

# Stainless steels for highly corrosive environments

Outokumpu Supra range

outokumpu  
high performance stainless steel



[outokumpu.com/supra](https://outokumpu.com/supra)





# We believe in a world that lasts forever

Outokumpu is a global leader in the advanced materials business, creating stainless steels that are efficient, long lasting, and recyclable. A strong customer focus, sustainability, and technical excellence are at the heart of everything we do.

As an open and approachable company, our customers rely on our advice to help them select products that will deliver the best long-term performance for their needs.

With over a century of innovation behind us and some of the best minds in the business, we continue to develop pioneering materials to meet the demands of tomorrow.

The durability of stainless steel means that it is not only the best, but also the most economically sustainable choice for a wide range of applications. All of our products are made from an average of 85% recycled material and are fully recyclable at the end of their lifecycles.

Together with our customers and partners, we are building a world that lasts forever.

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# The inside view

For multi-purpose use and more corrosive environments compared to the Core range.

At Outokumpu, we've been developing and producing high quality stainless steels for more than a century. This has resulted in an exceptionally wide range of products for every imaginable application. By grouping our products into ranges based on performance rather than stainless steel family we aim to make choosing the best product for your application easier.

Supra range products are designed for applications that demand higher than normal corrosion resistance, and are calculated with a Pitting Resistance Equivalent (PRE) value of 24 to 26. This range contains the popular Supra 316L/4404 and several alternatives. It also features a selection of low-nickel and nickel-free alternatives.

Supra range austenitics are also highly formable and weldable, making them suitable for a wide range of applications from claddings to storage tanks. The magnetic ferritic stainless steels in this range also have good formability, especially in terms of deep drawing, and are ideal for drinking water pipes and applications with elevated temperatures such as hot water tanks.

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All Supra range products are readily available around the globe and are delivered from mills that are well known for their quality and on-time delivery accuracy. You can depend on Outokumpu stainless steels to reliably and consistently meet the specifications that your application demands. Our customers also rely on us to deliver the best material selection advice, and we can often find more cost-effective solutions that help you to avoid over-specifying.



Ville Hakkarainen, Outokumpu

Contact us by [outokumpu.com/contacts](https://outokumpu.com/contacts) to find out which of our products is right for your next project.



The Pitting Resistance Equivalent (PRE) number can be used to compare the resistance of different stainless steels to pitting corrosion. It takes into account the effect of the most important alloying elements.

# Choosing the right product

Choosing the right stainless steel for an application is key to ensuring both the cost effectiveness and success of your project. Take a look at the individual Supra range products – and the applications they are best suited for – to get an idea of your options.

## Key product

### Supra 316/4401 and Supra 316L/4404

Our most widely used molybdenum-alloyed austenitic stainless steels. Supra 316/4401 and its low-carbon variant Supra 316L/4404 are stainless steels used in various process industries and other aggressive environments with high corrosion resistance requirements. Due to its low carbon content, Supra 316L/4404 is also weldable in thicknesses of more than 5–6 mm/ 0.19–0.23 in without sensitivity to intergranular corrosion.

#### Typical applications

- Equipment in the chemical and petrochemical industry
- Pulp and paper industry equipment
- Heat exchangers
- Textile industry equipment
- Food and beverage industry equipment
- Pharmaceutical industry equipment
- Medical applications
- Flanges and valves

#### Product forms

C, H, P, B, R, S, T

## Product forms



**C**

Cold rolled  
coil and sheet



**H**

Hot rolled  
coil and sheet



**P**

Quarto plate



**B**

Bar



**R**

Wire rod



**S**

Semifinished  
(bloom, billet, ingot & slab)



**T**

Pipe



# Supra range applications

- Pulp and paper industry stack liners
- Heat exchangers
- Equipment in coastal environments (when not in direct contact with seawater)
- Storage tanks
- Process equipment
- Pipes
- Swimming pools (Note! Not for load bearing details.)
- Food and beverage industry equipment
- Pharmaceutical industry equipment
- Chemical industry equipment
- Textile finishing
- Roofs and façade cladding
- Outdoor furniture, art and monuments



# Alternatives

Outokumpu name	Typical applications	Product forms
<b>Supra 316plus</b> The highest strength stainless steel in the Supra range. Supra 316plus is a cost-efficient, 21Cr, lower-nickel/molybdenum alternative to traditional molybdenum-alloyed austenitics like Supra 316L. This product has good formability, excellent weldability, and is usable in cryogenic applications.	<ul style="list-style-type: none"> <li>• Process and transport tanks</li> <li>• Water treatment and pipes</li> <li>• Heat exchangers</li> <li>• Architectural applications</li> </ul>	C, H, P
<b>Supra 316L/SANS4402</b> A high-strength, high-formability product often used in container transports and where there is an elevated temperature requirement.	<ul style="list-style-type: none"> <li>• Container tanks</li> </ul>	C, H, P
<b>Supra 316L/4432</b> Supra 316L/4432 is a low-carbon alternative to Supra 316/4436. The lower carbon content minimizes carbide precipitation as a result of heat input, for example during welding, giving improved resistance against intergranular corrosion.	<ul style="list-style-type: none"> <li>• Drinking water systems</li> <li>• Cooling systems</li> <li>• Wastewater systems</li> <li>• Flanges and valves</li> </ul>	C, H, P, B, R, S, T
<b>Supra 316/4436</b> A product with high resistance to non-oxidizing acids and chloride-containing media due to higher molybdenum content. Supra 316/4436 has good formability and weldability.	<ul style="list-style-type: none"> <li>• Pulp and paper industry equipment</li> <li>• Pharmaceutical industry equipment</li> <li>• Flanges and valves</li> </ul>	C, H, P, B, R, S, T
<b>Supra 316L/4435</b> A Supra 316L/4432 alternative with higher chromium and nickel content for enhanced corrosion resistance and formability.	<ul style="list-style-type: none"> <li>• Urea plants</li> <li>• Pulp and synthetic fiber plants</li> <li>• Flanges and valves</li> </ul>	C, H, P, B, R, S, T
<b>Supra 316Ti/4571</b> A titanium-stabilized alternative to Supra 316L/4404 – mainly used for elevated temperature applications. Due to its titanium-stabilization this product is weldable in all thickness ranges.	<ul style="list-style-type: none"> <li>• Flue gas applications</li> <li>• Flanges and valves</li> </ul>	C, H, P, B, R, S, T



# Nickel-free stainless steel

Nickel-free stainless steels offer good price stability along with good corrosion resistance and formability.

Outokumpu name	Typical applications	Product forms
<p><b>Supra 444/4521</b></p> <p>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.</p>	<ul style="list-style-type: none"><li>• Hot water tanks</li><li>• Drinking water pipes</li></ul>	<p>C, H, P, S</p>

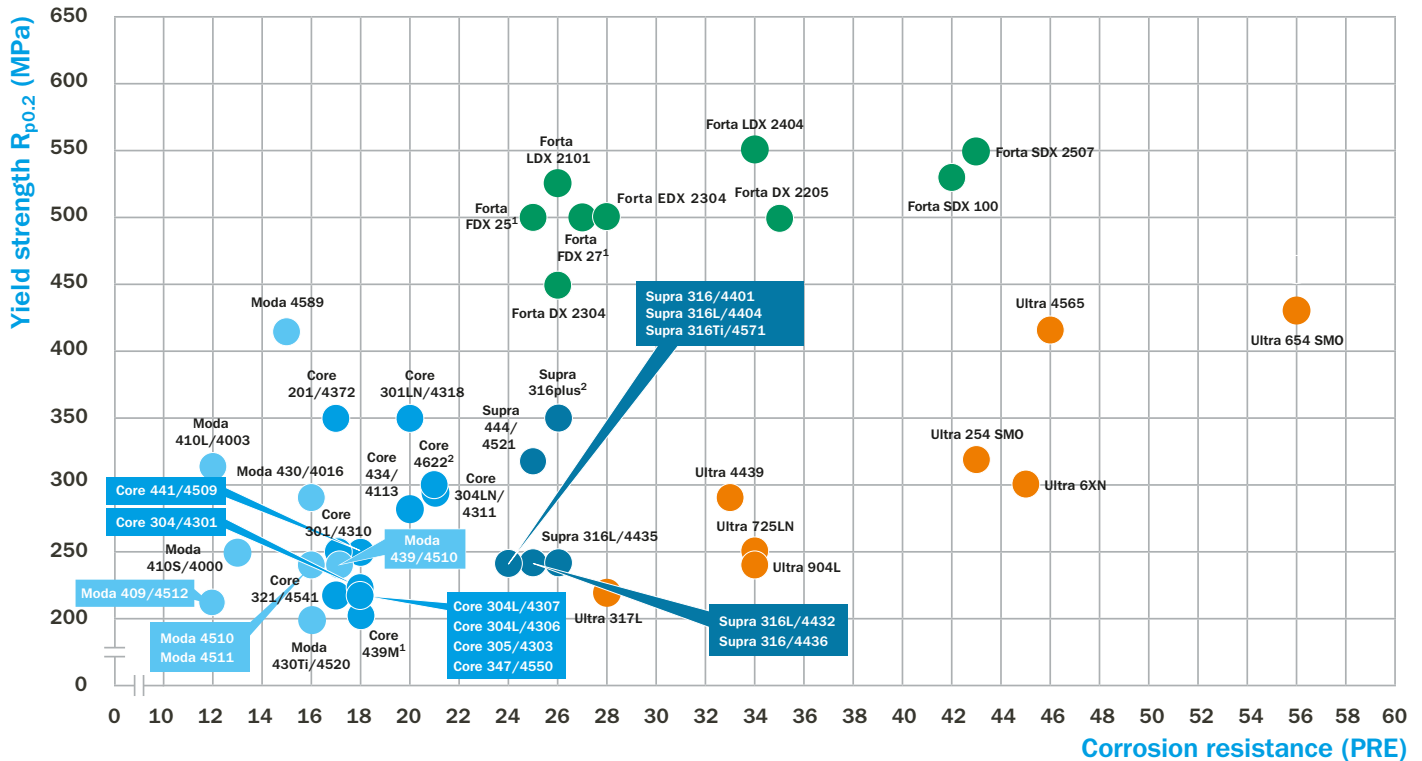


If you need steels for extremely corrosive environments (PRE > 26), check the Forta duplex and the Ultra range.

Contact us by [outokumpu.com/contacts](https://www.outokumpu.com/contacts) to find out which of our products is right for your next project.

# Product performance comparison

## Strength vs. corrosion resistance



- Moda – Mildly corrosive environments
- Core – Corrosive environments
- Supra – Highly corrosive environments
- Forta – Duplex and other high strength (PRE 16 to 43)
- Ultra – Extremely corrosive environments (PRE > 27)

PRE calculation =  $\%Cr + 3.3 \times \%Mo + 16 \times \%N$

Note: PRE values shown are Outokumpu typical values. Yield strength ( $R_{p0.2}$ ) according to EN 10088-2 minimum values for cold rolled strip. Yield strength for temper rolled products ranges from 500-2000 MPa.

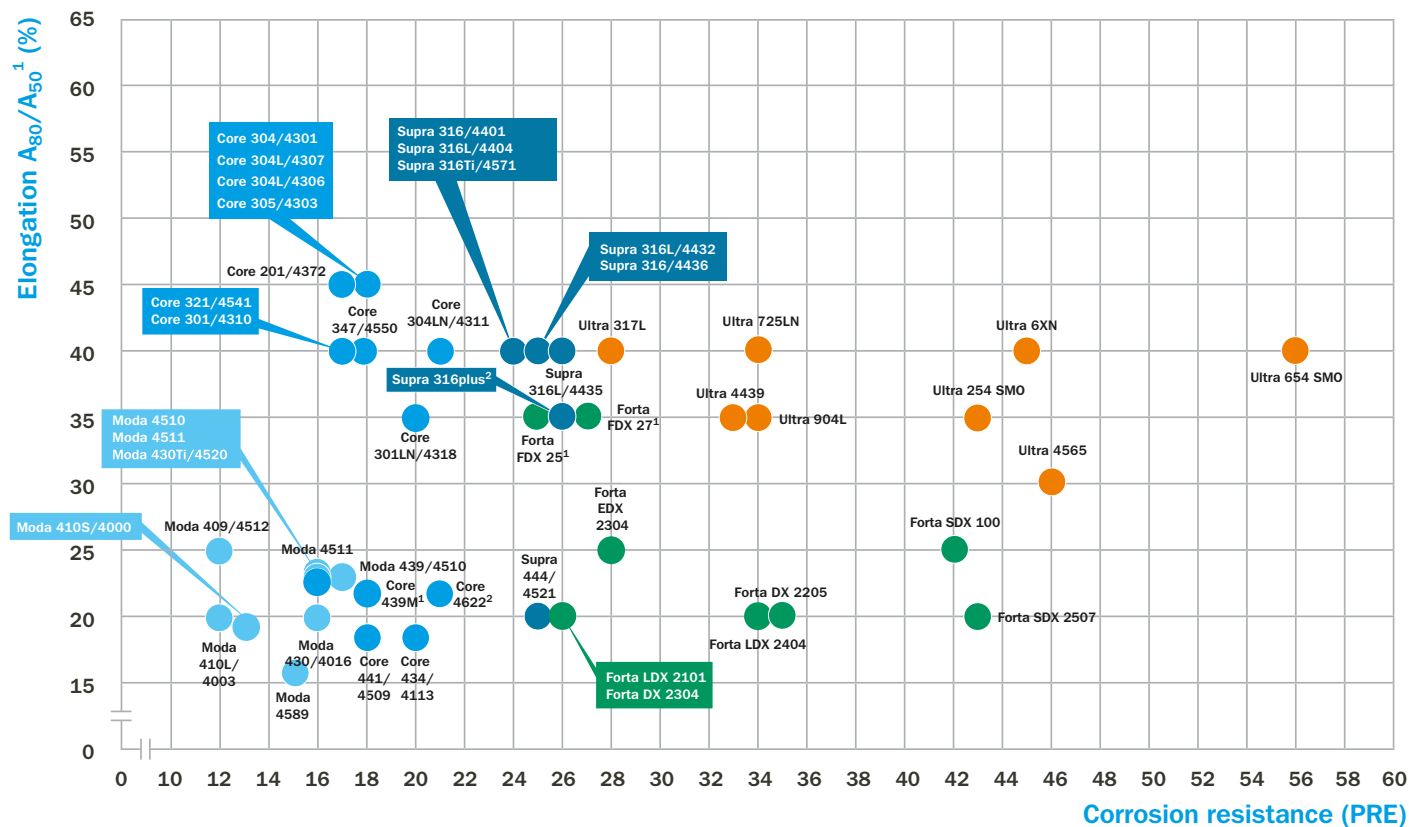
<sup>1</sup>) According to ASTM A240.

<sup>2</sup>) According to EN 10028-7.

For more values by product, please see [steelfinder.outokumpu.com](https://steelfinder.outokumpu.com)



## Elongation vs. corrosion resistance



- Moda – Mildly corrosive environments
- Core – Corrosive environments
- Supra – Highly corrosive environments
- Forta – Duplex and other high strength (PRE 16 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.

<sup>1)</sup> According to ASTM A240.

<sup>2)</sup> According to EN 10028-7.

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# Product properties

Supra range				Highly corrosive environments									
Steel designations				Performance				Typical chemical composition, % by mass					
Outokumpu name	EN	ASTM Type	UNS	PRE	A <sub>80</sub> %	R <sub>p0.2</sub> MPa	Grade family	C	Cr	Ni	Mo	N	Others
Supra 316/4401	1.4401	316	S31600	24	40	240	A	0.04	17.2	10.1	2.1	–	–
Supra 316L/4404	1.4404	316L	S31603	24	40	240	A	0.02	17.2	10.1	2.1	–	–
Alternatives													
Supra 316plus	1.4420	–	S31655	26	35 <sup>1)</sup>	350 <sup>1)</sup>	A	0.02	20.3	8.6	0.7	0.19	–
Supra 316L/SANS4402	SANS4402	–	–	24	50 <sup>2)</sup>	290 <sup>2)</sup>	A	0.02	17.2	10.1	2.1	–	–
Supra 316/4436	1.4436	316	S31600	25	40	240	A	0.04	16.9	10.7	2.6	–	–
Supra 316L/4432	1.4432	316L	S31603	25	40	240	A	0.02	16.9	10.7	2.6	–	–
Supra 316L/4435	1.4435	316L	S31603	26	40	240	A	0.02	17.3	12.6	2.6	–	–
Supra 316Ti/4571	1.4571	316Ti	S31635	24	40	240	A	0.04	16.8	10.9	2.1	–	Ti
Ni-free alternative													
Supra 444/4521	1.4521	444	S44400	25	20	320	F	0.02	18.0	–	2.0	–	Nb Ti

<sup>1)</sup> Min. values acc. to EN 10028-7. <sup>2)</sup> Min. values acc. to SANS 50028-7.

Note: Yield strength (R<sub>p0.2</sub>), elongation (A<sub>80</sub>) and tensile strength (R<sub>m</sub>) according to EN 10088-2 minimum values for cold rolled strip unless marked otherwise. Chemical compositions are Outokumpu typical values.

For specific values by product, please see [steelfinder.outokumpu.com](https://steelfinder.outokumpu.com)

Supra range products are available with the following surface finishes: 1, 2B, 2D, 2E, and our Deco range of special surfaces, including Deco BA/2R.

## Stainless steel types

**Austenitic stainless steels** have good to excellent corrosion resistance combined with very good weldability and formability. The austenitic structure has good creep resistance and good oxidation resistance that makes these steels useful at elevated temperatures. They can also be used in cryogenic applications and are, in the annealed condition, the only non-magnetic steel group.

**Ferritic stainless steels** have good resistance to corrosion, especially stress corrosion cracking. Their lower carbon and nitrogen content, together with niobium and/or titanium stabilization, improve both weldability and toughness. Ferritic stainless steels are magnetic.



# Supra 316plus in liquid transport containers

The Langh Group needed a corrosion resistant steel for liquid transport containers.

The properties of Supra 316plus allow for thinner wall thickness – meaning a lower overall container weight – while excellent corrosion resistance enables transportation of aggressive liquids.

Developed by Outokumpu, Supra 316plus is a unique product that provides a competitive alternative to 316L. Supra 316plus contains less nickel and molybdenum and has higher strength than 316L, even in the annealed condition, due to higher nitrogen alloying.



Looking for expert help to choose the best product for your next project?  
Contact us by [outokumpu.com/contacts](https://outokumpu.com/contacts)

# 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

**Moda**

Mildly  
corrosive  
environments

**Core**

Corrosive  
environments

**Supra**

Highly  
corrosive  
environments

outokumpu  
pro

**Forta**

Duplex  
& other  
high strength

**Ultra**

Extremely  
corrosive  
environments

**Dura**

High  
hardness

**Therma**

High  
service  
temperatures

**Prodec**

Improved  
machinability

**Deco**

Special  
surfaces

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high performance stainless steel



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