



Refinery and power generation

Your partner for innovative solutions

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www.voestalpine.com/steel

voestalpine

ONE STEP AHEAD.

Extraordinary requirements call for extraordinary steels.

We are your reliable partner in the supply of steels for pressure vessels, apparatuses and power generation equipment. We understand our customers and provide the quality they need. We are the world's only single-source supplier of shell plates, heads and cones in carbon steel and roll-bonded clad plates. This means optimized workability and lower expense for our customers. Our steels for pressure vessels are suited to both very high and very low temperatures. They are characterized by high strength, supplied in thick gauges and used in sour service. Roll-bonded clad plates are our answer to corrosion.

We are Europe's leading producer of roll-bonded clad plates and one of the leading producers worldwide. We are the first to provide high-strength TMCP steels with optimized weldability for penstocks in hydro-power stations.

We provide further processing steps in-house, including cut shapes, edge preparation for welding and shot blasting. We manufacture huge steel castings up to 200 tons per piece for turbines.

Our strengths are our expertise and experience:

- Steel produced in the LD process is of the highest purity and is made into slabs up to 355 mm thick in our steelworks. These slabs form the basis for high-quality heavy plates.
- We specialize in thermomechanical rolling with accelerated cooling.
- A wide product range combined with excellent project management meets the highest requirements of the energy business.

Customized solutions and high-quality products made by voestalpine

High strength and excellent toughness at extremely low temperatures, thick gauges, sour service and corrosion resistance: Even the most demanding requirements are met by our high-quality heavy plates, clad plates, heads, cones and castings. In cooperation with our customers, we continually develop new products to meet higher and more complex requirements.

Pressure-vessel plates

A high-quality package

- Shell plates, heads and cones from a single source
- Carbon steel, including sour-service and roll-bonded clad plates
- High-strength CrMo and CrMoV steels to reduce thick wall gauges
- Up to 200 mm in thickness and 24 tons per plate

Nickel plates

Tough at extremely low temperatures

- Thin and extra wide 9%-nickel plates for LNG tanks
- 5%-nickel shell plates and heads for LPG tanks
- Low carbon content for perfect weldability
- Prefabrication available and certified by KOGAS

Clad plates

Our answer to corrosion

- Europe's leading producer
- Economic alternative to expensive high-alloy solid material
- Roll-bonding provides excellent bond quality and wide dimensions
- Clad plates, heads and cones from a single source

Heads and cones

High-quality pressed parts

- Shell plates, heads and cones from a single source
- Made of carbon steel and roll-bonded clad plates
- Single-part and multi-part heads and cones, special pressed parts
- Up to 160 mm in head gauge and up to 14,000 mm in diameter

High-strength plates

Optimized weldability by TMCP for penstocks

- Complete package of steels for penstocks
- First reference of TMCP steels with minimum yield strength of 700 MPa
- TMCP for optimized weldability and excellent toughness
- Plate dimensions for pipe diameters up to 6 m



Customized solutions for refineries and power generation

- Pressure-vessel plates
- Nickel plates
- Clad plates
- Head and cones
- High-strength plates
- Pole sheets
- Castings

You will find our entire product range
and further information about
our solutions for refineries and
power generation on the Internet at
www.voestalpine.com/steel.

Pole sheets

The reliable solution

- Best electromagnetic properties and high strength
- Hot-rolled, TMCP and cut to order
- Cold-rolled for higher polarization values

Castings

Highly sophisticated
steel castings

- Castings for all aspects of energy applications
- Wide range of industry-specific materials
- Manufacturing and development in collaboration with our customers
- Competent partners in R&D projects



Pressure-vessel plates

A high-quality package

From a single source

We are a single-source supplier of shell plates, heads and cones made of plain carbon steel and in roll-bonded clad design. This results in the following advantages for our customers:

- Manufacturing and processing benefits, primarily in the field of welding, through use of the same steel for shell plates, heads and cones
- Technical consultation and coordination through quality assurance and research
- Simultaneous manufacturing and delivery of shell plates, heads and cones
- Lower customer costs

Boiler construction and apparatus engineering

Steels made by voestalpine Grobblech for boilers and pressure vessels are used in the chemical and petro-chemistry industries. Creep-resistant pressure vessel steels withstand the highest of temperatures in these applications. They are especially suited to applications in heated pressure vessels.

Thick, wide and heavy

- Steel grades according to EN 10028 and ASTM
- Plate thicknesses ranging between 5 and 200 mm
- Plate widths of up to 3,800 mm
- Plate lengths of up to 18,700 mm; up to 12,500 mm for quenched and tempered material
- Weights of up to 24 tons per plate

Shell plates, heads and cones





High-strength alloys

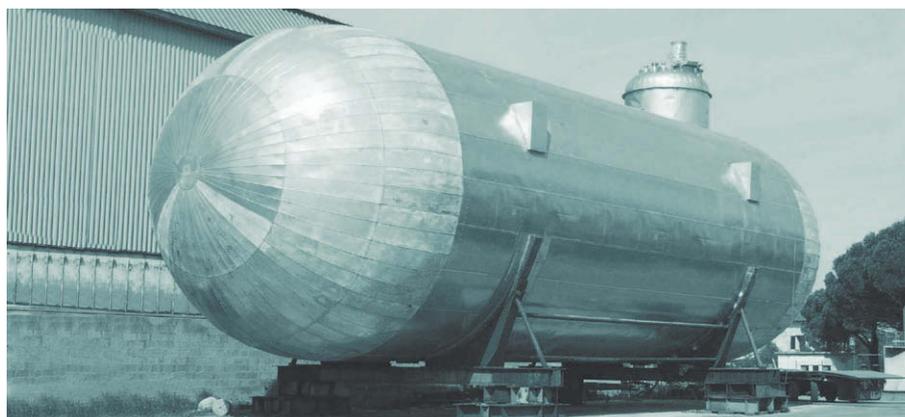
We supply high-strength CrMo and CrMoV steels to achieve reductions in the thick wall gauges of pressure vessels. Our customers use our P460 NL2 mod steel grade as plates and heads in LPG tank cars. Cryogenic 9%-nickel steels with toughness down to $-196\text{ }^{\circ}\text{C}$ are used in the construction of storage tanks for liquefied natural gas (LNG). We also supply heat-treatable fitting steels (WPHY) in as-rolled condition.

Thicker gauges and sour service

We supply heavy shell plates in selected steel grades and in gauges up to 200 mm. Based on ingot-casting pre-material, higher unit weights are available up to 24 tons.

We also offer steels for pressure vessels in sour-service condition. Steel grades SA 516, 60, 65 and 70 according to ASTM and in thicknesses up to 70 mm are delivered in normalized condition with simulated post-weld heat treatment (sim.pwht). These steels provide excellent sour-service properties and meet the highest requirements, including crack-length ratios (CLR) below 5% according to NACE TM 0284, EN 10229 and national standards such as SAMSS 016 of Saudi Aramco.

LPG tank





Nickel plates

Tough at extremely low temperatures

LNG and LPG

Cryogenic nickel plates are excellently suited to applications exposed to extremely low temperatures. They are used for the transport and storage of liquefied natural gas (LNG) and liquefied petroleum gas (LPG).

Thin and extra wide plates for LNG tanks

Natural gas is liquefied at the extremely low temperature of -164 °C, which shrinks its volume by a factor of 600. This makes its storage and transport possible and economically efficient. At these very low temperatures, the utilization of special 9%-nickel steels is necessary in order to guarantee sufficient toughness and resistance to brittle cracking. We supply extra-wide plates (widths of up to 3,800 mm) to this market segment. 5-mm-thick plates can even be supplied in widths of up to 2,800 mm.

Shell plates and heads for LPG tanks

The LPG process is used to produce propane and process gases from natural gas. These gases are liquefied at room temperature at low pressure and are stored in special tanks made of 5%-nickel steels. We supply shell plates and vessel heads from a single source.

Highest quality for the highest degree of safety

The basis of our high-quality nickel plates are high-purity slabs from our own steel-making plant. The very low carbon content guarantees perfect weldability. Further advantages are found in the product's excellent impact strength and the fracture-mechanical properties (CTOD). The entire plate surface undergoes ultrasonic testing. The residual magnetism is below 50 Gauss.

Steel grades and dimensions

We offer 5%- and 9%-nickel steels according to EN 10028-4 and ASTM 553 in plate thickness range of 5 to 70 mm, plate width up to 3,800 mm, plate length up to 12,400 mm and up to 10 tons per single plate.

Prefabrication

- Shot-blasted or shot-blasted and primed
- Weld-edge preparation: Minimal hardening of the flame-cut edge is a result of the low carbon content.
- Plate bending

Our product quality is certified by all of the leading certification institutions. We also meet the highest requirements of KOGAS, the state-operated Korean gas company.

Certifications for 5%-nickel steels

- Lloyd's Register of Shipping (LRS), Great Britain
- Technischer Überwachungsverein (TÜV), Germany
- Germanischer Lloyd (GL), Germany
- Registro Italiano Navale (RINA), Italy
- American Bureau of Shipping (ABS), USA
- Bureau Veritas (BV), France

Certifications for 9%-nickel steels

- Lloyd's Register of Shipping (LRS), Great Britain
- Technischer Überwachungsverein (TÜV), Germany



Clad plates

Our answer to corrosion

Europe's leading producer

Clad plates are the economic alternative to expensive high-alloy and non-clad plates. Roll-bonded clad plates are our answer to corrosion and explosion. With a cladding capacity of 40,000 tons a year, we are Europe's leading producer of roll-bonded clad plates and one of the leading producers worldwide.

Wide applications

Our roll-bonded clad plates, heads and cones are found in chemical equipment applications and refineries, in the oil and gas industry, coke drums and the grocery industry.

Strong advantages

The mechanical properties of the base material are optimally combined with the corrosion resistance of the cladding material. The metallurgical bond is created by high pressure at high temperature. The bond is inseparable and far exceeds the minimum shear strength of 140 MPa required by ASTM. The corrosion resistance of clad plates is as good as that of solid material.

Roll-bonded clad plates provide the following:

- Reduced wall thickness resulting in less weight and lower material costs as compared to solid corrosion resistant alloy (CRA)
- Improved surface condition and less dilution as compared to overlay welding
- Higher bonding quality and larger available dimensions as compared to explosive cladding

We are a single-source supplier of roll-bonded clad plates, heads and cones. This reduces acquisition costs for our customers.



Excellent materials

Clad plates consist of a base and a cladding material. The base materials for our clad plates are produced exclusively in our own steelmaking plant in Linz. Cladding materials are purchased in the form of slabs and sheets from renowned manufacturers.

The base materials are predominantly made of structural steels, steels for boilers and pressure vessels and fine-grained structural steels, all of which are characterized by good weldability and formability.

Cladding materials are made of ferritic and austenitic stainless steels, nickel and nickel-based alloys, copper and copper-nickel alloys and titanium, all of which have excellent anti-corrosive properties.

The base material surfaces are generally delivered in as-rolled or shot-blasted condition. In almost all instances, the surface of the cladding material is polished. Our standard polish is 80 grain. Other grain sizes are available upon request.

Available dimensions

- Total plate thicknesses between 6 and 150 mm
- Cladding thicknesses between 1.5 and 10 mm
- Plate widths of up to 3,800 mm
- Plate lengths of up to 15,000 mm;
up to 12,000 mm for quenched and tempered material
- Weights of up to 17 tons per plate



Heads and cones

High-quality pressed parts

From a single source

We supply from a single source shell plates, heads and cones made of both plain carbon steel and roll-bonded clad design. This results in the following advantages for our customers:

- Manufacturing and processing benefits, primarily in the field of welding, through use of the same steel for shell plates, heads and cones
- Technical consultation and coordination through quality assurance and research
- Simultaneous manufacturing and delivery of shell plates, heads and cones
- Lower costs for the customer

Successful throughout the world

Our dished heads are found in applications such as heat exchangers, separators, columns, compressors, storage containers and tank cars. Our customers are found in the petrochemistry, oil and gas, paper and pulp, energy and railcar manufacturing industries.

Clad heads and special pressed parts

We use structural steels, fine-grained structural steels and pressure vessel steels for carbon steel heads and pressed parts.

We manufacture clad heads and pressed parts from all conventional carbon steels. We supply stainless and heat-resistant steel grades and non-ferrous metals and alloys as cladding materials for optimum corrosion resistance.

For the energy industries we provide new special pressed parts as turbine components as efficient alternative to conventional casting.

Multi-part heads up to 14 m in diameter

We manufacture custom-made heads as a single part or welded from multiple parts. Multi-part heads and cones are available in head gauges of up to 160 mm and diameters of up to 14,000 mm.

Further treatment

- Heat treatment including quenching and tempering
- Edge preparation for welding
- Shot blasting for carbon steel heads
- Surface finish for clad heads
- Pre-assembly of multi-part heads



High-strength plates

Optimized weldability for penstocks by TMCP

Our Portfolio

We supply steel plates and material expertise for the penstocks of hydro-power stations. We also provide high-strength heavy plates as fine-grained steels with a minimum yield strength of 700 MPa in TMCP, direct-quenched and tempered or quenched and tempered condition. In a first-time application of high-strength TMCP steel, special-grade alform plate 700 M of voestalpine was successfully used in the penstock of the Reisseck pumped-storage hydro-power station in Austria.

Broad range of expertise

- Steel grades from S355 to S700
- Plate thicknesses of up to 150 mm
- Plate widths of up to 3,800 mm
- Plate lengths of up to 18,700 mm, pipe diameters of up to 6 m
- Weights of up to 20 tons per plate
- Cut shapes and edge preparation for welding

Optimized weldability

alform®

alform® steels are thermomechanically rolled, high-strength, fine-grained steels with excellent weldability, toughness and cold-forming behavior. The very low carbon content and the low carbon equivalent lead to benefits during welding: less hardening and low risk of cold cracks in the heat-affected zone (HAZ).

alform® steels provide excellent toughness for a reliably welded joint.

aldur®

aldur® steels are water-quenched, high-strength, fine-grained steels with excellent toughness at low temperatures.

The alform® welding system is the first perfectly tuned system of high-strength plates and high-strength filler metals, resulting in high efficiency and safety in the welding process. We support our customers with specific simulations and welding consultation.



Pole sheets

The reliable solution

Pole sheets made by voestalpine are characterized by the best electromagnetic properties and high strength. The excellent mechanical properties of our pole sheets guarantee the narrowest shape tolerances, even at high rotational speeds. Pole sheets made by voestalpine are your first choice for electromagnetic components such as rotors and stators, in which both electromagnetic and mechanical properties are of utmost importance.

Hot-rolled pole sheets

Hot-rolled pole sheets are thermomechanically rolled and combine good electromagnetic properties with high strength. They are typically used in electro-hydraulic applications. Hot-rolled pole sheets are cut to order in our laser-cutting line.

Cold-rolled pole sheets

Cold-rolled pole sheets achieve higher polarization values as compared to hot-rolled grades. They are preferred in large, fast-turning machinery such as exciters and hydro-electric generators.



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Castings

Steel castings for the energy industry

voestalpine Foundry Group can offer steel castings up to a delivery weight of 200 tons per piece.

Wide product range

- Inner and outer casings for steam turbines, valves, vane carriers
- Inner and outer casings for industrial turbines, valves
- Gas turbine casings, vane carriers, diffusors, seal rings
- Cast parts for Pelton, Kaplan and Francis turbines
- Pole head plates for generators

Highly experienced in special materials

All of the industry-specific materials are found in our product range. We are in a position to develop new and complex alloys for special customer requirements and extreme applications. voestalpine Foundry Group was heavily involved in the development of nickel-based alloys. The areas of application include steam-driven power plants that operate at or above 700°C (AUSC).

All castings are available in rough- or in finish-machined condition. Ready-to-install parts save our customers time and money.

Our strengths

- World-leading strategic partner in material and product development
- Member of international research networks in numerous R&D projects
- Effective infrastructure for materials testing, laboratories and numeric simulations
- Highly qualified, trained and experienced employees

Taking our responsibilities seriously

Quality assurance

Product integrity for pressure vessels, penstocks and components of power stations is of utmost importance. The products, processes and business systems of the voestalpine Steel Division are certified by Lloyds Register of Quality Assurance to ISO 9001. This certification covers all aspects of sales, service, design, manufacture and testing.

We are certified for heavy plates and for clad plates by the Verband der Technischen Überwachungsvereine (VdTÜV):

- AD-Merkblatt W0 / TRD 100
- Pressure Equipment Directive Nr. PED97/23/EC

Health, safety and environment (HSE)

voestalpine has created a work environment that values the following:

- Diversity in thought and experience
- Teamwork
- Ethical behavior
- Performance excellence

HSE management is based on continuous improvement in accordance with international standards (ISO 14001). We are extremely proud of our excellent safety performance. We use the EMAS management system to improve our environmental systems.

The comprehensive LIFE program of voestalpine is aimed at adapting corporate culture to find the best possible mix of performance, working conditions, health, sense of work and cooperation.



voestalpine Steel Division
We lead the way,
so our partners will be one step ahead.

We talk solutions

That is why we will never be satisfied with excellent product quality alone. Comprehensive services and unlimited dedication to the challenges of our customers are at the core of our philosophy.

Highly specialized and closely linked, the companies of the voestalpine Steel Division have one common goal: Providing our customers with optimized and individualized packages of benefits in the field of "Refinery and power generation".

Progress through R&D

- Continual product and process development
- Innovative solutions for products and processes
- Independent and fully accredited testing facility on site
- Simulations of material performance of weldability, deformation and edging behavior, fatigue tests and fracture mechanics
- Consultation in the fields of welding and processing

A unique logistics package

- Partnerships with our clients and customers
- Reliable and flexible delivery performance
- Professional project management ensuring successful delivery of complex orders
- Dedicated mill-based project management team for order management from pre-production to post-production to support
- Complete project documentation package (inspection and testing plan, manufacturing specifications, ultrasonic testing procedures)
- Prompt reaction to inquiries
- Web-based customer service center with customer access to order confirmations, invoices, test certificates and order status

Further in-house processing

- Cut shapes
- Edge preparation for welding and robot welding
- Annealing and shot blasting

A strong partnership

- Close collaboration with our Group companies in order to create unique expertise and the technological leadership of our products in the energy sector
- For more information about energy-related products supplied by the voestalpine Group, please also visit:
 - Böhler Welding Group (www.boehlerweldinggroup.com)
 - voestalpine Tubulars GmbH & Co KG (www.voestalpine.com/tubulars)
 - voestalpine Austria Draht GmbH (www.voestalpine.com/austriadraht)

Technically more advanced. Successful together. voestalpine Steel Division – the partner you can trust.

High-quality materials are the basis for our products. We strive to be the best partner for our customers and want to provide them with the best-possible solutions. We focus our expertise on two aspects:

The personal aspect, with dedicated and highly competent employees

The technical aspect, with high-quality methods, products and services

The companies in the voestalpine Steel Division and their employees understand partnership to be the following:

- Understanding for their customers' business
- Expertise and reliability
- Responsibility for satisfactory project completion
- Partnerships based on trust

Many years of successful partnerships with our customers prove our point.

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