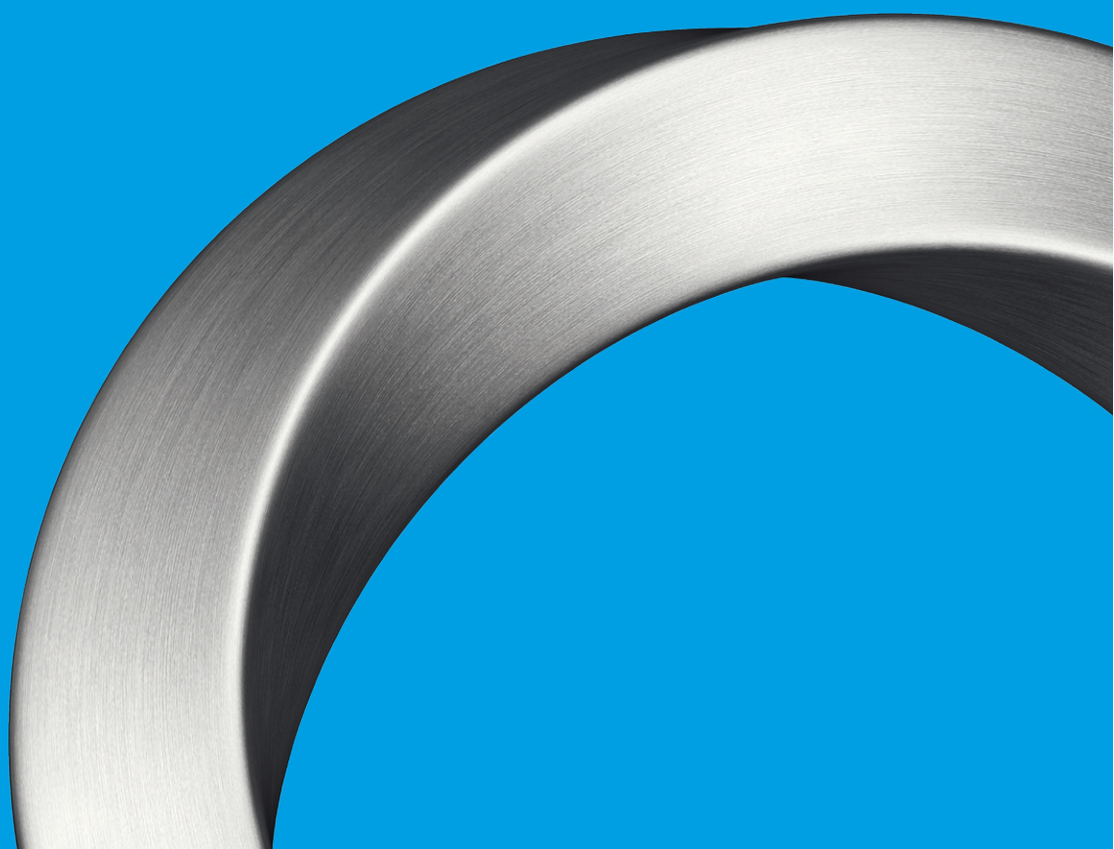
Outokumpu stainless grades to meet your needs

Introducing
Core 4622
Supra 316^{plus}



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. Recycled content rate in Outokumpu stainless steel is the highest in the industry and our products are fully recyclable at the end of their lifecycles.

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

The Kelpies, two 30-metre-high metallic horse heads overlooking the Forth & Clyde Canal in central Scotland are clad with more than 900 steel platelets manufactured, cut and processed by Outokumpu. Designed by a local sculptor Andy Scott, the artwork was completed by SH Structures in April 2014 to form the centrepiece of a new recreational complex near Falkirk. Each of the giant gleaming heads weighs more than 300 tonnes.

Photo courtesy of SH Structures.

Welcoming new family members

Outokumpu's legacy of innovation and consistent quality means that we have just the right product for every application. By grouping our products into two broad families with several ranges based on performance, rather than steel type, we aim to make choosing the best product for your application easier.

We are proud to introduce new products in our Core and Supra ranges, both part of the Outokumpu Classic family consisting of the most commonly used stainless steels for mildly to highly corrosive environments. These products are fully recyclable at the end of their lifecycles.

Because stainless steel is resistant to corrosion, our products far outlast carbon steel alternatives. Durability means that stainless steel is not only the best, but also the most economically sustainable choice for a wide range of applications.

Building on our long history of pioneering advanced materials we continue to work toward our vision of a world that lasts forever.

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

Core 4622 in mine rescue chambers

HEAT-IT Oy from Rovaniemi, Finland selected Outokumpu's high-chromium ferritic stainless steel Core 4622 as the material for their RESPETRA rescue chamber.

The RESPETRA rescue chamber is a stainless steel cabin used in mines. It provides protection for miners, for example in case of fire, for up to four days.

Core 4622 has a good combination of strength and toughness so it can handle pressure relief well. The walls of the rescue chamber are curved to provide protection against pressure and gases.

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.

Core 4622

Introduction

Outokumpu Core 4622 (EN 1.4622) ferritic stainless steel has improved corrosion resistance due to its high chromium content. That makes it ideal for a wide range of applications such as catering, household and architectural applications, as wells as in tubular products for the automotive and process industries. Core 4622 fulfills ASTM UNS S44330.

Essential features

Good corrosion resistance
Comparable to common austenitic grades 304 (EN 1.4301) and 304L (EN 1.4307).

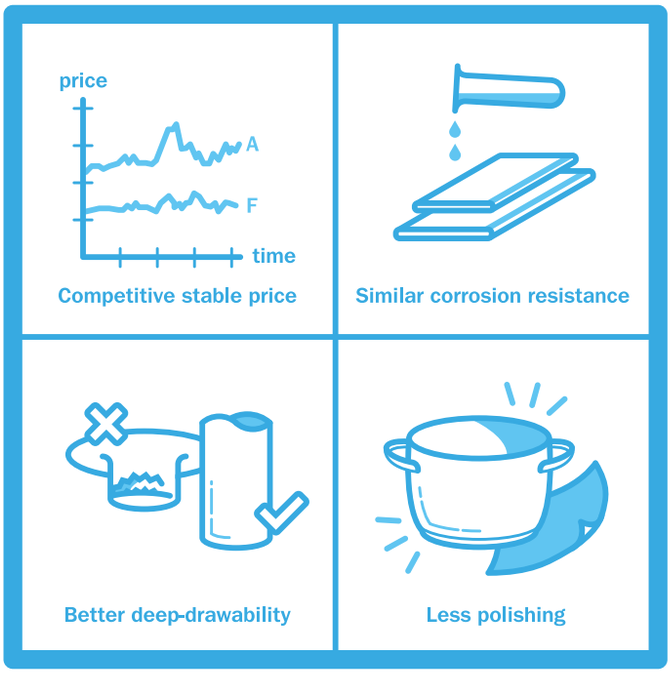
Competitive and stable price
Excellent cost stability compared to Ni-alloyed austenitic grades and Mo-alloyed acid proof grades.

Deep drawable
Ideal for deep drawing applications with high R-value and limiting drawing ratio (LDR).

Easy to polish
Virtually roping free for easy polishing. Improved surface properties due to low Ti content.

Good weldability
Low risk of sensitization due to stabilization. Less distortion than in austenitic grades due to higher heat transfer.

Good machinability
Lower work hardening versus austenitic grades.



Suitable applications

High chromium content makes this grade appropriate for replacing standard austenitic grades in many applications:

- Catering and household products
- Architectual applications both indoors and outdoors
- Tubular products for automotive industry
- Process equipment such as heat exchangers

How to avoid the uninvited guest – roping

Millions of tons of ferritic stainless steel are used each year in household appliances. While ferritic grades are a very good choice for pots and pans, forming ferritic stainless steels can cause “roping” or “ridging”, which is typically considered a visual defect in finished products on the final product. But how do you avoid this?

By selecting a material like Outokumpu Core 4622 roping can be effectively eliminated.

Core 4622 reduces production time of any product that requires forming via a method like deep-drawing. Because of its low degree of roping, polishing after forming is minimised – thus saving both time and money.

A cookware manufacturer in Asia produces annually millions of deep-drawn items of various ferritic grades. After test production with Core 4622, they reported much less visible roping directly after deep-drawing their pots. Further, the products were uniformly shaped and free of cracking and other visible flaws.

High-chromium stainless steel grade reduces process phases. If you can eliminate polishing, you can focus on totally new aspects of product optimisation. Moreover, by eliminating production steps, you have possibility to reduce production times.

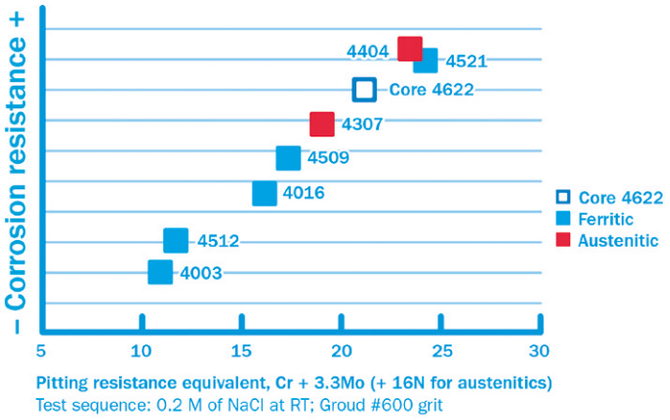
Kari Hänninen
Vice President for Business Development
Outokumpu APAC

Read more from Outokumpu’s blog
choosestainless.outokumpu.com/blogs

Corrosion resistance

Outokumpu produces Core 4622 typically with a chromium content of about 21 wt-%.

- High chromium content improves corrosion resistance, which is similar compared to some other stainless steels, like austenitic 304L (1.4307).
- Stabilization reduces sensitivity for intergranular corrosion.
- In chloride containing environments pitting and crevice corrosion is possible depending on various parameters like chloride concentration, temperature, pH value, redox potential, crevice geometry and others.
- Core 4622 is not susceptible to chloride induced stress corrosion cracking.
- The best material performance is reached usually with the help of adequate design, correct post-weld treatment and regular cleaning during use (if applicable).



Forming and machining

The grade can be formed using typical forming processes like folding, bending, drawing, etc.

- Grade has slightly higher proof strength than standard austenitic stainless steel grade 304L (1.4307) in combination with lower work hardening.
- Due to the stabilization, its R-value is higher compared to non-stabilized ferritic stainless steel.
- These characteristics mean excellent deep drawability.

Welding

Conventional welding methods are applicable, austenitic 316L filler metals can be used.

- Shielding gases should be Ar/He based, mixed with maximum of 2% oxygen to improve the arc stability. Hydrogen and nitrogen additions are forbidden.
- Heat input should be minimized to reduce the grain growth in the heat-affected zone.
- Stabilization prevents sensitization in the welds.
- Adequate corrosion resistance in the welds is achieved by using either mechanical descaling or pickling.

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.

Learn more at **outokumpu.com/core**

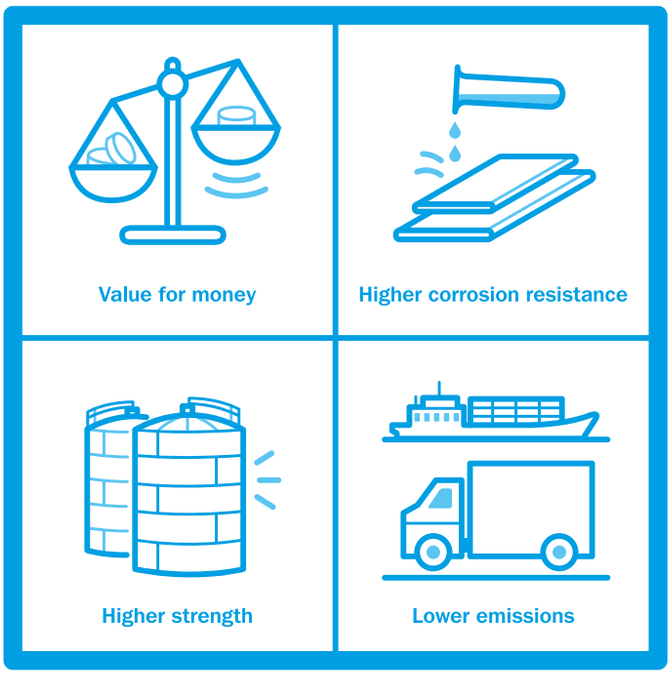
The new-generation steel grades from Outokumpu receive a resounding approval from Vemta, Finnish producer of premium-quality designer drains. The outstanding deep drawability of Outokumpu Core 4622 is an asset that clearly differentiates this grade from competing products.

The mix of air conditioning and humidity sets high requirements for a material. The illuminated 7-Eleven signs by Thailand's RBS Group now have a frame of stainless steel grade Outokumpu Core 4622.

Supra 316plus

Introduction

Outokumpu Supra 316plus is a trademark registered by Outokumpu, steel EN number is 1.4420 and ASTM designation UNS S31655. Its high chromium and nitrogen content delivers high corrosion resistance, high strength, good formability and excellent weldability. It's ideal for use in a variety of applications including heat exchangers, water treatment and piping as well as in architectural applications, such as indoor and outdoor façades.



Essential features

Value for money

- Available in more competitive and stable price.
- Supra 316plus has less price volatile alloys of nickel and molybdenum than 316L (1.4404), meaning better cost stability compared to standard Cr-Ni-Mo alloyed austenitic grades.

High corrosion resistance

- Considerable improvement over typical austenitic grades, including the 316L (EN 1.4404).
- Higher PRE value of ~26 due to alloy content with >20% Cr, 0,7% Mo, and 0,2% N.
- Low risk of intergranular corrosion even after welding thermal cycle due to low carbon content (<0,03%).
- Supra 316plus fits extremely well to challenging conditions, such as highly corrosive environments.

Higher strength

- Remarkably higher strength (+100 MPa) compared to 316L due to Nitrogen alloying.
- Makes thinner gauges possible, enabling lighter structures.
- Supra 316plus enables more end products with less material.

More cargo load – less emissions

- Higher strength Supra 316plus enables lighter structures and increased transport load volumes.
- Increased transport load volumes enable to decrease the total number of transports needed and reduce the fuel consumption.
- Supra 316plus decreases your carbon footprint.
- Outokumpu is committed to helping reduce emissions worldwide – ours, yours, and your customers'. (Target to reduce carbon profile 20% per ton by 2020 compared to 2009 level.)

Suitable applications

High chromium content makes this grade appropriate for replacing standard grades in many applications especially when high strength and good formability are demanded as well as excellent weldability is a must. New grade is suitable for:

- Construction industry
- Heat exchangers
- Water treatment
- Piping
- Indoor and outdoor architectural applications

The Langh Group needed a wear and corrosion-resistant steel for transport containers for ships, trucks, and trains. The properties of temper rolled 316plus allow for thinner wall thickness – meaning a lower overall container weight – while enabling transportation of aggressive and sharp bulk materials.

Corrosion resistance

Supra 316plus composition is designed to match or surpass typical 316L (EN 1.4404) corrosion resistance when PRE value is calculated or pitting corrosion is electrolytically measured.

- Supra 316plus has good resistance against intergranular corrosion due to low carbon and high nitrogen content.
- High chromium and nitrogen content with moderate molybdenum content improve resistance against uniform corrosion which in many cases is better compared to some other stainless steels, like austenitic 316L.
- In chloride containing environments pitting and crevice corrosion is possible depending on various parameters like chloride concentration, temperature, pH value, redox potential, crevice geometry and others.
- Supra 316plus is susceptible to chloride induced stress corrosion cracking like other austenitic stainless steels and it should be taken into consideration during design of application.
- The best material performance is reached usually with the help of adequate design, correct post-weld treatment and regular cleaning during use (if applicable).

Forming and machining

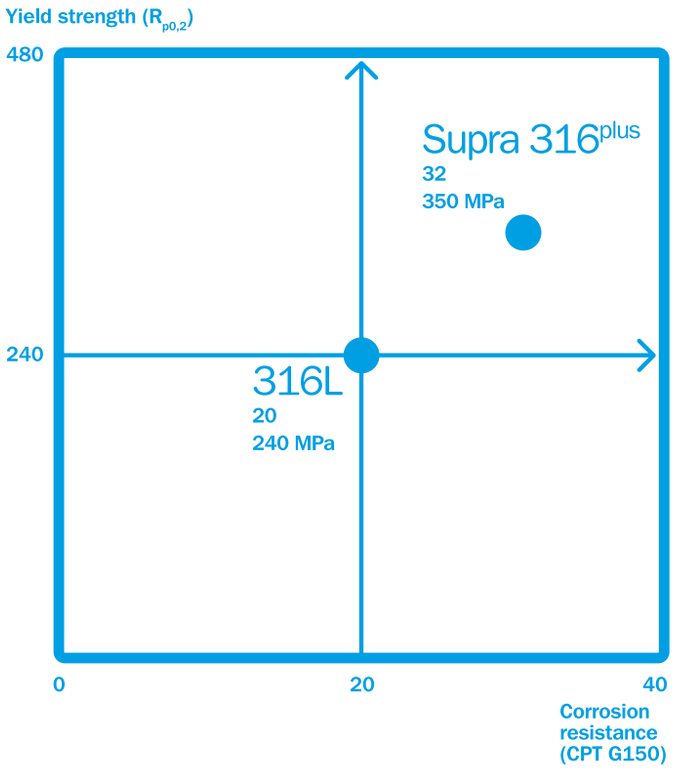
The grade can be formed using typical forming processes like folding, bending, drawing, etc.

- Higher strength values typically correspond to higher spring back after forming.
- New grade has remarkably higher proof strength than standard austenitic stainless steel grade Supra 316L (EN 1.4404) in combination with same degree of work hardening.
- Due to the design of composition the Erichsen Index and LDR (Limiting Drawing Ratio) are matching with well-known austenitic type of stainless steels like 304L (EN 1.4307) or 316L (EN 1.4404).
- These characteristics mean good deep-drawability and excellent stretch forming capabilities.

Welding

Conventional welding methods are applicable, austenitic 316L filler metals can be used to get matching corrosion resistance and 23 7 NL or 22 09 NL type duplex welding consumables to get matching strength.

- Shielding gases should be Ar/He based or contain up to 3 % nitrogen to minimize nitrogen drop.
- Typical heat input values for austenitic grades can be utilized. High nitrogen content tends to restrict grain growth during thermal cycle.
- Welds are not sensitized when normal welding procedures are followed.
- Corrosion resistance in the welds can be improved by using either mechanical descaling or pickling.



Learn more at **outokumpu.com/supra**

For a more in-depth look at our products, visit **steelfinder.outokumpu.com**

> “We are always very interested in any innovation or any new grade and we rely on steelmakers to inform us of new materials best suited for a particular product and sector.

Antonio Parra
Director of Production, Parcitank

Parcitank, one of European leading manufacturers of storage tanks located in Spain, is testing Outokumpu’s Supra 316plus for making wine tanks. As wine ferments, it produces carbon dioxide fumes that rise to the top. That is why, generally, the upper part of the tank is made of 316 steel, and the rest of the tank of 304.

Core 4622

Physical properties

Crystal structure is ferritic, and therefore material is ferromagnetic as soft annealed condition.

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]
Core 4622	7.70	220	10	21	460	0.65

Room temperature, RT.

Chemical composition

Outokumpu name	EN	C	Cr	Ni	Mo	Mn	N	Cu	Stabilization	Family
Core 4622	1.4622	0.02	21	–	–	0.40	0.02	0.40	Yes	F

Outokumpu typical values.

Mechanical properties

Steel name	$R_{p0.2}$	R_m	A_{50}/A_{80}	Hardness
Core 4622*	360	470	30	162 HB30
EN 1.4622**	300	430–630	22	–
UNS S44330***	205	390	22	max. 187 HBW

*) Outokumpu typical values, RT.
**) EN min. values, RT.
***) ASTM A240 min. values, RT.

Standardization (Status March 2016)

Current state	
EN steel number 1.4622	Registered in the Stahlinstitut VDEh – European Steel registration office
Polarit Material Specification	EN 1.4622 material standard prior to EN standards, more information from Outokumpu.
ASTM UNS designation	EN 1.4622 fulfills UNS S44330
ASTM A240/A240M – 15a Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications	Fulfills UNS S44330
ASME SA-240/SA-240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessel and for General Applications	Fulfills UNS S44330

Extensive standardization is in progress, more information from Outokumpu.

If you need steels for highly corrosive environments (PRE 22 to 26) such as those in the pulp and paper and chemical industries, check Supra 316/4401, or other products from the Supra range.

Contact us at **outokumpu.com/contacts** to find out which of our products is right for your next project.

Supra 316plus

Physical properties

Crystal structure is austenitic and therefore material is not ferromagnetic as soft annealed condition.

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]
Supra 316plus	7.90	200	16	15	500	0.73

Room temperature, RT.

Chemical composition

Outokumpu name	EN	ASTM	C	Si	Cr	Ni	Mo	Mn	N	Family
Supra 316plus	1.4420	UNS S31655	<0.03	0.45	20.30	8.60	0.70	1.80	0.20	A

Outokumpu typical values.

Mechanical properties

Steel name	$R_{p0.2}$	$R_{p0.1}$	R_m	A_{50}/A_{80}	Hardness
Supra 316plus*	385	405	725	42	195 HV10
EN 1.4420**	350	380	650–850	35	–
UNS S31655***	310	–	635	35	241 HBW

*) Outokumpu typical values, RT.
**) EN min. values, RT.
***) ASTM A240 min. values, RT.

Standardization (Status March 2016)

Current state	
Supra 316plus is a trademark registered by Outokumpu.	
EN steel number 1.4420	Registered in the Stahlinstitut VDEh – European Steel registration office
Polarit Material Specification	EN 1.4420 material standard prior to EN standards, more information from Outokumpu.
ASTM UNS designation S31655	Available
ASTM A240/A240M – 15a Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications	Available
NACE MR0103–2012 and NACE MR0175/ISO 15156-1 / NACE MR0175/ISO 15156-3	Available
ASTM A249-15 ASTM A269-15 ASTM A358-15 ASTM A554-15 ASTM A312-15 tube and pipe	Available

Extensive standardization is in progress, more information from Outokumpu.

If you need steels for extremely corrosive environments (PRE > 27), check the Ultra range.

Contact us at **outokumpu.com/contacts** to find out which of our products is right for your next project.

Our technical expertise at your service

Stainless steel is a material more than 100 years old. There are still new grades being developed and further characterizations to be made in order to fully utilize the excellent properties of this type of material. Through many years of close co-operation with our customers and our good research facilities we have built up experience on the performance of our grades in service and during fabrication. There are technical market support engineers available to assist in material selection, fabrication and other issues, well backed up by the expertise within the research departments.

We publish information brochures, technical articles etc. for further user assistance. Outokumpu regularly gives training seminars covering stainless steels, their properties and suitability for use.

Development work is focusing upon the products that are of special market interest. This is includes polished, brushed and decorated surfaces as well as work hardened high strength stainless steels and grades with a special corrosion resistance. Both material properties and production techniques are of interest.

Looking for expert help to choose the best product for your next project? Contact us at **outokumpu.com/contacts**

Stay up to date on our latest innovations, follow market trends, and get inspired by success stories – subscribe to our magazines and newsletters: **outokumpu.com/newsletter**

Stainless Stainless

Our four value propositions showcase our strengths, which answer key sustainability needs and deliver added value to our customers. Combined, we call them Stainless Stainless.

Recycling maximized means that of all the stainless steel on the market, ours contains the most recycled content. This is a key benefit to customers concerned with sustainability.

Nothing to hide stands for our own supply chain, emphasizing high standards and transparency. When we supply a customer, our supply chain becomes part of theirs – they benefit, as do their customers.

Pays for itself refers to the long-term economic benefits of our stainless, and the value of investing now – guided by our expertise – in a material made for the long term.

Indispensable points out that our stainless makes any product more sustainable. In many cases, it's the only material that fits the bill.

By selecting Outokumpu, these benefits become an extra layer of marketing for your own brand, free of charge.

Find out more at **outokumpu.com/stainlessstainless** or contact your local Outokumpu representative.

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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

outokumpu.com