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Stainless steels for highly corrosive environments

Outokumpu Supra range datasheet

General characteristics

The Supra range contains nine stainless steel products designed for highly corrosive environments (PRE 22 to 27).

Key product

Outokumpu name	Typical applications	Product forms
Supra 316L/4404 Our most widely used molybdenum-alloyed austenitic stainless steel. Supra 316L/4404 is a low-carbon alternative and is used in various process industries and other aggressive environments with higher than average corrosion resistance requirements. Due to its low carbon content, this product is also weldable in thicknesses of more than 5–6 mm/0.19–0.23 in.	• Chemical industry • Petrochemical industry • Pulp and paper industry • Textile industry • Food and beverage industry • Pharmaceutical industry • Medical applications • Flanges and valves	C, H, P, B, R, S, T

Alternatives

Outokumpu name	Typical applications	Product forms
Supra 316/4401 A normal-carbon alternative to Supra 316L/4404 that is widely used for various applications.	• Heat exchangers • Flanges and valves	C, H, P, B, R, S, T
Supra 316plus The highest strength stainless steel in the Supra range. Supra 316plus is a cost-efficient, 21Cr lower-nickel/molybdenum alternative to traditional molybdenum austenitics like Supra 316L. This product has good formability, excellent weldability, and is usable in cryogenic applications.	• Process and transport tanks • Water treatment and pipes • Heat exchangers • Architectural applications	C, H, P
Supra 316L/SANS4402 A high-strength, high-formability product often used in container transports and where there is an elevated temperature requirement.	• Container tanks	C, H, P
Supra 316L/4432 A product with high resistance to non-oxidizing acids and chloride-containing media due to higher molybdenum content. Supra 316L/4432 has good formability and weldability.	• Drinking water systems • Cooling systems • Wastewater systems • Flanges and valves	C, H, P, B, R, S, T

Outokumpu name	Typical applications	Product forms
Supra 316/4436 A Supra 316L/4432 alternative with higher carbon content and similar corrosion resistance.	• Pulp and paper industry equipment • Pharmaceutical industry equipment • Flanges and valves	C, H, P, B, R, S, T
Supra 316L/4435 A Supra 316L/4432 alternative with higher chromium and nickel content for enhanced corrosion resistance and formability.	• Urea plants • Pulp and synthetic fiber plants • Flanges and valves	C, H, P, B, R, S, T
Supra 316Ti/4571 A titanium-stabilized, molybdenum-alloyed austenitic alternative to Supra 316L/4404 – mainly used in Germany for elevated temperature applications. Due to its titanium-stabilization this product is weldable in all thickness ranges.	• Flue gas applications • Flanges and valves	C, H, P, B, R, S, T

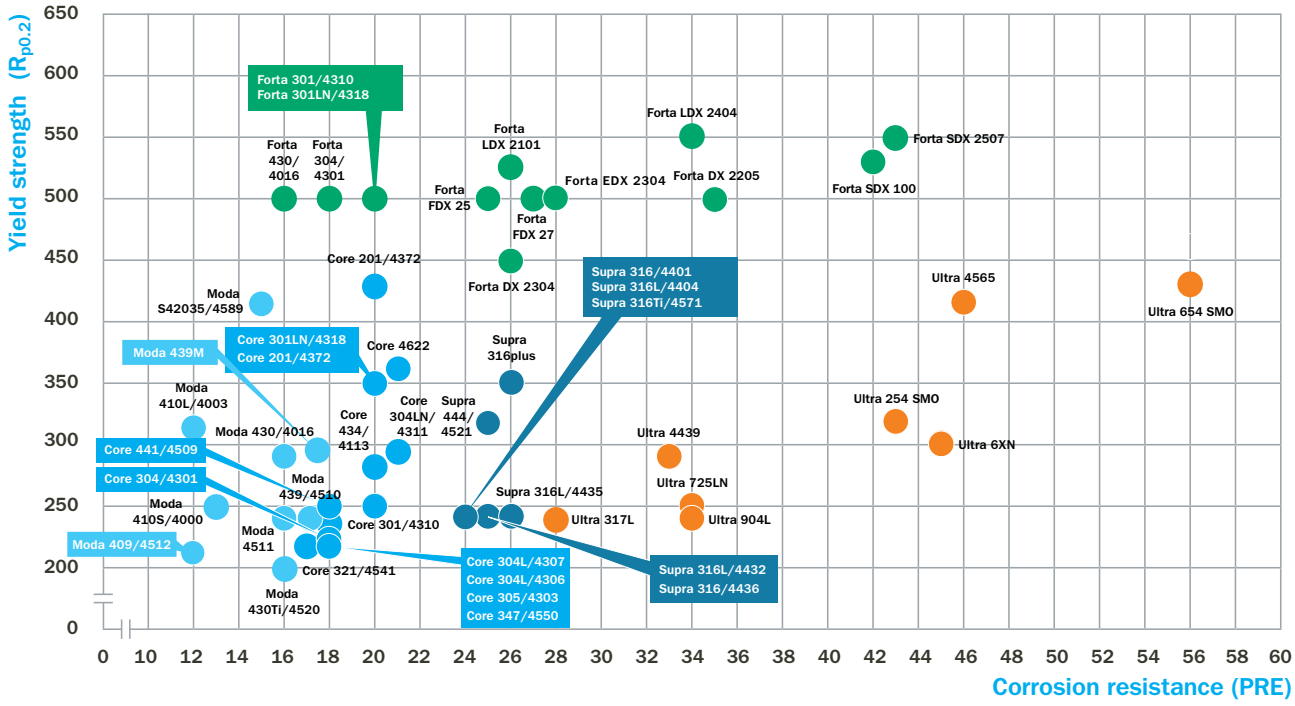
Nickel-free stainless steels

Outokumpu name	Typical applications	Product forms
Supra 444/4521 A nickel-free molybdenum alloyed ferritic stainless steel with very good corrosion resistance, good cold formability and high strength. Supra 444/4521 allows for thinner walls in tanks and is not prone to stress-corrosion cracking.	• Hot water tanks • Drinking water pipes	C, H, P, S

Product forms:
C = Cold rolled coil and sheet
H = Hot rolled coil and sheet
P = Quarto plate
B = Bar
R = Wire rod
S = Semi-finished (bloom, billet, ingot & slab)
T = Pipe

Product performance comparison

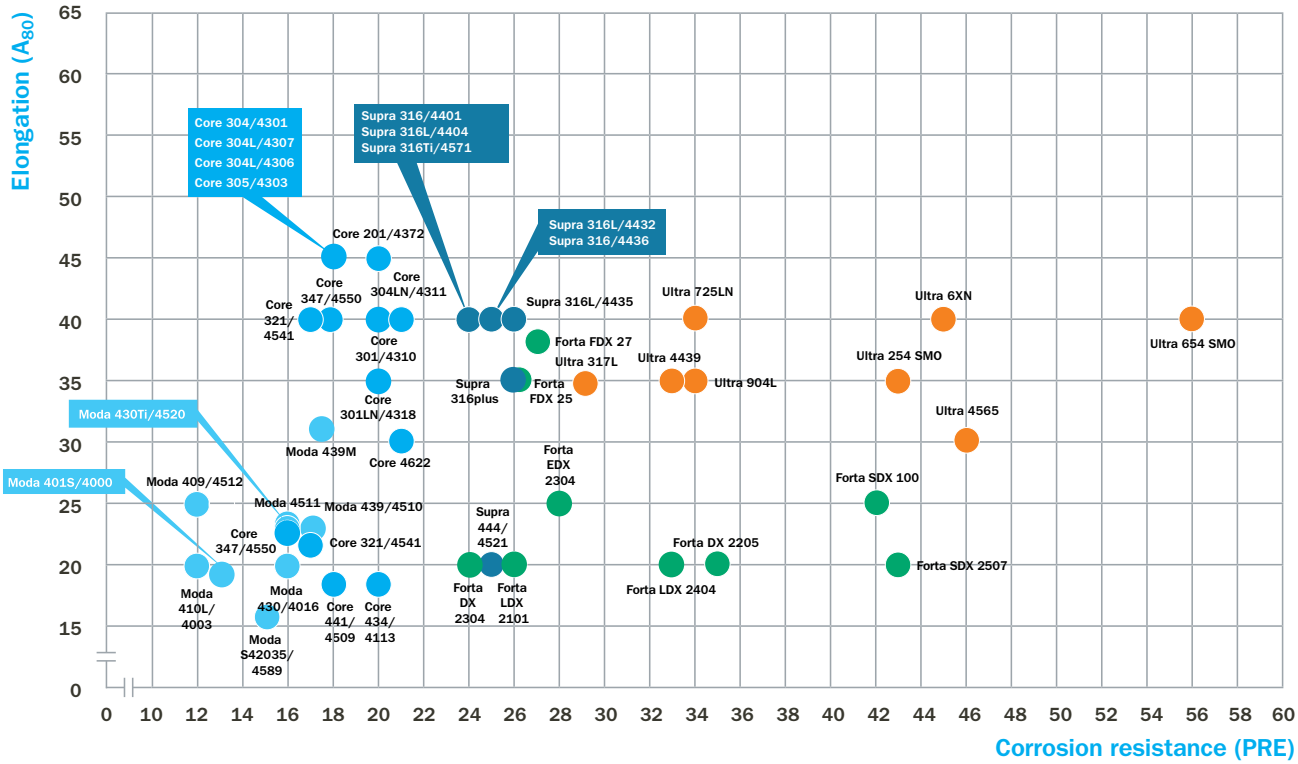
Yield strength vs. corrosion resistance



PRE calculation = %Cr + 3.3 x % Mo + 16 x %N

Note: PRE values shown are Outokumpu typical values. Yield strength ($R_{p0.2}$) according to EN 10088-2 minimum values for cold rolled strip. For more values by product, please see **steelfinder.outokumpu.com**

Elongation vs. corrosion resistance



- Moda – Mildly corrosive environments (PRE up to 17)
- Core – Corrosive environments (PRE 17 to 22)
- Supra – Highly corrosive environments (PRE 22 to 27)
- Forta – Duplex and other high strength (PRE 18 to 43)
- Ultra – Extremely corrosive environments (PRE > 27)

PRE calculation = %Cr + 3.3 x % Mo + 16 x %N

Note: PRE values shown are Outokumpu typical values. Elongation (A_{80}) according to EN 10088-2 minimum values for cold rolled strip. For more values by product, please see **steelfinder.outokumpu.com**

Products and dimensions

To find the minimum and maximum thickness and width by surface finish for a specific product in the Supra range, please visit **steelfinder.outokumpu.com**

Chemical composition

Supra 316/4401 and Supra 316L/4404 are used in the majority of application areas, and are widely available around the world. Some applications require more specific properties, and for this reason a number of other closely related austenitic steels, generally with modified alloying compositions, are also available. These include:

- Stainless steels containing nitrogen for higher strength
- Stainless steels with lower nickel content to promote higher work hardening
- Stainless steels with higher nickel content for specialist cryogenic applications or to increase deep drawability
- Stainless steels with titanium stabilization to improve corrosion resistance at elevated temperatures

A nickel-free ferritic alternative, Supra 444/4521, is also available. Supra 444/4512 has good corrosion resistance and excellent deep drawability.

The chemical composition is given as % by mass.

Outokumpu name	C	Cr	Ni	Mo	N	Others	Family
Key products							
Supra 316L/4404	0.02	17.2	10.1	2.1	–	–	A
Alternatives							
Supra 316/4401	0.04	17.2	10.1	2.1	–	–	A
Supra 316plus	0.02	20.3	8.6	0.7	0.19	–	A
Supra 316L/SANS4402	0.02	17.2	10.1	2.1	–	–	A
Supra 316L/4432	0.02	16.9	10.7	2.6	–	–	A
Supra 316/4436	0.04	16.9	10.7	2.6	–	–	A
Supra 316L/4435	0.02	17.3	12.6	2.6	–	–	A
Supra 316Ti/4571	0.04	16.8	10.9	2.1	–	Ti	A
Nickel free stainless steel							
Supra 444/4521	0.02	18.0	–	2.0	–	Nb Ti	F

Table uses Outokumpu typical values. The required standard will be fully met as specified in the order.

For the full chemical composition list for different standards by stainless steel product, see **steelfinder.outokumpu.com**

Corrosion resistance

Product name	PRE
Key grades	
Supra 316L/4404	24
Alternatives	
Supra 316/4401	24
Supra 316plus	26
Supra 316L/SANS4402	24
Supra 316L/4432	25
Supra 316/4436	25
Supra 316L/4435	26
Supra 316Ti/4571	24
Nickel-free stainless steels	
Supra 444/4521	25

Pitting Resistance Equivalent is calculated using the following formula: PRE = %Cr + 3.3 x %Mo + 16 x %N. All products in the Supra range are suitable for highly corrosive environments.

Surface finish and other factors determine the actual corrosion resistance of a particular product. Contact us at outokumpu.com/contacts to discuss what product is right for your next project.

Corrosion resistance of Supra range austenitics

Supra range products have excellent corrosion resistance and are suitable for a wide range of applications.

Uniform corrosion

Uniform corrosion is characterized by a uniform attack on the steel surface that has come into contact with a corrosive medium. The corrosion resistance is generally considered good if the corrosion rate is less than 0.1 mm/0.004 in per year.

Supra range stainless steels have a good resistance to uniform corrosion in many organic and inorganic chemicals. The addition of molybdenum enhances the alloy's corrosion resistance in many acidic environments. Austenitic stainless steels that contain molybdenum are therefore sometimes denoted as 'acid-proof grades'. This does not, however, mean that these materials will not corrode in all circumstances. Strong mineral acids at elevated temperatures are environments where even higher alloyed stainless steels may need to be used. Hydrochloric acid, for example, may cause uniform corrosion, pitting, and crevice corrosion even at quite low concentrations and at moderate temperatures. For more details about highly alloyed products, see the Ultra range.

Pitting and crevice corrosion

Pitting and crevice corrosion typically occur in acidic, neutral, or slightly alkaline chloride solutions. Supra range products provide excellent resistance to pitting and crevice corrosion. Resistance to these types of corrosion is enhanced by increasing the steel's chromium, molybdenum and nitrogen content. Nickel reduces the pitting propagation rate and facilitates re-passivation after pitting corrosion has started.

Atmospheric corrosion

Supra range austenitic stainless steels offer good resistance to atmospheric corrosion in applications where superficial surface staining from incipient pitting or crevice corrosion is usually undesirable. These products can normally be used in temperate industrial and coastal areas.

When high amounts of chlorides or pollutants are present, as is the case in certain industrial areas or in marine splashing zones, higher-alloyed stainless steels from the Ultra range may need to be considered, especially if the environment is also hot or humid.

In coastal, industrial, or heavily polluted areas, regular washing can prevent the build up of deposits that can lead to corrosion. A smooth surface finish supports natural rinsing by rain water and can prolong the service interval.

Stress corrosion cracking

Supra range austenitics are susceptible to chloride-induced stress corrosion cracking (SCC). Critical service conditions – i.e. applications subjected to combinations of tensile stresses, temperatures above about 50 °C/120 °F, and solutions containing chlorides – should be avoided. Stress corrosion cracking may also occur in hot, strong alkaline solutions (above 110 °C/230 °F). Depending on the specific application, ferritic or duplex stainless steels are usually more suitable for applications demanding high resistance to SCC.

Supra range stainless steels are not suitable for load-bearing structures in swimming pool halls, such as hangers for roof constructions. To address the risk of SCC in pool environments, only the steel grades given in Eurocode 3, EN 1993-1-4 should be used for load bearing parts exposed to environments above indoor swimming pools.

Intergranular corrosion

A low carbon content extends the time required for significant sensitization. Modern steel making methods enable much lower carbon contents to be achieved.

Still, operations that increase the risk of intergranular corrosion are welding of thick sections, heat treatment operations within the critical temperature interval 550–850 °C/1020–1560 °F, and slow cooling after heat treatment or hot forming. Steels with low carbon content (< 0.03%) or with a titanium addition have better resistance to intergranular corrosion after such operations.

Corrosion resistance of Supra range ferritic stainless steels

Outokumpu produces Supra 444/4521 with a typical chromium content of 18% and molybdenum content of 2% by mass. The resistance to localized corrosion is close to the Supra 316/4401 "acidproof" austenitic. Supra 444/4521 is not susceptible to chloride-induced SCC. In solutions containing chlorides, pitting and crevice corrosion is possible depending on various parameters such as chloride concentration, temperature, pH value, redox potential, and crevice geometry. The best material performance is usually reached with the help of adequate design, correct postweld treatment, and regular cleaning during use (if applicable).

For further information on corrosion resistance, please refer to the corrosion tables in the Outokumpu Corrosion Handbook, available from our sales offices.

outokumpu.com/contacts

Mechanical properties

Outokumpu name	Product form	Yield strength $R_{p0.2}$ (MPa)	Yield strength $R_{p1.0}$ (MPa)	Tensile strength R_m (MPa)	Elongation A (%)	Elongation A_{80} (%)
Key product						
Supra 316L/4404	C	240	270	530 – 680	40	40
	H	220	260	530 – 680	40	40
	P	220	260	520 – 670	45	45
	R*	220	260	530	55	–
	B*	400	–	600	25	–
Alternatives						
Supra 316/4401	C	240	270	530 – 680	40	40
	H	240	270	530 – 680	40	40
	P	220	260	520 – 670	45	45
	R*	190	220	500	55	–
	B*	400	–	600	25	–
Supra 316plus	C*	380	–	700	45	–
	H*	390	400	710	45	–
Supra 316L/SANS4402	C**	290	330	600–680	50	50
	H**	290	320	590–680	48	48
	P**	220	260	520–670	45	45
Supra 316L/4432	C	240	270	550 – 700	40	40
	H	240	270	550 – 700	40	40
	P	220	260	520 – 670	45	45
	R *	220	260	530	55	–
Supra 316/4436	C	240	270	550 – 700	40	40
	H	240	270	550 – 700	40	40
	P	220	260	530 – 730	40	40
	R*	220	260	530	55	–
	B*	400	–	600	25	–
Supra 316L/4435	C	240	270	550 – 700	40	40
	P	220	260	520 – 670	45	45
	R*	270	310	570	55	–
	B*	400	–	600	25	–
Supra 316Ti/4571	C	240	270	540 – 690	40	40
	H	240	270	540 – 690	40	40
	P	220	260	520 – 670	40	40
	B*	400	–	600	25	–
Nickel-free stainless steel						
Supra 444/4521	C	300	–	420 – 640	–	–
	H	280	–	400 – 600	–	–
	P	300	–	420 – 620	–	–

Note: Figures according to EN 10088-2 minimum values unless marked otherwise.

*Outokumpu typical values.
**SANS 50028-7 South African National Standard

A_{80} initial length = 80 mm, A initial length = $5.65\sqrt{S0}$

Product forms: cold rolled coil and sheet (C), hot rolled coil and sheet (H), Quarto plate (P), wire rod (R), cold drawn bar, $10 < d \leq 16$mm (B). More product forms may be available than shown in the table.

For more information, please see **steelfinder.outokumpu.com**

The strength of the Supra range austenitic steels increases with increasing levels of carbon, nitrogen and, to a certain extent, molybdenum and manganese. Austenitic steels exhibit very high ductility; they have a high elongation to fracture. The steels are very tough, a property that extends to cryogenic temperatures.

Ferritic stainless steels typically have higher proof strengths than austenitic stainless steels. Elongation and forming properties are equivalent to those of standard carbon steels.

Outokumpu uses the European Standard EN 10088 where applicable. The permitted design values may vary between product forms; see the relevant specification for the correct value.

Mechanical properties at elevated temperatures

An elevated temperature is usually defined as being up to 500–600 °C/930–1100 °F, with high temperature being in excess of this. Outokumpu Supra range austenitic stainless steels possess useful elevated and high temperature strength and oxidation resistance. The highest elevated temperature strength among these steels is exhibited by the nitrogen-alloyed steels and those containing titanium or niobium. Most the products are approved for pressure vessel applications, with pressure vessel codes giving design values for temperatures up to 400 °C/750 °F. For applications such as heaters, catalytic converters, and furnaces – where pressure is not a factor – austenitic corrosion-resistant stainless steels can be used up

Outokumpu name	Product form	Yield strength $R_{p0.2}$ (ksi)	Yield strength $R_{p1.0}$ (ksi)	Yield strength R_m (ksi)	Elongation A_{50} (%)
Key product					
Supra 316L/4404	C	25	–	70	40
	H	25	–	70	40
	P	25	–	70	40
	R*	32	38	–	–
Alternatives					
Supra 316/4401	C	30	–	75	40
	H	30	–	75	40
	P	30	–	75	40
	R*	28	32	–	–
Supra 316plus	C	45	–	92	35
	H	45	–	92	35
	P	45	–	92	35
Supra 316L/4432	C*	44	48	90	–
	H*	46	52	89	–
	P*	38	41	83	–
	R*	32	38	–	–
Supra 316/4436	C*	43	48	87	–
	H*	46	52	89	–
	P*	38	44	86	–
	R*	32	38	–	–
Supra 316L/4435	C*	42	46	88	–
	P*	38	44	83	–
	R*	39	45	–	–
Supra 316Ti/4571	C	30	–	75	40
	H	30	–	75	40
	P	30	–	75	40
Nickel-free stainless steel					
Supra 444/4521	C	40	–	60	–
	P	40	–	60	–

Note: Figures according to ASTM A240 unless marked otherwise.

*Outokumpu typical values.

A_{50} initial length = 50 mm

Product forms: cold rolled coil and sheet (C), hot rolled coil and sheet (H), Quarto plate (P), wire rod (R). More product forms may be available than shown in the table.

For more information, please see **steelfinder.outokumpu.com**

to approximately 800 °C/1470 °F, depending on specific circumstances.

Structural fire resistance

The performance requirements of a stainless steel structure that may be subjected to accidental fire loading are similar to those of carbon steel. Supra range austenitic stainless steels generally retain a higher proportion of their room temperature strength than carbon steels above temperatures of about 550 °C/1000 °F, and a higher proportion of their stiffness at all temperatures.

The behavior of stainless steel differs from that of most other metals at fire temperatures in that its mechanical properties (mainly modulus of elasticity and proof strength) are maintained comparatively well up to temperatures corresponding to a 30-minute standard fire. The temperature of unprotected stainless steel after a 30-minute standard fire is 800–830 °C/1470–1520 °F depending on the thickness of the material. There are significant differences in the values of the effective proof strengths used in structural design between stainless steel grades. For example, the titanium-stabilized Supra 316Ti/4571 has higher strength values at elevated temperatures than other stainless steel products. Therefore, the selection of steel involves balancing the need for elevated temperature strength.

Where mechanical resistance in the case of fire is required, the structure should be designed and constructed in such a way that it maintains its load-bearing function during the relevant fire exposure. EN 1993-1-2 “Eurocode 3 – Design of steel structures – Part 1-2: General rules – Structural fire design”, 2010 AISC Specification for Structural Steel Buildings (AISC, 2010c) and Euro Inox “Design Manual for Structural Stainless Steel” (2006) give further guidance on fire design for stainless steels.

Mechanical properties at cryogenic temperatures

Supra range austenitic stainless steels are not susceptible to brittle fracture in the solution-annealed condition. Due to their high impact toughness at very low temperatures, they are suitable for cryogenic applications.

Physical properties

Outokumpu name	Density [kg/dm³]	Modulus of elasticity at 20 °C [GPa]	Coefficient of thermal expansion 20–100 °C [10^{-6} / K]	Thermal conductivity at 20 °C [W/(m*K)]	Thermal capacity at 20 °C [J/(kg*K)]	Electrical resistivity at 20 °C [Ω*mm² / m]
Key product						
Supra 316L/4404	8	200	16	15	500	0.75
Alternatives						
Supra 316/4401	8	200	16	15	500	0.75
Supra 316plus	7.9	200	16	15	500	0.75
Supra 316L/SANS4402	8	200	16	15	500	0.75
Supra 316L/4432	8	200	16	15	500	0.75
Supra 316/4436	8	200	16	15	500	0.75
Supra 316L/4435	8	200	16	15	500	0.75
Supra 316Ti/4571	8	200	16.5	15	500	0.75
Nickel-free stainless steel						
Supra 444/4521	7.7	220	10.4	23	430	0.8

Outokumpu name	Density [lbm/in³]	Modulus of elasticity [psi]	Coefficient of thermal expansion 68-212 °F [µin / (in* °F)]	Thermal conductivity [Btu/(hr*ft* °F)]	Thermal capacity [Btu/(lbm *°F)]	Electrical resistivity [µΩ*in]
Key product						
Supra 316L/4404	0.289	$29 * 10^6$	8.89	8.7	0.119	29.53
Alternatives						
Supra 316/4401	0.289	$29 * 10^6$	8.89	8.7	0.119	29.53
Supra 316plus	0.285	$29 * 10^6$	8.89	8.7	0.119	29.53
Supra 316L/SANS4402	0.289	$29 * 10^6$	8.89	8.7	0.119	29.53
Supra 316L/4432	0.289	$29 * 10^6$	8.89	8.7	0.119	29.53
Supra 316/4436	0.289	$29 * 10^6$	8.89	8.7	0.119	29.53
Supra 316L/4435	0.289	$29 * 10^6$	8.89	8.7	0.119	29.53
Supra 316Ti/4571	0.289	$29 * 10^6$	9.17	8.7	0.119	29.53
Nickel-free stainless steel						
Supra 444/4521	0.278	$31.9 * 10^6$	5.78	13.3	0.103	31.5

Fabrication

Supra range austenitics

Formability

Supra range austenitics can be readily formed by all cold forming methods. All grades share common forming properties:

- Excellent stretch formability
- High work-hardening rate
- Average strain ratio r of approximately one

The stability of the austenite decreases with lower alloying element content; more martensite is formed during cold working. In addition to the chemical composition, the martensite transformation depends on the forming temperature. At about 150 °C/300 °F no martensite is formed even for the most unstable grades. It follows that the formability of metastable austenitic stainless steels can be modified by selective heating of the piece being worked.
For very demanding deep drawing applications and for multiple-step forming operations, stable grades with higher nickel content are preferable. These stable grades are designed to minimize martensite formation, but do retain their work-hardening capacity in the subsequent forming steps. Stable grades can also result in slightly reduced tool wear, lower elastic springback, and better dimensional tolerances.

Hot forming

Hot forming can be carried out in the 850–1150 °C/1550–2100 °F range. For maximum corrosion resistance, forgings should be annealed at 1070 °C/1950 °F and rapidly cooled in air or water after hot forming operations. Slow cooling may have adverse effects on the ductility and corrosion properties of the product.

Heat treatment

Solution annealing should be performed at 1000–1100 °C/1830–2010 °F and followed by rapid cooling in water or air. For titanium-stabilized grades, annealing temperatures above 1070 °C/1950 °F may impair the resistance to intergranular corrosion. Titanium-stabilized grades may also be given a stabilizing treatment at lower temperatures. However, temperatures below 980 °C/1790 °F should only be used after due consideration of the intended service

environment. In applications where high residual stresses cannot be accepted, stress relief treatment may be necessary. This can be performed by annealing as outlined above.

Supra range austenitic stainless steels cannot be hardened by heat treatment, but they can be readily hardened by cold working.

Machinability

Due to their high toughness and work hardening behavior, austenitic steels are more difficult to machine than carbon steels but are still comparatively easy to machine compared to more highly alloyed stainless steel grades. They require higher cutting forces than carbon steels, show resistance to chip breaking, and have a high tendency to built-up edge formation. The best machining results are obtained by using high-power equipment, sharp tooling, and a rigid set-up.

Better machinability performance is given by Prodec range variants, which have been modified for improved machinability. For more information please see the Prodec range datasheet.

Welding

Supra range austenitic stainless steels have excellent weldability and are suitable for the full range of conventional welding methods except oxyacetylene.

In thin sections, autogenous welding may be used. In thicker sections, products with lower carbon content are preferred. To ensure that the weld metal properties (e.g. strength and corrosion resistance) are equivalent to those of the parent metal, matching or slightly over-alloyed fillers are preferable. In some cases, however, a differing composition may improve weldability or structural stability.

Austenitic steels have about 50% higher thermal expansion and lower heat conductivity compared to ferritic and duplex steels. This means that larger deformation and higher shrinkage stresses may result from welding.

Generally, post-weld heat treatment is not required. In special cases where there is a high risk of stress corrosion cracking or fatigue, stress relief treatment may be considered. In order to fully restore the corrosion resistance of the weld, the weld oxides should be removed by pickling.

More detailed information about welding procedures can be obtained from the Outokumpu Welding Handbook, available from our sales offices.

outokumpu.com/contacts

Supra range ferritics

Formability

Supra 444/4521 can be formed using typical forming processes such as folding, bending, and drawing. It has higher minimum proof strength than a standard austenitic stainless steel like Core 304/4301 in combination with lower work-hardening behavior. Due to the stabilization, the r value is higher compared to nonstabilized ferritic stainless steels such as Moda 430/4016. These characteristics mean excellent deep drawability.

Welding

Conventional welding methods and filler materials 316L/309LMO can be used for Supra 4521. Heat input in welding should been kept to a minimum. Shielding gases should be based on argon or helium, and should not contain hydrogen, nitrogen, or carbon dioxide. Generally, welded structures show lower ductility compared to that of the base material.

More detailed information about welding procedures can be obtained from the Outokumpu Welding Handbook, available from our sales offices.

outokumpu.com/contacts

Surface finishes

A wide variety of surface finishes are available for Supra range products. Many are produced at the mill, and other surface finishes can be applied later during processing either at a service center or after fabrication.

Supra range finishes include 1D, 2B, 2E, and rolled finishes. Deco range offers Deco BA/2R, polished (#3 and #4), brushed, and patterned finishes. 2H finishes are available in the Forta range. The surface finish also plays an important role in influencing the corrosion resistance of the stainless steel, especially in the case of atmospheric corrosion or where splashing is common. A smooth surface finish increases the resistance to corrosion.

In general, the roughness of the hot rolled 1D surface is higher than cold rolled surfaces. The bright- annealed surface (Deco 2R/BA) is highly reflective and very smooth compared to the cold rolled, annealed, pickled, and skin-passed (2B) surface.

More information about surface finishes can be found in the Deco range brochure.

Standards and approvals

The most commonly used international product standards are given in the table below. For a full list of standards by product, see **steelfinder.outokumpu.com**

Standards

Supra range stainless steels meet the following standards:

Standards	
Flat products	
EN ISO 18286	Hot-rolled stainless steel plates – Tolerances on dimensions and shape.
EN 10051	Hot-rolled steel strip.
EN 10088-1	Stainless steels – list of stainless steels
ISO 15510	Stainless steels – chemical composition
EN ISO 9445	Cold-rolled stainless narrow strip, wide strip, plate/sheet and cut lengths.
ASTM A 480	General requirements for flat-rolled stainless and heat resisting steel
ASTM A 959	Harmonized standard grade compositions for wrought stainless steels
ASME IID	Materials – Physical properties tables
Flat and long products	
EN 10028-7	Flat products for pressure purposes – Stainless steels
EN 10088-2	Stainless steels – sheet/plate and strip for general purposes
EN 10088-3	Stainless steels – semi-finished products, bars, rods sections for general purposes
EN 10088-4	Technical delivery conditions for sheet/plate and strip
EN 10088-5	Technical delivery conditions for bars, rods wire, sections and bright products of corrosion resisting steels for construction purposes
EN 10095	Heat resisting steels and nickel alloys
EN 10151	Stainless steel strip for springs
EN 10302	Creep resisting steels, nickel and cobalt alloys
ASTM A 167	Stainless and heat-resisting Cr-Ni steel plate, sheet, and strip
ASTM A 176	Stainless and heat-resisting Cr steel plate, sheet, and strip
ASTM A 240	Heat-resisting Cr and Cr-Ni stainless steel plate, sheet and strip for pressure vessels
ASTM A276	Stainless steel and heat resisting steel bars and shapes
ASTM A479/479M	Stainless steel bars for boilers/pressure vessels
ASTM A493	Stainless steel and heat-resisting steel rod and wire for cold heading and forging
ASTM A555	General requirements for stainless and heat resistant steel wire and wire rod
ASTM A 666	Austenitic stainless steel sheet, strip, plate, bar for structural and architectural applications
ASME IIA	Materials. Part A – Ferrous Material Specifications

Certificates and approvals

Outokumpu meets the most common certifications and approvals around the world, including:

- AD 2000 Merkblatt
- Approval of Material Manufacturers
- Factory Production Control Certificate
- ISO 9001
- ISO 14001
- ISO 50001
- ISO/TS 16949
- NORSOK
- OHSAS 18001

For the full list of certificates and approvals by mill, see **outokumpu.com/certificates**

Contacts and enquiries

Contact us

Our experts are ready to help you choose the best stainless steel product for your next project.

outokumpu.com/contacts

1561EN-GB:1. May 2015. Erweko, Finland.

Working towards forever.

We work with our customers and partners to create long lasting solutions for the tools of modern life and the world's most critical problems: clean energy, clean water, and efficient infrastructure. Because we believe in a world that lasts forever.

outokumpu classic			outokumpu pro					
Moda	Core	Supra	Forta	Ultra	Dura	Therma	Prodec	Deco
Mildly corrosive environments	Corrosive environments	Highly corrosive environments	Duplex & other high strength	Extremely corrosive environments	High hardness	High service temperatures	Improved machinability	Special surfaces

outokumpu
high performance stainless steel

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