

Industeel



ArcelorMittal

Steel solutions for the biofuel industry



A wide range of steel solutions to fit your requirements in the biofuel industry

More than 150 years of experience of melting, casting, rolling and finishing special steel plates.

Technical support for material selection and fabrication.

The largest size range of plate products.

Prefabrication forming, bevelling, bending, painting, cutting.

R&D fully dedicated to development and optimization of Industeel products for your business.

Certified to all major certification and quality systems.

Key Benefits

- High quality steel plates
- High level of technical expertise
- Largest dimensional range
- Innovation



Our steel is made from recycled scrap

Leading producer of high quality steels

Industeel is specialized in the production of hot rolled as well as forged steel plates, ingots and formed pieces, with the largest dimensional range worldwide.

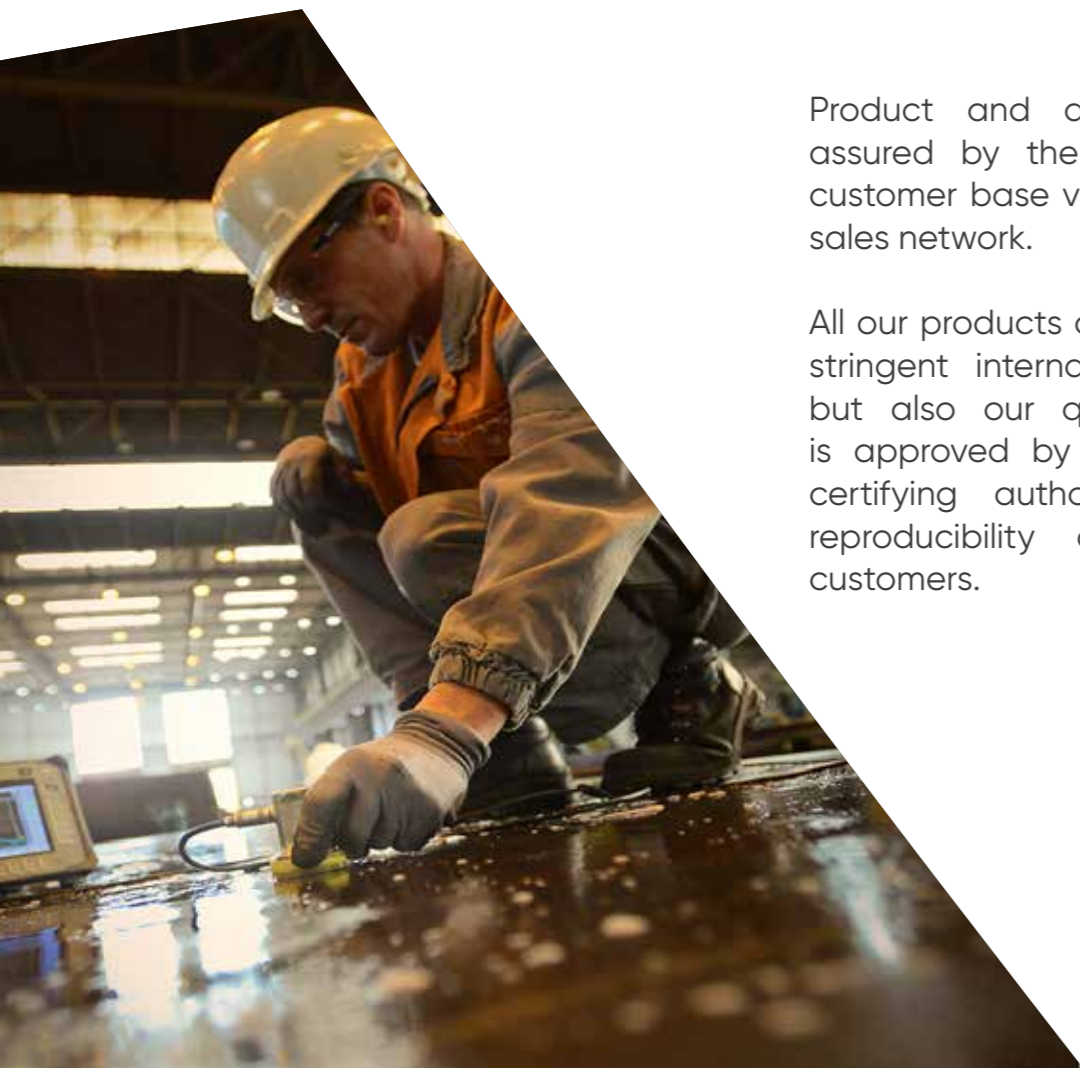
Industeel offers a complete range of high quality steel grades designed to meet the most severe customer specifications.

Industeel regroups 3 production facilities and 2 prefabrication shops rich with a long tradition of metallurgical know-how and different product specialities.



Product and application innovation is assured by the proximity to its global customer base via a dedicated worldwide sales network.

All our products are submitted to the most stringent internal and external controls, but also our quality assurance system is approved by the largest international certifying authorities, a guarantee of reproducibility and reliability for our customers.



With a wide range of specialized equipment

With over 150 years of experience, the Industeel name stands for high performance steel at its best.

Careful selection of raw materials to produce **high purity steel** melted by electric arc furnace.

Fine tuned secondary metallurgy, vacuum and special degassing processes for **high cleanliness steels**.

Continuous casting or bottom-poured ingot programs and **latest industrial techniques**.

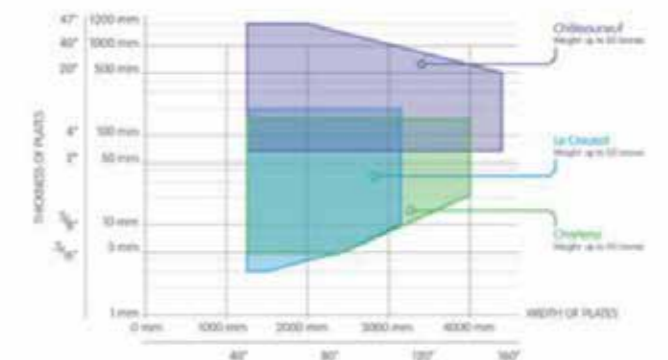
Computer controlled **quarto plate rolling mills**.

Automatic quenching devices and high precision tempering furnaces to create **homogeneous hardness and microstructure** through the cross section.



Largest dimensional range worldwide

- CHARLEROI**
Thickness: 5 - 175 mm - Width: up to 4.000 mm
Weight: up to 20 tonnes
- LE CREUSOT**
Thickness: 4 - 180 mm - Width: up to 3.100 mm
Weight: up to 20 tonnes
- CHÂTEAUNEUF**
Thickness: 80 - 1200 mm - Width: up to 4.300 mm
Weight: up to 80 tonnes



Wear resistant steels for abrasive applications

Industeel provides a complete range of advanced grades to withstand abrasion induced by biomass crushing. Creusabro® grades are designed to provide a cost-effective combination of wear resistance and easy fabrication.

The original chemical composition and manufacturing processes applied to Creusabro® provides a unique combination of distinctive metallurgical features that extend the lifetime of wear parts in critical applications compared to classical wear plates.

Creusabro® grades outperform classical wear plates exposed to the combined influence of abrasion and corrosion in wet or mild corrosive environment. Through the XCarb Recycled and Renewably Produced brand, Creusabro® 4800 and Creusabro® 8000 have a best-in-class product carbon footprint.

COMMERCIAL GRADE	HARDNESS LEVEL, HB
Creusabro® Superten	300-380
Creusabro® 4800	340-400 → 410-470
Creusabro® 8000	430-500 → 500-570
Creusabro® Dual	430-500 → 500-570



Creusabro® grades have proven their added value in the bioethanol industry, especially for biomass harvesting and handling



Example of the sugar cane industry

Sand (silica) and other abrasive materials harvested with sugarcane, added to humidity, temperature and the presence of chemical products, cause severe wear and corrosion on various sugar mill components during operation.

Creusabro® grades are the answer to these combined degradation mechanisms and have been used successfully to manufacture various equipment (dryers, conveyors, washers, shredders, ...).



Stainless steels for corrosive environments

Industeel provides austenitic and duplex stainless steels to withstand a wide variety of corrosive environments.

Austenitic stainless steels

Austenitic stainless steels present a good combination of ductility, ease of working and good corrosion resistance. They are derived from the 18Cr-8Ni stainless steel Type 304. Addition of stabilizing elements like titanium or niobium (columbium) provides better resistance to high temperature

applications. Austenitic stainless steels are also available in the heat resistant version (H grades) with a higher carbon content and coarser grain size to improve creep resistance. They can be used up to 870°C /1600°F.

Grade	UNS	EN	C	Cr	Ni	Mo	N	Other
UR™ 304L	S30403	1.4306	< 0.030	18	10	-	-	-
UR™ 316L	S31603	1.4404	< 0.030	17	10.5	2.1	-	-
UR™ 321	S32100	1.4541	< 0.080	17.5	9.5	-	-	Ti ≥ 5 x (C+N)
UR™ 347	S34700	1.4550	< 0.080	17.5	9.5	-	-	-
UR™ 304H	S30400	1.4301	≥ 0.040	18	8	-	-	-

Duplex stainless steels

Duplex stainless steel grades have a ferritic-austenitic microstructure, with a phase balance of approximately 50% ferrite and 50% austenite. They provide attractive features at lower alloy cost compared to

conventional austenitic stainless steels like 304L and 316L : higher resistance to stress corrosion cracking and higher mechanical properties.

Grade	UNS	EN	C max	Cr	Ni	Mo	N	Other	PREN* min
UR™ 2101	S32101	1.4162	0.025	21.2	1.5	< 0.8	0.21	4.3 Mn	25
UR™ 2202	S32202	1.4062	0.03	22	2	< 0.45	0.2	1.3 Mn	25
UR™ 2304	S32304	1.4362	0.03	23	4	-	0.14	-	25
UR™ 2205	S31803	1.4462	0.03	22	5.3	2.7	0.18	-	33/34
UR™ 2205Mo	S32205	1.4462	0.03	22.5	5.5	3.1	0.18	-	35/36
UR™ 2507	S32750	1.4410	0.03	25	7	3.5	0.27	-	41
UR™ 2507W	S32760	1.4501	0.03	25	7	3.5	0.23	0.6 Cu, 0.6 W	41
UR™ 2507Cu	S32520 S32550	1.4507	0.03	25	7	3.5	0.23	1.5 Cu	41

* PREN = Pitting Resistance Equivalent Number = %Cr + 3.3%Mo + 16%N

Austenitic and duplex stainless steels can be employed in various steps of the biofuels production process

Distillation units and digesters

Austenitic stainless steels can provide the corrosion resistance needed for distillation units and digesters. In some cases, duplex stainless steels can be cost-effective alternatives to standard austenitic stainless steels providing a significant thickness reduction while maintaining good corrosion resistance.



Biomass pretreatment with sulfuric acid

Most austenitic and duplex stainless steels can cope with a large variety of sulfuric acid concentrations and temperatures encountered for biomass pretreatment. Our lean duplex stainless steel UR™ 2202 is an excellent cost-effective alternative to the standard austenitic grade 316L for sulfuric acid concentrations up to 20% and 60°C/140°F. The presence of impurities, higher temperature, or higher acid concentrations will require more highly alloyed materials like the super-duplex UR™ 2507 or super-austenitic stainless steels. Our technical team can help you choose the most relevant stainless steel for your sulfuric acid application.



Vegetable oils

Vegetable oils are mainly composed of triglycerides and fatty acids. If any grade of stainless steel is resistant at room temperature, the austenitic grade 304L is not recommended above 150°C/302°F while 316L is resistant to about 200°C/392°F. In this case, the lean duplex UR™ 2202 can be a cost-effective alternative to austenitics.



Stainless steels for corrosive environments

Industeel offers a complete range of super-austenitic and heat resistant stainless steels designed for highly corrosive environments.

Super-austenitic stainless steels

Super-austenitic grades have been developed to provide special corrosion resistance properties by adding molybdenum, chromium and/or nitrogen.

These steels approach the performance of highly corrosion resistant nickel based alloys at a significant lower cost.

Grade	UNS	EN	C max	Cr	Ni	Mo	N	Other	PREN* min
UR™ 31	N08031	1.4562	0.03	26.5	31	6.3	0.2	-	48
UR™ 254	S31254	1.4547	0.03	20	18	6	0.2	0.7 Cu	43
UR™ 28	N08028	1.4563	0.03	27	31	3.5	-	1 Cu	39
UR™ 904L	N08904	1.4539	0.03	20	24	4	0.1	1.5 Cu	35

Heat resistant alloys

For higher temperature applications, heat resistant alloys provide creep resistance and resist to high temperature corrosion (600°C-1100°C/1112°F-2012°F). They can

be found in applications where high-temperature oxidation resistance or high-temperature strength is required, for instance in biorefineries.

Grade	UNS	EN	C max	Cr	Ni	Mo	N	Other	PREN* min
SIRIUS™ 310S	S31009	1.4845	0.100	25	19.5	-	-	-	25
SIRIUS™ 314	S31400	1.4841	0.100	25	19	-	-	1.8 Si	25
SIRIUS™ 800	N08800	1.4876	0.100	21	32	-	-	0.25 Al 0.25 Ti	21
SIRIUS™ 4828		1.4828	0.100	19.5	11.5	-	-	1.6 Si	20
SIRIUS™ 815	S30815	1.4835	0.100	21	11	-	0.16	1.6 Si Ce > 0.03	24

* PREN = Pitting Resistance Equivalent Number = %Cr + 3.3%Mo + 16%N



Super-austenitic stainless steels can be applied when impurities like chlorides are present in the oil.

Vegetable oils

While standard austenitics are immune to vegetable oils at room temperature, more highly alloyed materials like UR™ 904L or UR™ 254 are recommended at higher temperature, or if impurities are present in the oil (example: chlorides in re-used oil). Our R&D team can provide assistance to select the most appropriate material.

Hydrochloric acid and ammonium chloride deposit

These corrosive compounds commonly found in biorefineries require highly alloyed corrosion resistant materials. Super-austenitic stainless steels can be good alternatives to more alloyed materials for this application. Guidance for material selection can be provided upon request.

Pressure vessel steels for biorefining equipment

Industeel offers a complete range of pressure vessel grades able to serve in various conditions

Carbon and carbon manganese steels

Carbon and carbon manganese steels are the backbone of the pressure vessel offer. They are easily weldable and can offer interesting properties for low temperature service down to $\sim -40^{\circ}\text{C}$ and up to $\sim 300\text{--}350^{\circ}\text{C}/572\text{--}662^{\circ}\text{F}$. They can be offered in various thicknesses, from thin gauges from few millimeters thick (typical of piping equipment) up to several hundreds of millimeters thick (typical of large process equipment). Depending on corrosivity of media, they can be used either naked or overlaid with corrosion resistant alloys. They can also be used as backplate during the production of clad plates.

Grade	ASTM/ASME	EN	Typical YS (MPa)
CarElso™ 60 (HIC)	A/SA 516 gr 60	EN 10028-3 P275 NH/NL1 & 2	220
CarElso™ 65 (HIC)	A/SA 516 gr 65	EN 10028-3 P275 NH/NL1 & 2	240
CarElso™ 70 (HIC)	A/SA 516 gr 70	EN 10028-3 P355 N/NH/NL1 & 2	260
CarElso™ HIC Premium *	A/SA 516 gr 60/65/70		260
CarElso™ 70 (SOHIC)	A/SA 516 gr 70	EN 10028-6 P355 Q/QH/QL1 & 2	260
	A/SA 537 Class 2	-	415



Low alloy steels and chromium molybdenum steels

Low alloy steels (such as MnNiMo alloys) are slightly more alloyed than carbon steels and carbon manganese steels and hence offer better performances, through higher strength or higher toughness at lower temperature. More specifically, chromium molybdenum steels have been developed for very demanding high temperature equipments such as heavy pressure vessels used in refining/biorefining installations. They are able to sustain service at high temperature, in presence of hydrogen. These alloys can be produced in very thick sections and are used in overlaid conditions.

Grade	ASTM/ASME	EN	Typical YS (MPa)
SuperElso® 533E	A/SA 533 Type E Class2	-	485
SuperElso® 500HR	-	EN 10028-6 P500Q/QH/QL1 & 2	500
CromElso™ 11	A/SA 387 gr 11 Class 2	EN 10028-213CrMoSi5-5	310
CromElso™ 22	A/SA 387 gr 22 Class 2	EN 10028-210CrMo9-10	310
CromElso™ 22 Enhanced	A/SA 542 tp B Class 4	EN 10028-212CrMo9-10	415
CromElso™ 22V	A/SA 542 tp D Class 4a	EN 10028-213CrMo9-10	415

Storage tanks

Duplex stainless steels offer excellent mechanical properties combined with good corrosion resistance over a broad range of environments

Properties

- High mechanical strength (> 400 MPa, > 58 ksi)
- Usual temperature range : -50 to 300°C (-58 to 572°F)
- Similar thermal expansion compared to carbon steels

Fabrication

- Good weldability, a welding guideline is available upon request
- Weld properties are predictable

Corrosion resistance

- Wide range of corrosion resistance available
- Lower susceptibility to stress corrosion cracking than austenitics

5 reasons to choose duplex for your storage tanks

- The duplex "family" covers a broad range of corrosive environments
- Using duplex grades to design tanks provides reductions in thickness optimizing the total cost compared to other grades
- Using Industeel's wide plates reduces the number of shell courses minimizing welding
- Duplex can be easily welded to carbon steel
- Duplex plates for tanks can prefabricated in our workshop in Dunkirk : bevelling and forming

Grade	UNS	EN	C max	Cr	Ni	Mo	N	Other	PREN* min
UR™ 2101	S32101	1.4162	0.025	21.2	1.5	< 0.8	0.21	4.3 Mn	25
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UR™ 2205	S31803	1.4462	0.03	22	5.3	2.7	0.18	-	33/34
UR™ 2205Mo	S32205	1.4462	0.03	22.5	5.5	3.1	0.18	-	35/36
UR™ 2507	S32750	1.4410	0.03	25	7	3.5	0.27	-	41

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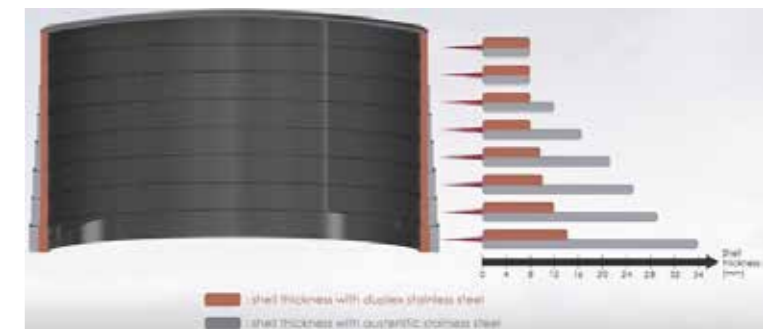
Choose duplex stainless steels for your storage tank

UR™ 2202 Cost Savings for your tank

The Stockton, CA project consisted of Ten (10) various size tanks from 28' (8.5 m) diameter X 36' (11 m) high to 90' (27.5 m) diameter X 50' (15.3 m) high.

The tanks are able to be used for storing cooking grade palm oil and were constructed of either stainless steel or carbon steel.

The stainless steel tanks were a special lean duplex grade from Industeel UR™ 2202.



Industeel R&D Center (CRMC)

A real centre of innovation, with 50 researchers dedicated to our customers, located in Le Creusot. Industeel's CRMC is a world class research facility with unequalled concentration of high-tech equipment and steel experts

R&D

Each year, half a dozen new products are put on the market thanks to the work of the research center. Over 40 products and process patents from the R&D center are currently in operation.

Innovation

In collaboration with customers, our engineers design new solutions to respond to specific market requirements with innovative products and/or processing methods. With dedicated expert, the research center offers the best available expertise in the business.

Technical assistance, cost control

Our team gives you on-field technical assistance to help you gain full advantage of Industeel grades.

During the lifetime of the project, we provide solutions in terms of heat treatment, welding, cutting and forming recommendations and other specific technical issues such as corrosion testing.



50 steel specialists to
guide your projects
from A to Z





XCarb[®]

Recycled and renewably
produced

Steels with a low carbon
footprint, made through
the electric arc furnace
using recycled scrap and
renewable electricity.
Product carbon footprint
is third-party verified.



ArcelorMittal

Smarter steels for people and planet

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-35%
CO₂ emissions
by 2030

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