish Washers, Washing Machine, Sinks, Refrigerator*
- *Automotive trims*

Corrosion Resistance:

430L has excellent corrosion resistance to a wide variety of corrosive media including nitric acid as well as sulphur gases and many organic and food acids. Being ferritic, stress corrosion cracking resistance of this alloy is very high.

Oxidation Resistance:

Because of its relatively high chromium content, the material provides good resistance to oxidation. It resists oxidation at temperatures up to 875°C for intermittent service, and up to 740°C for continuous service. Because of its low thermal expansion, the scale formed is tightly adherent and not easily shed during sudden temperature changes.

Formability:

430L can be welded by all commercial processes normally used to weld stainless steels. For best results the stainless parts to be joined must be completely free of grease, oil or other surface contamination. Satisfactory joints can be made with austenitic weld deposits from 308L or 309L weld wire, or with a ferritic weld deposit of base metal. Welding these alloys will cause a decrease in ductility of the weld and heat affected zones due to the formation of martensite during cooling. The weld heat affected zone will also suffer a marked loss of corrosion resistance in some environments. But ductility and corrosion resistance can be restored by annealing.

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FERRITIC STAINLESS STEEL

General Characteristics:

430 SM is a cost effective alloy designed for 430 grade used in indoor applications which require moderate corrosion resistance.

Chemical Composition:

	%C	%Mn	%S	%P	%Si	%Ni	%Cr
Min	--	--	--	--	--	--	13.0
Max	0.015	0.50	0.030	0.040	1.00	0.75	14.0

Mechanical Properties:

UTS (MPa)	YS (MPa)	%EL	Hardness
415 min	205 min	22 min	89 HRB max

Physical Properties:

Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion($\mu\text{m}/\text{m}/^{\circ}\text{C}$)	Thermal Conductivity (W/m $^{\circ}\text{C}$)	Specific Heat (J/Kg $^{\circ}\text{K}$)	Electrical Resistivity ($\mu\Omega\text{m}$)
7700	200	10.3	25.9	460	600

Products available:

Hot Rolled Plates & Coil, Cold Rolled Coil & Sheets

Applications:

- Decorative Panels
- Home appliances: Dish Washers, Washing Machine, Sinks, Refrigerator
- Automotive trims

Corrosion Resistance:

Salt Spray Test: 8 hrs spraying and 16 hrs dry multiple by three (3) times, then total 72hrs should be resistant against corrosion.

8hrs spraying → 16 hrs dry → 8hrs spraying → 16 hrs dry → 8hrs spraying → 16 hrs dry
→ completion of minimum test period

Test Temperature: 35 degree C
Media: 5% NaCl

1. Concentration of salt: 5% (+/-1%)
2. Pressure: 1.0 (+/-0.025)
3. Temperature: 35 °C
4. Spray density: 1 - 2 ml/h
5. Humidity: 95 - 100%

Results: There is no staining on the surface of samples after 72 hrs.

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FERRITIC STAINLESS STEEL

General Characteristics:

430 alloy is the most commonly used ferritic stainless steel containing 16% minimum Chromium. It exhibits good corrosion resistance in mildly corrosive environments and good oxidation resistance at elevated temperatures. Grade 430 is ductile in annealed condition, does not work harden excessively during cold work and can be formed using a variety of roll forming or mild stretch forming operations as well as the more common deep drawing and bending processes.

This alloy is magnetic in all conditions and is generally not susceptible to stress corrosion cracking. Grade 430 displays excellent polishing characteristics and is therefore extensively used in applications such as architectural appliances and other surface critical applications.

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Ni	%Cr
UNS S43000	Min	--	--	--	--	--	--	16.0
	Max	0.12	1.00	0.030	0.040	1.00	0.75	18.0

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 - UNS S43000	450 min	205 min	22 min	89 HRB max

Physical Properties:

Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion (μm/m/°C)	Thermal Conductivity (W/m °C)	Specific Heat (J/Kg °K)	Electrical Resistivity (μΩm)
7700	200	10.3	25.9	460	600

Products available:

Hot Rolled Plates & Coil, Cold Rolled Coil & Sheets

Applications:

- *Decorative Panels*
- *Home appliances: Dish Washers, Washing Machine, Sinks, Refrigerator*
- *Automotive trims*

Corrosion Resistance:

Grade 430 has excellent corrosion resistance to a wide variety of corrosive media including nitric acid and many organic and food acids. Being ferritic, stress corrosion cracking resistance of this alloy is very high and may be used where 304 stainless steel might fail under this condition. However, this grade does not provide the same resistance to pitting in chloride and acid containing media that is provided by austenitic stainless steels with higher chromium content.

Oxidation Resistance:

Because of its more than 16% chromium content, the alloy provides good resistance to oxidation up to 875°C for intermittent service, and up to 740°C for continuous service. Because of its low thermal expansion, the scale formed is tightly adherent and not easily shed during sudden temperature changes.

Formability:

Grade 430 is readily cold formed by the standard methods such as bending, deep drawing, contour forming, etc. Compared to the austenitic grades, 430 steel has a low work hardening rate, which is reflected in its low elongation and consequently this grade is less appropriate for stretch forming applications than austenitic grades. However, the low work hardening of the type 430 is favorable in compressive forming (extrusion, cold stamping, upsetting, coin and spinning). In pure deep drawing 430 grade can even surpass the performance of 304 grade.

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STABILIZED FERRITIC STAINLESS STEEL

General Characteristics:

J432 contains more than 17% Cr coupled with molybdenum and niobium. It exhibits high corrosion resistance in various oxidizing environments. 432 is low cost grade of J436L due to low molybdenum content. The presence of niobium in 432 improves high temperature oxidation resistance, creep and thermal fatigue resistance. In addition, it leads to a fine equiaxed grain structure with excellent deep drawability. Being a ferritic grade, it is endowed with excellent resistance to stress corrosion cracking in the presence of chlorides.

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Cr	%Mo	%N	%Nb
JIS G4305 - SUS436J1L	Min	--	--	--	--	--	17.0	0.40	--	8*(C+N)
	Max	0.025	1.00	0.030	0.040	1.00	20.0	0.80	0.025	0.80

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
JIS G4305 - SUS436J1L	410 min	245 min	20min	90 HRB max

Physical Properties:

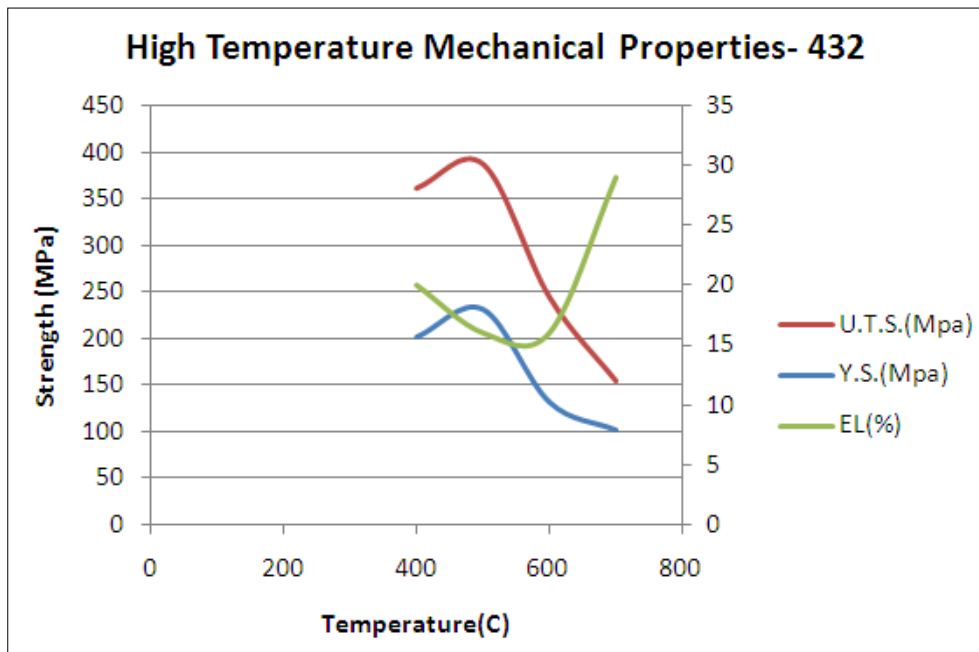
Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion (μm/m/°C)	Thermal Conductivity (W/m °C)	Specific Heat (J/Kg °K)	Electrical Resistivity (μΩm)
7700	205	10.4	25.2	454	600

Products available:

Hot Rolled & Cold Rolled coils and sheets

Applications:

- Visible parts of Automotive Exhaust: Central & Rear Muffler, Exhaust pipes
- Automotive trim and outdoor panels
- Kitchen furnishing
- Home appliances



Corrosion Resistance:

J432 grade provides excellent general corrosion resistance and pitting or crevice corrosion resistance in salt spray environment. The ferritic structure of this grade provides excellent resistance to stress corrosion cracking in presence of chlorides. Stabilization with niobium results superior resistance to inter-granular corrosion and high drawability in weld zone.

Oxidation Resistance:

This alloy exhibits good oxidation resistance at high temperatures upto 900°C.

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STABILIZED FERRITIC STAINLESS STEEL

General Characteristics:

436L contains more than 16% Cr along with molybdenum and niobium. It exhibits high corrosion resistance in various oxidizing environments. The addition of molybdenum enhances its pitting and crevice corrosion resistance. The presence of niobium in 436L improves high temperature oxidation resistance, creep and thermal fatigue resistance. In addition, it leads to a fine equiaxed grain structure with excellent deep drawability. Being a ferritic grade, it is endowed with excellent resistance to stress corrosion cracking in the presence of chlorides.

There exists a titanium stabilized variant of 436L in which Niobium is replaced by titanium. As per JIS G4305, the minimum content of chromium is 16% in this grade as shown below:

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Ni	%Cr	%Mo	%N	%Ti	%Nb
UNS S43600	Min	--	--	--	--	--	--	16.0	0.75	--	--	5XC
	Max	0.12	1.00	0.030	0.040	1.00	--	18.0	1.25	--	--	0.80
JIS G4305 - SUS 436L	Min	--	--	--	--	--	--	16.0	0.75	--	8X(%C+%N)	--
	Max	0.025	1.00	0.030	0.040	1.00	0.50	19.0	1.50	0.025	0.75	--

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 – UNS S43600	450 min	240 min	22 min	89 HRB max
JIS G4305 – SUS 436L	410 min	245 min	20 min	96 HRB max

Physical Properties:

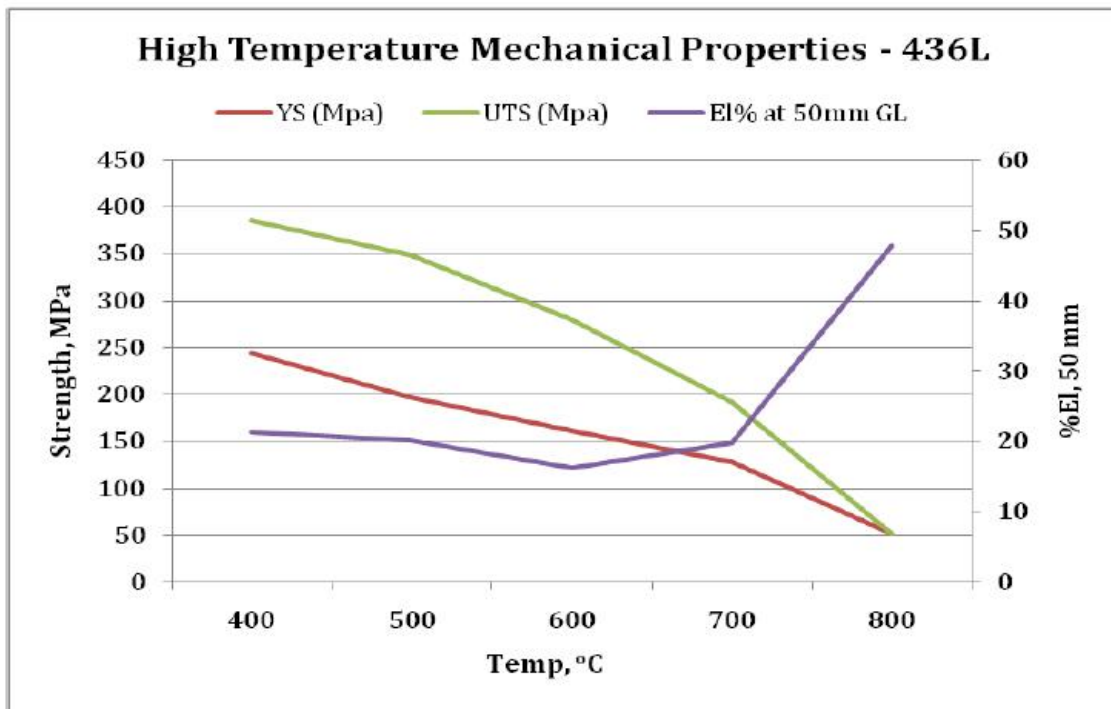
Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion (μm/m/°C)	Thermal Conductivity (W/m °C)	Specific Heat (J/Kg °K)	Electrical Resistivity (μΩm)
7800	200	11.5	24.2	454	600

Products available:

Hot Rolled & Cold Rolled coils and sheets

Applications:

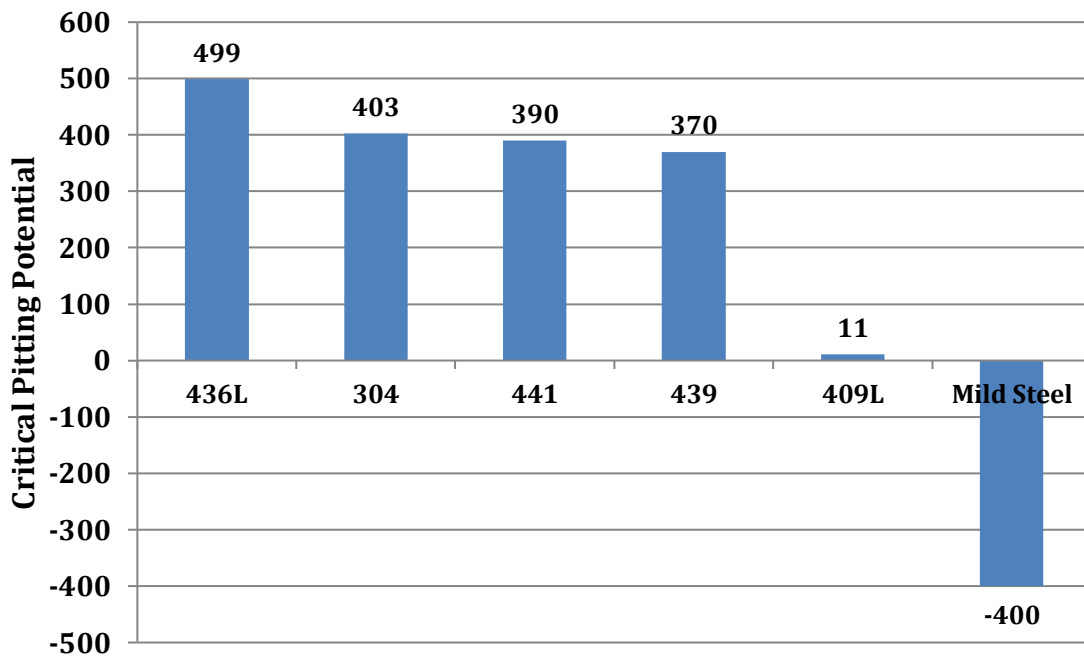
- Visible parts of Automotive Exhaust: *Central& Rear Muffler, Exhaust pipes*
- *Automotive trim and outdoor panels*
- *Solar Water heater*
- *Communication system shelter*



Corrosion Resistance:

This alloy provides excellent general corrosion resistance and pitting or crevice corrosion resistance in salt spray environment, thus ensuring excellent corrosion resistance in synthetic muffler condensate testing. The ferritic structure of 436L alloy provides excellent resistance to stress corrosion cracking in presence of chlorides. It is stabilized with niobium or titanium thus providing resistance to inter-granular corrosion and high performance drawability in weld zone. The following table and figures show the relative critical pitting potential for 1000ppm chloride.

Critical Pitting Potential for 1000ppm chloride



Oxidation Resistance:

This alloy exhibits good oxidation resistance at high temperatures upto 900 °C.

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STABILIZED FERRITIC STAINLESS STEEL

General Characteristics:

439 is a higher grade version of 409L which contains more than 17% Cr. The higher chromium content provides an increased level of corrosion/oxidation resistance in various oxidizing environments from fresh water to boiling acids. The stabilization of carbon and nitrogen with titanium exhibits good resistance to inter-granular corrosion. This grade is approximately equal to that of austenitic grade AISI 304 in terms of resistance to general and pitting corrosion and this grade replaces 430 when better performances in ductility, formability, inter-granular corrosion are required in the as-welded condition.

439 is a good choice for the manufacture of automotive exhaust systems when application temperatures are too high for 409L.

Chemical Composition:

UNS		%C	%Mn	%S	%P	%Si	%Ni	%Cr	%N	%(Ti+Nb)	%Al
S43932	Min	--	--	--	--	--	--	17.0	--	0.2+4X(C+N)	-
	Max	0.030	1.00	0.030	0.040	1.00	0.50	19.0	0.030	0.75	0.15

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 – UNS S43932	415 min	205 min	22 min	89 HRB max

Physical Properties:

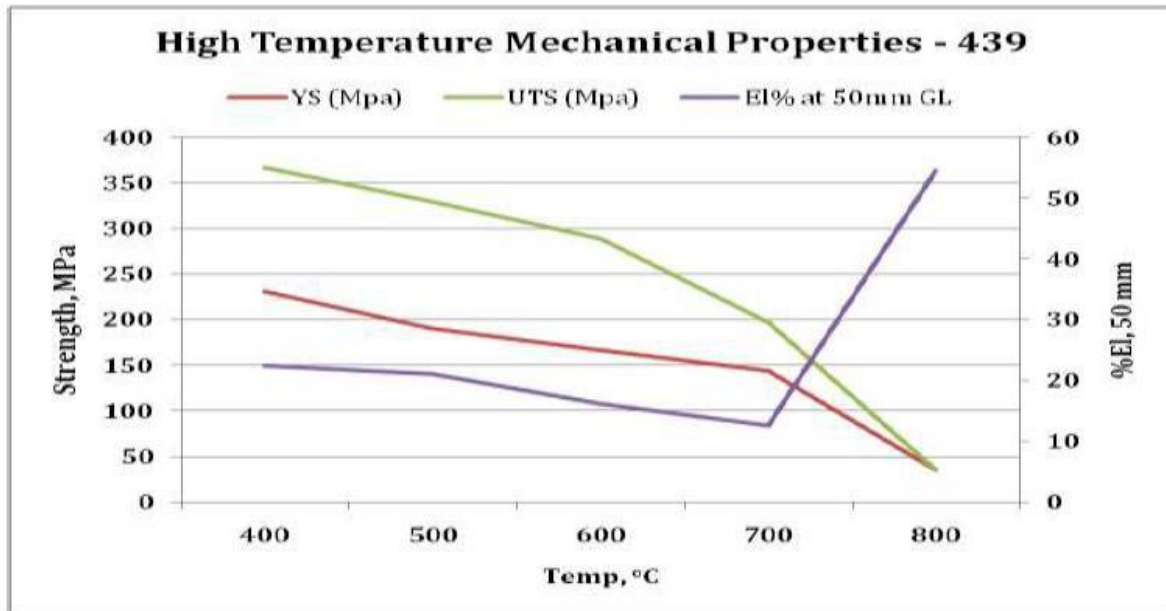
Density (Kg/m ³)	Modulus of Elasticity (GPa)	Thermal Conductivity (W/m °C)	Specific heat (J/Kg °K)	Electrical Resistivity (μΩm)
7700	220	25.4	460	600

Products available:

Hot Rolled Coil, Cold Rolled Coil & Sheets

Applications:

- Automotive Exhaust system: Manifolds, Central mufflers, catalytic converters
- Direct fired hot water tanks
- Electrical appliance: Washing machine



Corrosion Resistance:

439 increases 430 application choices as titanium stabilization allow the grade to obtain good inter-granular corrosion resistance. The stabilization of the sulphur by the titanium increases the resistance to pitting corrosion, thus ensuring pitting resistance of this grade to be superior to that of AISI 304. This grade is not subject to stress corrosion cracking which may cause premature failure of AISI 304 in presence of chloride bearing environments such as hot waters used in heat exchangers.

Oxidation Resistance:

439 has higher oxidation resistance than AISI 304 in oxidizing atmosphere, for temperatures above 850 °C. AISI 304 forms an external scale which is non adherent at 950 °C in oxygen atmosphere which leads to a higher oxidation rate. Due to addition of nitride and carbide forming element titanium, the structure of the stabilized 17%Cr steels is fully ferritic at all temperatures, thus ensuring this property has a beneficial effect on the oxidation resistance of these steels, due to the absence of any ferrite to austenite phase transformation which could damage the protective oxide film.

Table: Comparison of weight gain b/w 409L and 439 for 100hr oxidation in still air

No of hours	Temperature (°C)	Weight Gain(mg/cm ²)	
		409L	439
100 Hour Oxidation in still air	750	0.1	0.05
	830	0.8	0.2
	900	6	0.5
	940	24	1
	980	70	1.4
	1050	160	2.5

From above table, it is clearly evident that recommended service temperature for 409L is up to 800 °C and for 439 is (850-950) °C.

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STABILIZED FERRITIC STAINLESS STEEL

General Characteristics:

This grade contains more than 17.5% chromium endowing it with good corrosion resistance. It is dual stabilized with niobium and titanium, thus ensuring excellent resistance to inter-granular corrosion. The addition of niobium improves high temperature oxidation resistance, creep and thermal fatigue resistance. In addition, it leads to a fine equiaxed grain structure with excellent deep drawability. On account of very low interstitial content and stabilization, this steel is characterized by good weldability and retains good mechanical properties in heat affected zone of weld.

441 is a good choice for the manufacture of automotive exhaust systems that require good mechanical strength at high temperature, corrosion resistance at high and low temperature and good cold ductility.

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Cr	%Ti	%Nb
UNS S43940	Min	--	--	--	--	--	17.5	0.10	0.3+3*C
	Max	0.030	1.00	0.015	0.040	1.00	18.5	0.60	--

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 - UNS S43940	430 min	250 min	18 min	88 HRB max

Physical Properties:

Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion (μm/m/°C)	Thermal Conductivity (W/m °C)	Specific Heat (J/Kg °K)	Electrical Resistivity (μΩm)
7700	220	10.0	26.0	470	600

Products available:

Hot rolled and Cold Rolled coils and sheets

Applications:

- Automotive Exhaust system: Manifold, Catalytic converter
- Solar hot water tank, Solar Collector, Solar panel
- Exchanger tubes

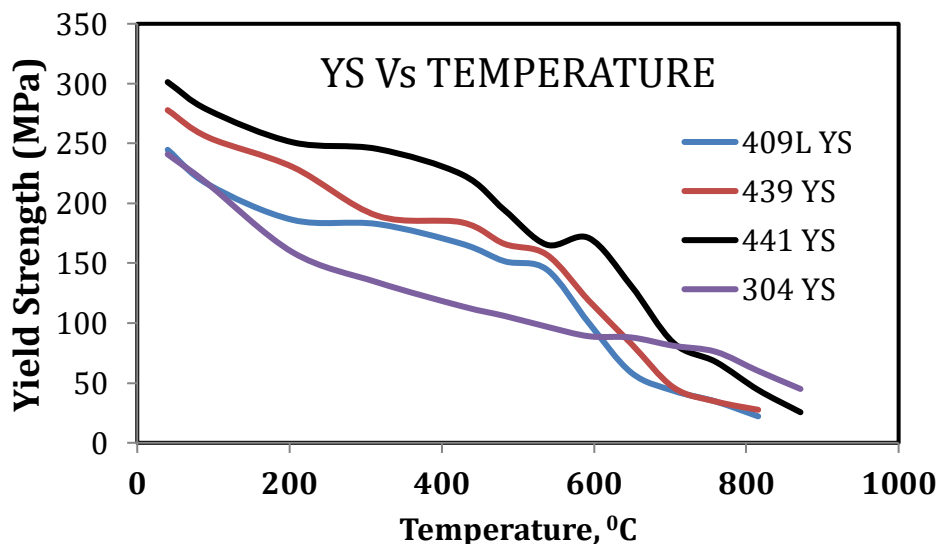
Corrosion Resistance:

In addition to good resistance to inter granular corrosion, being ferritic 441 has very high resistance to stress corrosion cracking. The following tables show the relative corrosion resistance compared to types 304, 439, 409L in a variety of laboratory tests.

5% Neutral Salt Spray Test-ASTM B117		
Grade	Time of Exposure in Hours	Surface Attack
441	500	No
304	500	No

Oxidation Resistance and Strength at high temperature:

This alloy exhibits good oxidation resistance at high temperatures and in particular cyclic oxidation, enabling its use up to 980 °C.



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DUAL-STABILIZED FERRITIC STAINLESS STEEL

General Characteristics:

444 is a dual stabilized ferritic stainless steel containing 1.75% molybdenum. Grade 444 is a low-carbon, low nitrogen ferritic stainless steel with exceptional pitting and crevice corrosion resistance, superior to most ferritic stainless steels. Thanks to the molybdenum alloying and rather high 17.5 % chromium content, the grade has excellent corrosion properties. Considering weldability, it is also stabilized with titanium and niobium which reduces or prevents the sensitization and formation of martensite. Grade 444 routinely used as SCC resistant grades for hot water tank applications. Current uses include food processing, brewery and wine-making equipment; hot-water tanks and heat exchanger tubing and automotive components.

Chemical Composition:

Designation	%C	%Mn	%S	%P	%Si	%Ni	%Cr	%Mo	%N	%(Ti+Nb)
UNS S44400	Min	--	--	--	--	--	17.5	1.75	--	0.20+4*(C+N)
	Max	0.025	1.00	0.030	0.040	1.00	19.5	2.50	0.035	0.80

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240 – UNS S44400	415 min	275 min	20min	96 HRB max

Physical Properties:

Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion(μm/mK)	Thermal Conductivity (W/m K)	Specific Heat (J/Kg K)	Electrical Resistivity (μΩm)
7750	200	10.8	26.8	430	570

Products available:

Hot Rolled & Cold Rolled coils and sheets

Applications:

- *An ideal material for heat exchangers, water heaters and Boilers.*
- *Addition of molybdenum and high chromium content make it an alternative to acid-proof austenitic stainless steel for special applications*
- *Applications requiring superior corrosion resistance and resistance to chloride stress corrosion cracking are ideal for this grade*

Corrosion Resistance:

Grade 444 provides excellent corrosion resistance in many types of environments that include chlorides and organic acids found in foods and beverages. It also provides satisfactory resistance to dilute sulfuric acid solutions.

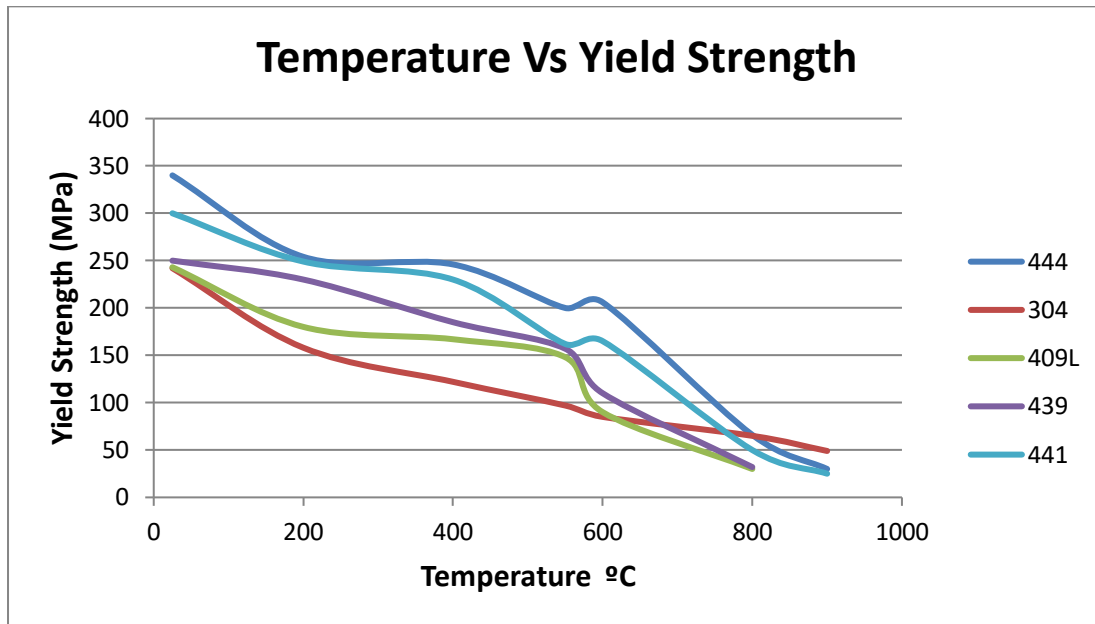
5% Neutral Salt Spray Test ASTM B-117		
Grade	Time of Exposure in Hrs	Surface attack
441	500	No
304	500	No
444	500	No

Typical stress Corrosion Cracking Test Results in Boiling solutions		
Grade	42% MgCl	26% Nacl
441	R(225 hrs)	R(500 hrs)
439	R(210 hrs)	R(500 hrs)
444	R(500 hrs)	R(500 hrs)

Note:- R=Resistant, F= Fails at indicated hours

Strength at high temperature:

Grade 444 carries high strength at elevated temperatures.



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STABILIZED FERRITIC STAINLESS STEEL

General Characteristics:

Grade 445 is low carbon ferritic stainless steels conforming to UNS S44500. This grade offers outstanding resistance to corrosion and is well suited for a wide range of applications, typically used for hot water tanks and tubing, heat exchangers, solar collector panels, food processing and handling equipment, sinks and architectural panels. Grade 445 is stabilized with niobium to prevent sensitization and intergranular corrosion when welded. This grade is not susceptible to chloride stress corrosion cracking. The alloy cannot be strengthened by heat treatment as work hardening of ferrite is much less than for austenite.

Chemical Composition:

Designation	%C	%Mn	%S	%P	%Si	%Ni	%Cr	%Cu	%N	%Nb
UNS S44500	Min	--	--	--	--	--	19.0	0.30	--	10X(C+N)
	Max	0.020	1.00	0.012	0.040	1.00	21.0	0.60	0.03	0.80

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
ASTM A240	427 min	205 min	22 min	83 HRB max

Physical Properties:

Density (Kg/m ³)	Modulus of Elasticity (GPa)	Coefficient of thermal expansion (μm/m/°C)	Thermal Conductivity (W/m °C)	Specific Heat (J/Kg °K)	Electrical Resistivity (μΩm)
7700	200	11.8	25.8	460	700

Products available:

Cold Rolled coils and sheets

Applications:

- **White goods:** Dish washer and dryers, refrigerator business use, microwave ovens, washing machine tubs, induction heaters, rice cookers
- **Automotive Exhaust system:** Catalytic converter
- **Kitchenware:** Cookware

Corrosion Resistance:

Grade 445 has equivalent corrosion resistance to SUS304 in general environment. No rusting was observed in the materials after exposure of 500 hrs in salt spray (ASTM B-117).

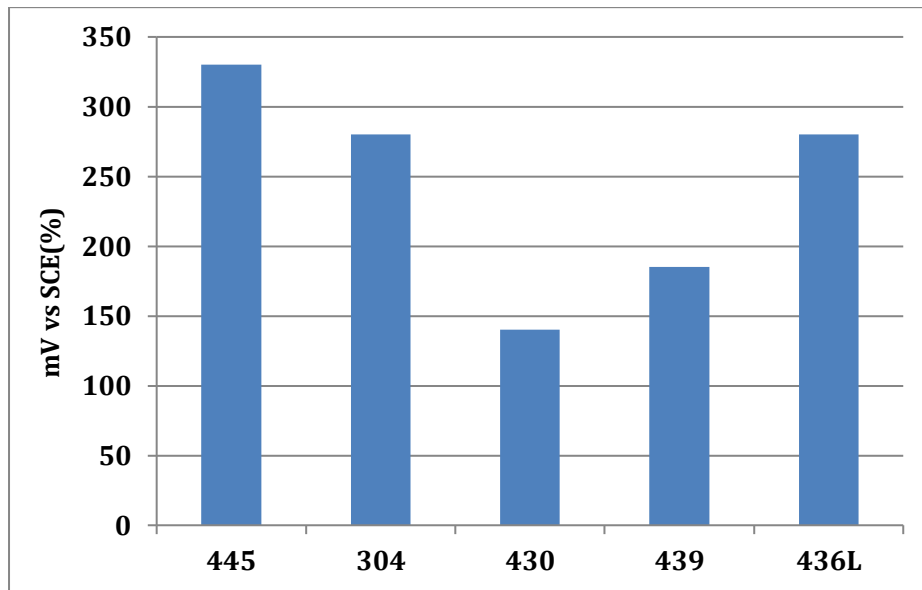


Fig1. Pitting potential measurement (3.5% NaCl at 25 °C)

PREN No: $\%Cr + 3.3 * \%Mo + 16 * \%N = 19.5$ approximately

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MARTENSITIC STAINLESS STEEL

General Characteristics:

J410 is martensitic stainless steel having moderate corrosion resistance and supplied in annealed conditions.

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Cr	%Ni
UNS S41000	Min	0.08	--	--	--	--	11.5	--
	Max	0.15	1.00	0.030	0.040	1.00	13.5	0.75

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
UNS S41000	450 min	205 min	20 min	96 HRB max

Products available:

Hot Rolled & Cold Rolled coils and sheets

Applications:

- Cutlery, knives,
- Pump parts, valves, fasteners

Corrosion Resistance:

This alloy has good corrosion resistance to mild atmospheres. The surface should be properly passivated and free from foreign contamination for best results.

The safe limit for continuous service temperature is upto 650°C after which scaling formation is observed.

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MARTENSITIC STAINLESS STEEL

General Characteristics:

J410DB is designed for Disc Brake application as per customer specifications.

Chemical Composition: (as per Specs)

	%C	%Mn	%S	%P	%Si	%Ni	%Cr	%N
Min	--	1.00	--	--	--	--	10.0	--
Max	0.09	2.50	0.030	0.040	0.50	0.60	14.50	0.030

Mechanical Properties: (as per Specs)

UTS (MPa)	YS (MPa)	%EL	Hardness
410 min	205 min	20 min	75-88 HRB

Products available:

Hot Rolled coils and sheets

Applications:

- Disc Brake for two-wheelers and four-wheelers.

Corrosion Resistance:

This material has superior abrasion resistance coupled with moderate corrosion resistance required for disc brake applications.

MARTENSITIC STAINLESS STEEL

General Characteristics:

J415 is designed for applications requiring high toughness (imparted by Ni) and good corrosion resistance (low carbon and higher Chromium along with Molybdenum).

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Ni	%Cr	%Mo	%N
UNS S41500	Min	--	0.50	--	--	--	3.5	11.5	0.5	--
	Max	0.05	1.00	0.030	0.030	0.60	5.5	14.0	1.0	--

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness Brinell
ASTM A240	795 min	620 min	15 min	302 max

Products available:

Hot Rolled plates

Applications:

- Heavy engineering applications

Corrosion Resistance:

This grade has good corrosion resistance to mild acids and alkalis and moderate levels of chlorine concentrations.

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MARTENSITIC STAINLESS STEEL

General Characteristics:

J420 grades are hardenable martensitic stainless steel used for cutlery, pump bushings and valves.

Chemical Composition:

Grade		%C	%Mn	%S	%P	%Si	%Ni	%Cr	%N
420J1 (JIS G4305)	Min	0.16	--	--	--	--	--	12.0	--
	Max	0.25	1.00	0.030	0.040	1.00	0.6	14.0	--
420J2 (JIS G4305)	Min	0.26	--	--	--	--	--	12.0	--
	Max	0.40	1.00	0.030	0.040	1.00	0.6	14.0	--

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness
420J1 (JIS G4305)	520 min	225 min	18 min	97 HRB max
420J2 (JIS G 4305)	540 min	225 min	18 min	99 HRB max

Products available:

Hot Rolled coils and sheets

Applications:

- Cutlery
- Pump Valves/ Bushings
- Screw-drivers.

Corrosion Resistance

This grade has moderate corrosion resistance to atmosphere, fresh water, mild acids present in fruit juices and milk like lactic, tartaric, citric acids, mild alkalis etc.

The corrosion resistance is best in hardened and tempered conditions.

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MARTENSITIC STAINLESS STEEL

General Characteristics:

J431 is hardenable stainless steel with good toughness values due to nickel and relatively better corrosion resistance due to lower Carbon and higher Chromium contents.

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Ni	%Cr
UNS S43100 (ASTM A176)	Min	--	--	--	--	--	1.25	15.0
	Max	0.20	1.00	0.030	0.040	1.00	2.50	17.0

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL	Hardness (Brinell)
ASTM A176	--	--	--	285 max

Products available:

Hot Rolled plates/ sheets

Applications:

- Heavy machinery structural components

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FERRITIC STAINLESS STEEL

General Characteristics:

Type EN1.4003 is a utility ferritic stainless steel which is a moderate modification of 12%Cr stainless steel grades 409 and 410 and has a chemistry to ensure good weldability. This grade is suitable for many applications where carbon steel, galvanized, aluminized, painted steel or aluminum give unsatisfactory life. It offers the benefits of highly alloyed steels such as strength, abrasion resistance, durability and low maintenance. In addition, EN1.4003 is weldable and formable allowing it to be fabricated using conventional techniques. Type EN1.4003 stainless steel conforms to EN1.4003 as per EN 10088-2 and UNS S40977/S41003 as per ASTM A240.

Chemical Composition:

Table 1

Grade		%C	%Mn	%S	%P	%Si	%Ni	%Cr	%N
EN1.4003/S40977	Min	-	-	-	-	-	0.30	10.50	-
	Max	0.030	1.50	0.015	0.040	1.00	1.00	12.50	0.030

UNS		%C	%Mn	%S	%P	%Si	%Ni	%Cr	%N
S41003	Min	-	-	-	-	-	-	10.50	-
	Max	0.030	1.50	0.030	0.040	1.00	1.50	12.50	0.030

Mechanical Properties:

Table 2

Grade	Product Form	Thickness (mm) Max	Yield Strength (MPa, min)	Tensile Strength (MPa)	Elongation (%in 50mm) min	Hardness	
						Rockwell Max	Brinell max
EN1.4003	cold rolled strip	8	280(long)	450-650	20	--	--
	hot rolled strip	13.5	320(transverse)				
	hot rolled plate	25	250(long) 280(transverse)		18		
S40977	--	--	280	450 min	18	88 HRB	180
S41003	--	--	275	455 min	18	20 HRC	223

Physical Properties:

Table 3

Density (kg/m ³)	Elastic Modulus (GPa)	Coefficient of thermal expansion (µm/m/°C)			Thermal Conductivity (W/m.°C) 100°C	Specific Heat 0-100°C (J/kg.K)	Electrical Resistivity(nΩ.m)
		0-100°C	0-300°C	0-550°C			
7700	220	10.4	11.2	11.9	25	430	600

Products available:

- *Forms: Coils, sheets, strips and plates.*
- *Hot rolled thicknesses: 2.5 to 60mm*
- *Cold rolled thickness: 0.5 to 3mm*
- *Width up to 1650mm*
- *Finish: No 1, 2D, 2B*

Applications:

The properties of type EN1.4003 make it the ideal material for all applications of conventional structural steel, with the advantage of improved resistance to service in moderately corrosive environments. Some of the applications are:

- *Bulk wet materials handling*
- *Vehicle frame/chassis*
- *Rail car hoppers*
- *Sweeper/gritter vehicles*
- *Conveyors, chutes, screens, troughs*
- *Bunkers, hoppers*
- *Tanks and containers*
- *Chimneys, ducting*
- *Enclosures, cabinets*
- *Walkways, stairs, railings*

Weldability:

Type EN1.4003 has a fine-grained microstructure which reduces growth in the heat affected zone (HAZ) allow high integrity welds in section thicknesses up to 30mm. It can be fabricated easily and is weldable by conventional techniques such as SMAW, GTAW, FCAW, PAW, laser resistance, spot and seam to austenitic stainless steels. All welding procedures must ensure that heat inputs are kept to a minimum - particularly GTAW (TIG) and GMAW (MIG). Filler wire pre-qualified by AS 1554.6 (EN1.4003 referred to as "4003") is grade 309, although 309L, 309Mo, 316L and 308L are being used successfully. Argon plus 1-2% oxygen shielding gases are recommended. The weld discolouration should be removed by pickling and passivating to restore maximum corrosion resistance

Cost Benefit:

Type EN1.4003 was developed to offer lower cycle costs than coated carbon steels where service conditions involve corrosion and/or abrasion. As compared to coated carbon steels, there are options to reduce initial cost by elimination of protective coatings and corrosion allowances. In service cost savings come from reduced maintenance and significantly longer life.

As type EN1.4003 does not contain significant quantities of expensive alloying elements such as Nickel and Molybdenum, this is a lower cost material than austenitic stainless steel and can be considered as an alternative option where these grades are not an economically viable choice.

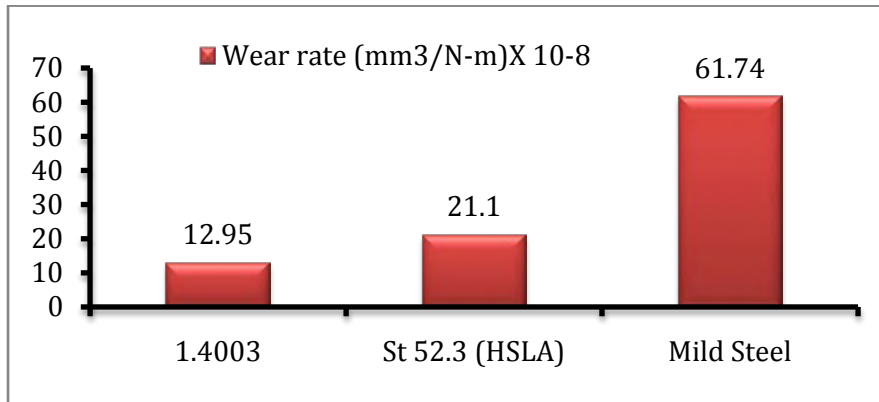
Corrosion Resistance:

Type EN1.4003 is effective in many applications where carbon steel, galvanized, aluminized or painted steel or aluminum give unsatisfactory life. The atmospheric corrosion testing of type EN1.4003 has given corrosion rates as low as 0.0015-0.003mm/year in moderate marine environments- an improvement of 250 times the life of unpainted mild steel under the same

conditions. This grade is not recommended for decorative purposes because in aggressive environments, it will tend to form a light surface discolouration. This discolouration is superficial and does not affect the structural performance of the steel. Alternatively, corrosive protective coatings, like epoxy or acrylic based primers and paint systems, can be applied where aesthetics is a key requirement.

Wear Resistance:

EN1.4003 grade is known for its high wear resistance. Under the sliding wear test condition EN1.4003 grade is 1.6 times better than HSLA steel and 4.7 times better than normal mild steel.



Oxidation Resistance:

Type EN1.4003 has good oxidation resistance in intermittent service up to 740°C and in continuous service up to 650°C . But if under stress, the temperature should be limited to 450°C in continuous or 600°C in intermittent. This grade suffers negligible embrittlement after extended exposure at temperatures of $450\text{-}550^{\circ}\text{C}$. Thus it can be used safely at these temperatures without loss of impact toughness at room temperature.

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MARTENSITIC STAINLESS STEEL

General Characteristics:

EN1.4116 are hardenable martensitic stainless steels used for cutlery applications.

Chemical Composition:

Designation		%C	%Mn	%S	%P	%Si	%Ni	%Cr	%Mo	%N	%V
EN 1.4116 (EN 10088-2)	Min	0.450	--	--	--	--	--	14.0	0.50	--	0.10
	Max	0.550	1.00	0.015	0.040	1.00	--	15.0	0.80	--	0.20

Mechanical Properties:

Mechanical properties	UTS (MPa)	YS (MPa)	%EL (min)	Hardness (Max)
EN 1.4116 (EN 10088-2)	850 max.	--	12	100 HRB

Products available:

Hot Rolled coils and Cold rolled coils

Applications:

Cutlery applications e.g. Professional knives.

Corrosion Resistance:

This grade has good corrosion resistance due to higher Chromium and addition of Molybdenum.

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