

# HEAT TREATMENT LINE

HIGH-TEMPERATURE FURNACE/LOW-TEMPERATURE FURNACE (HTF/LTF)

SPECIFICATION SHEET

## SIJ METAL RAVNE

SIJ Metal Ravne with its 1,000 employees and almost 80,000-ton annual production belongs to the group of mini-mills at the global level. We found our opportunity in the so-called niche production which is characterized by specific knowledge and experience, larger flexibility and higher added value. We produce steel in an electric arc furnace, casting it into ingots and rolling or forging into high-quality long steel products. For the most challenging conditions, we use VOD (Vacuum Oxygen Decarburization) and ESR (Electroslag Remelting) methods. Our own Steel Plant, Forging Shop, Rolling Mill and a wide range of heat treatment and machining processes allow us to produce a rich pallet of more than 200 steel grades in different dimensional shapes.

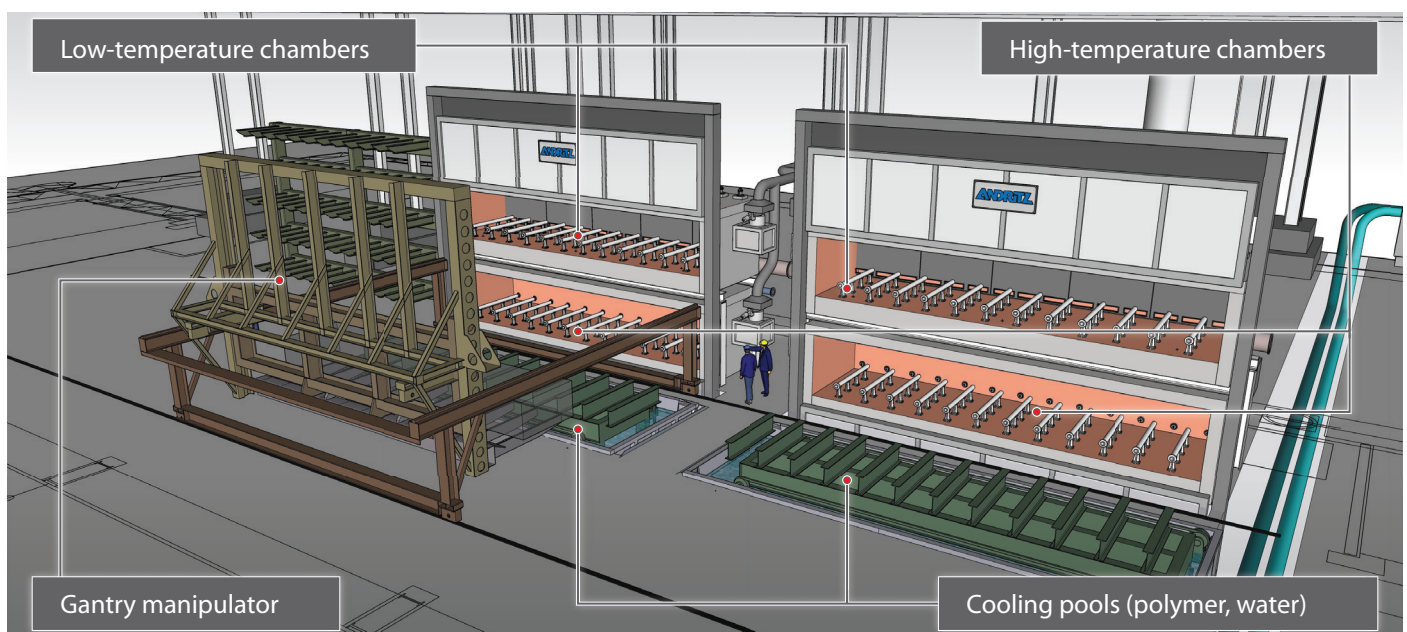
**In SIJ Metal Ravne we have the capacity and knowledge for heat treatment of all dimensions; rolled and forged products. Below we present a new special heat treatment line for most demanding products.**

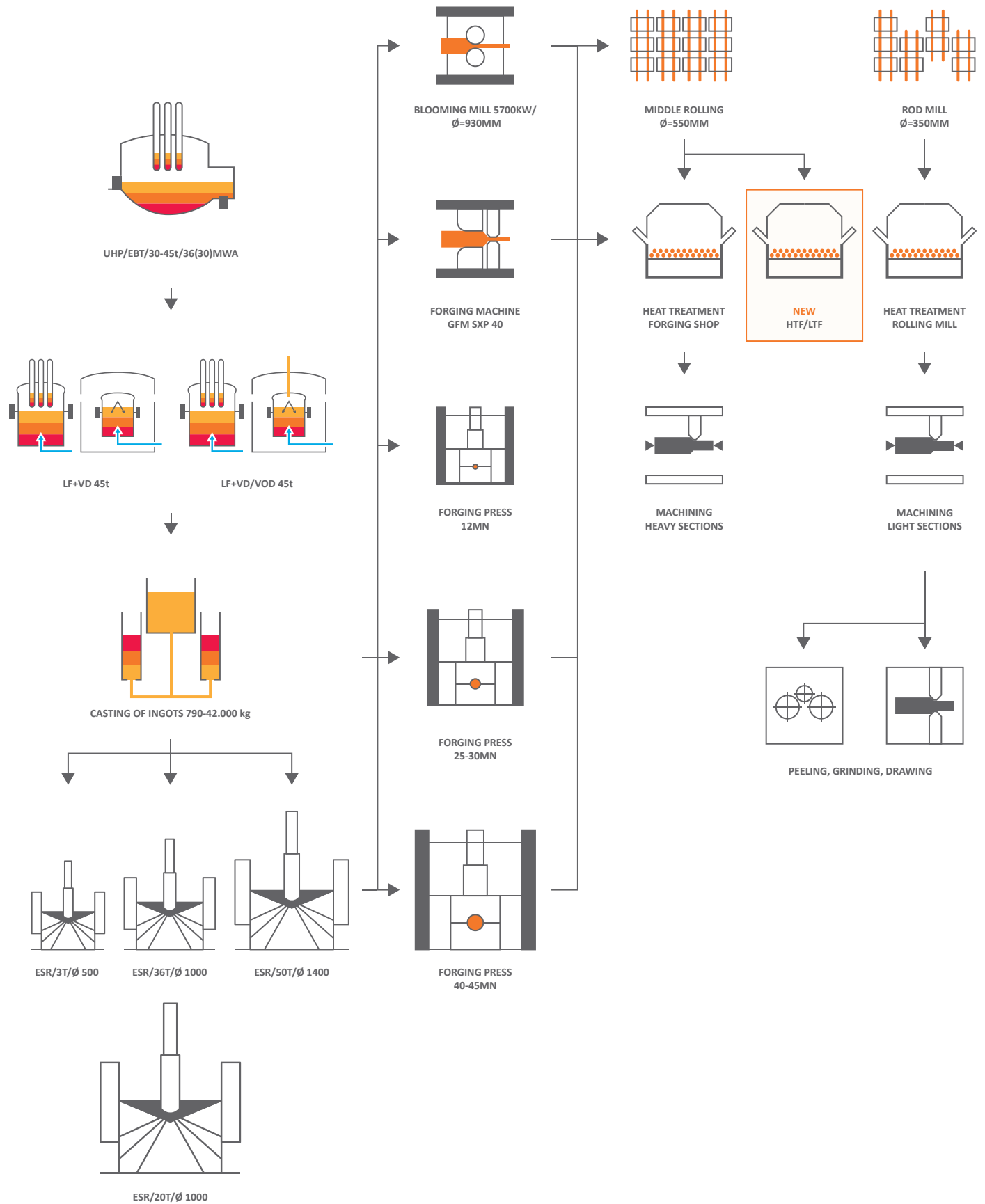
SIJ Metal Ravne is a member of the SIJ Group – Slovenian Steel Group

## NEW LINE FOR HEAT TREATMENT OF THE MOST DEMANDING PRODUCTS

We present a new special furnace for the most demanding heat treatment of products used in energy sector, aircraft industry and other demanding sectors.

The line consists of two two-chamber furnaces (2 VTP + 2 NTP). Each “twin” consists of a high-temperature and a low-temperature chamber. In addition to the furnaces, the line consists of two cooling pools and a gantry manipulator with a load capacity of up to 25 tons which enables accurate charging of products.





**GENERAL CHARACTERISTICS OF FURNACES:****Temperature range:**

- high-temperature furnace (HTF): up to 1280 °C
- low-temperature furnace (LTF): from 200 °C to 850 °C

**Furnace dimensions:**

- maximum usable length: 10000 mm
- maximum usable width: 2000 mm
- maximum usable height: 900 mm

**Weight limitations:**

- maximum weight of lot (charge): 25 tonnes
- maximum weight of individual forging: 16 tonnes

**Coolant:**

- water
- polymeric concentrate with cooling characteristics of quenching oil

**DIMENSIONAL RANGE**

- Sleeves, plates:  $\varnothing$  up to 2000 mm, height up to 900 mm (maximum weight of forging is 16 tonnes).
- Flat products: Rolled: thickness from 50 mm up to 90 mm and width from 50 mm up to 550 mm; Forged: from 80 × 70 mm to 260 × 120 mm or from 261 × 80 mm to 1600 × 550 mm (maximum weight of forging is 10 tonnes).
- Square products: Rolled: thickness from sq. 50 mm to 150 mm; Forged: from sq. 50 mm up to sq. 900 mm, length up to 10000 mm (maximum weight of forging is 10 tonnes).
- Round products: Rolled: from  $\varnothing$  50 mm to 105 mm; Forged: from  $\varnothing$  90 mm up to  $\varnothing$  900 mm, height up to 10000 mm (maximum weight of forging is 16 tonnes).
- Open-die machined forgings (rolls, exles, shafts, rings, discs, bushes).

## STEEL GRADES

Below we present some of the more demanding grades from each steel group. Other steel grades from our wide range or according to special customer requirements are also available.

### AUSTENITIC STAINLESS STEELS

SIJ BRAND	W.Nr.	EN	AISI/SAE/other	TYPICAL ANALYSIS	APPLICATION
<b>SINOXX<sup>***</sup></b> S490	-	-	Nitronic 60, S21800	C ≤ 0.10   Si = 3.80   Mn = 8.00   Cr = 17.00   Ni = 8.50	Shafts, valves, components for dairies, machine-building and paper industry.
<b>SINOXX<sup>***</sup></b> 4301	1.4301	X5CrNi18-10	AISI/SAE 304	C ≤ 0.07   Si ≤ 1.00   Mn ≤ 2.00   Cr = 18.25   Ni = 9.25	Weldable, deep drawable austenitic stainless steel grade - cutlery tools, medical and sanitary equipment. Resistant to intergranular corrosion.
<b>SINOXX<sup>***</sup></b> 4305	1.4305	X8CrNiS18-9	AISI/SAE 303	C ≤ 0.10   Si ≤ 1.00   Mn ≤ 2.00   Cr = 18.00   Ni = 9.00   Cu ≤ 1.00	Used in an incredibly wide variety of parts both in screw and general machining industries. Applications include hardware, fasteners, valve parts, nozzles and trim. For the food processing industry, dairies, photographic industry, for paint, soap, paper and textile production.
<b>SINOXX<sup>***</sup></b> 4401	1.4401	X5CrNiMO17-12-2	AISI/SAE 316	C ≤ 0.07   Si ≤ 1.00   Mn ≤ 2.00   Cr = 17.5   Mo = 2.25   Ni = 9.25	Widely used in industry. Components for the cellulose, paper, oil, soap and textile industry, production of paints, meat processing industry, breweries, dairies and surgical instruments. Also for application in cold extrusion, as spring steel and steel for pressure purposes.
<b>SINOXX<sup>***</sup></b> 4541	1.4541	X6CrNiTi18-10	AISI/SAE 321	C ≤ 0.08   Si ≤ 1.00   Mn ≤ 2.00   Cr = 18.00   Ni = 10.50   min. Ti = 5 x C x 0.7	Jet engine parts, furnace heat-treated parts, expansion joints, turbo superchargers, oil refiners, exhaust manifolds and high- temperature chemical production equipment.
<b>SINOXX<sup>***</sup></b> 4980	1.4980	X6NiCrTiMoVB25-15-2	AISI/SAE A-286	C ≤ 0.08   Si ≤ 1.00   Mn ≤ 2.00   Cr = 15.00   Ni = 25.00   Mo = 1.30   V = 0.3   Ti = 2.10	Used for aviation and energy production applications. For heavy-duty rotors, gas turbine blades, , pressure equipment parts, parts for jet engines and rockets, exhaust systems.

### FERRITIC STAINLESS STEELS

SIJ BRAND	W.Nr.	EN	AISI/SAE/other	TYPICAL ANALYSIS	APPLICATION
<b>SINOXX<sup>***</sup></b> 2099	1.2099	-	-	C ≤ 0.09   Si ≤ 0.55   Mn = 1.20   Cr = 12.50   Ni ≤ 0.80	Air, water and steam resistant components for water turbines, valves, different machine parts, components for petrochemical and shipbuilding industry.
<b>SINOXX<sup>***</sup></b> 4000	1.4000	X6Cr13	AISI/SAE 410S	C ≤ 0.08   Si ≤ 1.00   Mn ≤ 1.00   Cr = 13.00	Construction of turbines, water and steam resistant ferritic steel components, parts for water turbines, valves, diff. machine parts, components for petrochemical and shipbuilding industry. machines and ships engines (sweet water), paper-, textile and dairy machines, vapor- and water armatures.

## MARTENSITIC STAINLESS STEELS

SIJ BRAND	W.Nr.	EN	AISI/SAE/other	TYPICAL ANALYSIS	APPLICATION
<b>SINOXX<sup>***</sup></b> 4021	1.4021	X20Cr13	AISI/SAE 420	C = 0.20   Si ≤ 1.00   Mn ≤ 1.50   Cr = 13.00	Dental and surgical instruments, cutlery, pump shafts, plastic moulds and dies, steel balls, and various hand tools, pump components, shafts, turbine blades, pressing dies for tablets, glass and plastics processing tools.
<b>SINOXX<sup>***</sup></b> 4028	1.4028	X30Cr13	AISI/SAE 420F	C = 0.31   Si ≤ 1.00   Mn ≤ 1.50   Cr = 13.00	Dental and surgical instruments, cutlery, pump shafts, gears pinions and cams, steel balls, and various hand tools. Not recommended for vessels containing high-pressure gases or liquids or for plastic moulds where high surface finishes are required.
<b>SINOXX<sup>***</sup></b> 4034	1.4034	X46Cr13	AISI/SAE 420	C = 0.47   Si ≤ 1.0   Mn ≤ 1.0   Cr = 13.50	All kinds of cutting tools - knives, shears, surgical instruments, moulds for plastics production, as well as for surgical instruments and measuring gauges.
<b>SINOXX<sup>***</sup></b> 4057	1.4057	X17CrNi16-2	AISI/SAE 431	C = 0.17   Si ≤ 1.00   Mn ≤ 1.50   Cr = 16.00   Ni = 2.00	Variety of aircraft and general industrial applications. These include fasteners, shafts, bolts, valve components and chemical equipment, components for dairies, machine-building and paper industry. Steel with high polishability. For application up to working temperature 500 °C.
<b>SINOXX<sup>***</sup></b> 4122	1.4122	X39CrMo17-1	-	C = 0.39   Si ≤ 1.00   Mn ≤ 1.00   Cr = 16.50   Mo = 1.05   V ≤ 1.00	Pump shafts, fitting and compressor parts, as well as steam and water control valves and boat shafts for use in fresh water.
<b>SINOXX<sup>***</sup></b> 4313	1.4313	X3CrNiMo13-4	AISI/SAE CA6-NM	C ≤ 0.05   Si ≤ 0.60   Mn ≤ 1.00   Cr = 13.25   Mo = 0.55   Ni = 4.00	Used for parts subjected to high mechanical stress in fittings and pump construction, for compressors and turbines in hydroelectric power stations and refrigerating systems.
<b>SINOXX<sup>***</sup></b> 4542	1.4542	X5CrNiCuNb17-4-4	AISI/SAE 17-4PH	C ≤ 0.07   Si ≤ 0.70   Mn ≤ 1.50   Cr = 16.00   Mo ≤ 0.60   Ni = 4.00   Cu = 3.50	Used for a variety of applications including oil field valve parts, chemical process equipment, aircraft fittings, fasteners, pump shafts, nuclear reactor components, gears, paper mill equipment, missile fittings and jet engine parts.
<b>SINOXX<sup>***</sup></b> 4731	1.4731	X40CrSiMo10-2	-	C = 0.40   Si = 2.50   Mn ≤ 0.80   Cr = 10.50   Mo = 1.05   Ni ≤ 0.50	Escape valves in carburets and diesel engines parts.
<b>SINOXX<sup>***</sup></b> 4903	1.4903	X10CrMoVNb9-1	AISI/SAE A213/P91	C = 0.10   Si = 0.35   Mn = 0.45   Cr = 8.50   Mo = 0.95   Ni ≤ 0.40   V = 0.22   Nb = 0.53   N = 0.05   Al ≤ 0.040	Boiler tube sector and for superheated steam fittings.
<b>SINOXX<sup>***</sup></b> 4913	1.4913	X19CrMoNbVN11-1	-	C = 0.19   Si = 0.30   Mn = 0.55   Cr = 10.75   Mo = 0.75   Ni = 0.55   V = 0.20   Nb = 0.33   N = 0.08   B ≤ 0.0015	For fastening elements in thermal energy plants, screws, nuts.
<b>SINOXX<sup>***</sup></b> 4922	1.4922	X20CrMoV11-1	-	C = 0.20   Si ≤ 0.50   Mn ≤ 1.00   Cr = 11.25   Mo = 1.00   Ni = 0.55   V = 0.30	Components for steam turbines and other components, resistive to compressed hydrogen for chemical industry.
<b>SINOXX<sup>***</sup></b> 4938	1.4938	X12CrNiMoV12-3	-	C = 0.11   Si = 0.18   Mn = 0.70   Cr = 11.75   Mo = 1.75   Ni = 2.50   V = 0.33	Components for steam turbines.

## TOOL STEELS

SIJ BRAND	W.Nr.	EN	AISI/SAE/other	TYPICAL ANALYSIS	APPLICATION
<b>SIMOLD</b> <sup>***</sup> S133	-	-	-	C = 0.28   Si = 0.10   Mn = 1.40   Cr = 1.30   Mo = 1.00   Ni = 0.50   V = 0.20	Typically used for relatively low-temperature applications such as injection moulds, synthetic plastic moulds, particularly suitable for large moulds in different fields of industry.
<b>SIMOLD</b> <sup>***</sup> 2083	1.2083	X40Cr14	AISI/SAE 420 mod.	C = 0.35   Si = 0.40   Mn = 0.25   Cr = 13.00   Ni = 0.20   Mo = 0.20	Moulds for corrosive plastic materials such as PVC, recycled polymers etc., moulds for chemically aggressive plastics and plastics containing abrasive fillers, mould inserts, dies and gauges for PVC extrusions, screws and barrels for extruders, moulds for automotive, food, medical and optical industry such as spectacles, compact discs, lenses.
<b>SIMOLD</b> <sup>***</sup> 2085	1.2085	X33CrS16	-	C = 0.30   Si ≤ 1.00   Mn ≤ 1.40   Cr = 15.00–17.00   Ni ≤ 1.00	All kinds of cutting tools - dies and die-blocks in the plastics industry such as PVC, knives, shears, surgical instruments, moulds for plastics production, as well as for surgical instruments and measuring gauges.
<b>SIHARD</b> <sup>***</sup> 2360	1.2360	X48CrMoV8-1-1	-	C = 0.47   Si = 0.80   Mn = 0.40 Cr = 7.50   Mo = 1.37   V = 1.35	Severely stressed machine blades for cellulose and paper industry, woodworking milling cutters, flat and circular blades for cutting sheets/plates of thickness 5 to 15 mm.
<b>SITHERM</b> <sup>***</sup> 2343	1.2343	X37CrMoV5-1	AISI/SAE H11	C = 0.37   Si = 1.0   Mn = 0.38   Cr = 5.15   Mo = 1.30   V = 0.40	Tools for hot forging of light metal. Pressure die casting tools. Dies, mandrels, punchers, knives, moulds.
<b>SITHERM</b> <sup>***</sup> 2344	1.2344	X40CrMoV5-1	AISI/SAE H13	C = 0.39   Si = 1.00   Mn = 0.38   Cr = 5.15   Mo = 1.35   V = 1.00	Hot die work, die casting and extrusion dies, wear-resisting tools, pressure die casting tools, pressing tools for light and heavy metal.
<b>SITHERM</b> <sup>***</sup> 2362	1.2362	X63CrMoV5-1	-	C = 0.63   Si = 1.10   Mn = 0.40   Cr = 5.25   Mo = 1.0   Ni = 0.30	Intermediate rolls for cluster mills, trimming dies, hot cutting shears.
<b>SITHERM</b> <sup>***</sup> 2367	1.2367	X38CrMoV5-3	-	C = 0.38   Si = 0.40   Mn = 0.40   Cr = 5.00   Mo = 2.95   V = 0.50	Wear-resisting tools, pressure die casting tools, pressing tools for light and heavy metal.

## DUPLEX STAINLESS STEELS

SIJ BRAND	W.Nr.	EN	AISI/SAE/other	TYPICAL ANALYSIS	APPLICATION
<b>SINOXX</b> <sup>***</sup> 4462	1.4462	X2CrNiMoN22-5-3	-	C = 0.02   Si = 0.50   Mn = 1.00   Cr = 22.00   Mo = 3.00   Ni = 5.50	Chemical and oil processing industry. Highly resistant to stress corrosion in chlorine surroundings.

## STRUCTURAL STEELS

SIJ BRAND	W.Nr.	EN	AISI/SAE/other	TYPICAL ANALYSIS	APPLICATION
<b>SIQUAL</b> <sup>***</sup> M244	-	35NiCrMoV12-5	38XH3MΦA	C = 0.37   Si ≤ 0.35   Mn = 0.35   Cr = 1.30   Ni = 3.20   Mo = 0.40   V = 0.15	Structural parts for military applications.
<b>SIQUAL</b> <sup>***</sup> 6580	1.6580	30CrNiMo8	AISI/SAE 4340	C = 0.30   Si ≤ 0.40   Mn = 0.45   Cr = 2.00   Mo = 0.40   Ni = 1.90	For permanently stressed components with large cross-sections for automotive and mechanical engineering. For economic performance under severe dynamic stress, parts must be designed for optimum strength or toughness.
<b>SIQUAL</b> <sup>***</sup> 6582	1.6582	34CrNiMo6	AISI/SAE 4337/4340	C = 0.34   Si ≤ 0.40   Mn = 0.65   Cr = 1.50   Mo = 0.23   Ni = 1.50	Typical applications are for structural use, such as aircraft landing gear, power transmission gears and shafts and other structural parts, general engineering parts, through-hardened gears, connecting rods and bolts, gun barrels.
<b>SIQUAL</b> <sup>***</sup> 6957	1.6957	27NiCrMoV15-6	-	C = 0.27   Si ≤ 0.30   Mn = 0.28   Cr = 1.50   Mo = 0.35   Ni = 3.70   V = 0.10	Turbine and power generator parts, parts for oil and gas industry, such as valves housings, flanges and pipes
<b>SIQUAL</b> <sup>***</sup> 6981	1.6981	21CrMoNiV4-7	-	C = 0.20 ≤ 0.30   Mn = 0.55   Cr = 1.25   Mo = 0.70   Ni = 0.60   V = 0.30	Screws and nuts as well as forged components for steam turbines. Resistant to working temperature max. 530 °C.
<b>SIQUAL</b> <sup>***</sup> 7380	1.7380	10CrMo9-10	AISI/SAE A182 Grade F22	C = 0.12 ≤ 0.40   Mn = 0.55   Cr = 2.25   Mo = 1.00   Ni ≤ 0.50	Components for steam boilers and turbines, shafts for higher temperature ranges.
<b>SIQUAL</b> <sup>***</sup> 7734	1.7734	15CDV6	-	C = 0.15   Si ≤ 0.20   Mn = 0.95   Cr = 1.38   Mo = 0.90   V = 0.25	Components for the aircraft industry.
<b>SIQUAL</b> <sup>***</sup> 8070	1.8070	21CrMoV5-11	-	C = 0.21   Si = 0.45   Mn = 0.45   Cr = 1.35   Mo = 1.10   Ni ≤ 0.30   V = 0.30	Screws and nuts and forged components for steam engines up to working temperatures of maximum 539 °C.
<b>SIQUAL</b> <sup>***</sup> 8509	1.8509	41CrAlMo7-10	-	C = 0.41   Si ≤ 0.40   Mn = 0.65   Cr = 1.65   Mo = 0.33   Al = 1.00	Structural parts with high surface hardness - piston rods, extruders, cylinders, shafts, straightening tools, measuring tools, etc.
<b>SIQUAL</b> <sup>***</sup> 8550	1.8550	34CrAlNi7-10	-	C = 0.34   Si ≤ 0.40   Mn = 0.55   Cr = 1.65   Mo = 0.20   Ni = 1.00   Al = 1.00	Structural parts with high surface hardness - piston rods, extruders, cylinders, shafts, straightening tools, measuring tools, etc.

## NICKEL ALLOYS

## TITANIUM ALLOYS

## ➤ BENEFITS

- The furnace ensures extremely uniform homogeneity of the temperature field over the entire volume of the furnace (class 2 according to AMS 2750) and extremely fast transfer from the furnace to the quenching medium (maximum 30 seconds).
- Capacity increase – shorter delivery time.
- Products, heat-treated on the HTF/LTF line, are used for very demanding purposes. Due to better mechanical properties, they have a longer life cycle, which allows the end-user to reduce operating costs.
- The heat treatment line is certified according to the following standards:
  - AMS 2750F, class 2,
  - API 6A,
  - ASTM A991.
- Optional certification according to NORSOK standards.

## ➤ INDUSTRIES

- aerospace industry
- energy
- oil & gas industry
- chemical industry
- machine building
- tooling
- other industries where the products with the most demanding heat treatment are required

## ➤ QUALITY SYSTEM MANAGEMENT

- EN/AS 9100
- ISO 9001
- ISO 14001
- ISO 45001
- ISO/IEC 17025

## ➤ DISCLAIMER

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