

Industeel



ArcelorMittal

Steel Solutions for highly corrosive applications



Our business

Leading supplier of high quality steel plates

A subsidiary of ArcelorMittal, Industeel is dedicated to the production of hot rolled steel plates, ingots and formed pieces in the widest range of dimensions. Specializing in carbon and stainless steels, Industeel offers a complete range of high quality steel grades designed to meet the most severe specifications.

High quality materials designed to meet the most strict specifications.

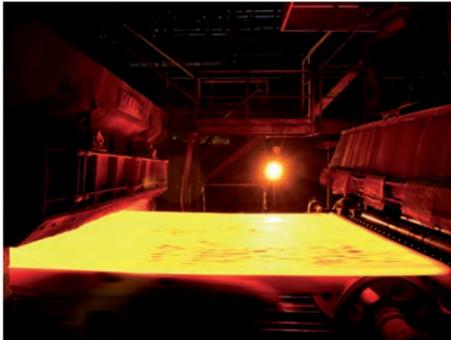
The widest dimensional range to meet all customer requirements due to our 3 integrated mills.

A high level of technical support provided by a dedicated research & development centre.

Electric arc furnace



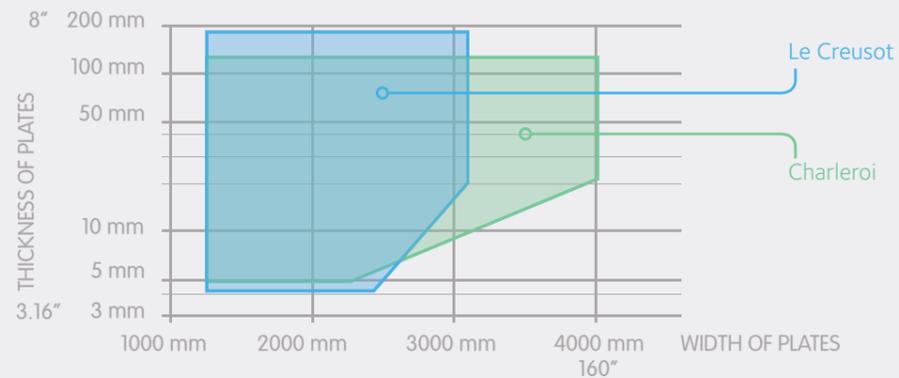
Steel plate



High level of technical support



The widest dimensional range of plates



Our expertise

First-class producer of stainless steel and nickel based alloy plates for corrosive applications

With over 150 years 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 high plate rolling mills.

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

As a result, materials with uniform properties, providing consistent performance in service.



It all starts with advanced metallurgical processes to produce premium corrosion resistant alloys



Our added value

High quality products, increased value for our customers

Our strength is a combination of correct materials selection, high level of technical expertise, flexibility and innovation, that will translate into appropriate use of high quality products and optimized cost solutions.

No one-fits-all product, but a complete and complementary range of grades to meet any situation.

Technical assistance and tailor-made solutions from our dedicated team of specialists.

In-house R&D to keep our products at the leading edge of innovation for corrosion solutions.



Our products

Our dedicated offer: a wide range of grades to fit your requirements

Austenitics and super - Austenitics

These are the most popular of the stainless steels because of their ductility, ease of working and good corrosion resistance; they are derived from the 18Cr-8Ni stainless steel Type 304.

Highly alloyed nickel-chromium-molybdenum super-austenitic steels have been developed to respond to severe corrosion environments. Industeel supplies the complete range including our in-house special grade UR™ 66.

Duplex

Duplex stainless steels have been actively developed by European companies since 1935. In view of the continuous improvement of their properties and their increasing availability, Duplex stainless steels will remain an attractive solution for the future needs of designers and users in mechanical engineering, particularly for weight saving through their enhanced mechanical properties.



Absorption column in UR™ 904L with courtesy of ALLIA

Nickel based alloys

Nickel based alloys have nickel as the primary constituent. They can be alloyed with iron, chromium and molybdenum and are used in the most aggressive corrosion environments, e.g., in flue gas desulfurization units and other demanding applications.

Industeel supplies NBA grades in both solid and clad plates.

Specialties

These grades have been developed by our researchers in close collaboration with our customers to meet their stringent and specific requirements in nitric, sulfuric or urea media.

Consequently, we can tailor-made grades to fulfill aggressive environment.

Corrosion resistant alloys

Our dedicated offer: a wide range of grades to fit your applications

	GRADE	UNS	DIN	PREN	Rm* (MPa)	Rp 0.2* (MPa)	EI* (%)	NITRIC ACID	PHOSPHORIC ACID	SULFURIC ACID	CAUSTIC SODA	ORGANIC ACID	HYDRO METALLURGY	UREA	WATER TREATMENT	FGD CO ₂ CAPTURE	GEO THERMAL	OIL & GAS
Nickel based alloys	UR™ 625	N06625	2.4856		730	320	40	***	***	***	***	***	***		***	***	***	***
	UR™ 825	N08825	2.4858		640	300	30	**	**	**	***		**		**	**	**	***
	SIRIUS™ 600	N06600	2.4816		590	270	35				***	***						**
Superaustenitic	UR™ 66	S31266	1.4659	55**	880	490	50		***	***		***	***		***	***	***	***
	UR™ 31	N08031	1.4562	48	720	330	40		**	**		**	**		**	**	**	**
	UR™ 4565	S34565	1.4565	46	880	480	50		**	**		**	**		**	**	**	**
	UR™ 926	N08926	1.4529	43	720	380	40		**	*		**	*		**		**	**
	UR™ 367	N08367		43	710	365	35			*					**	**		**
	UR™ 254	S31254	1.4547	43	690	350	35			**					**			**
	UR™ 28	N08028	1.4563	39	620	275	40		**	***	***		**			**		**
	UR™ 904L	N08904	1.4539	35	615	315	40		**	*			*			*		**
Specialties	UREA™ 310 MoLN	S31050	1.4466	32	625	320	40						***					
	UREA™ 316L	S31603	1.4435	27	585	280	45						**					
	UR™ 32615	S32615		18	605	275	25			***								
	UR™ S1	S30600	1.4361	17	585	270	40	***										
	UR™ 65	310LNAG	1.4335	25	550	250	40	**										
	UR™ 16	304LNAG		19	570	265	45	**										
Duplex	UR™ 2507W	S32760	1.4501	41	790	625	25			*					**	**	**	**
	UR™ 2507Cu	S32550/S32520	1.4507	41	795	630	25			**	*		**		**	**	**	**
	UR™ 2507	S32750	1.4410	41	820	620	25			*	*	**		**	**	*	*	**
	UR™ 2205	S31803	1.4462	34	750	530	25			*	*	**	**	**	**	**	*	**
	UR™ 2304	S32304	1.4362	25	670	480	25	*			**	**	*		**	*		**
	UR™ 2202	S32202	1.4062	25	710	520	30				**	*	*		**	*		**
Austenitic	UR™ 317L	S31703	1.4438	29	599	318	40			*					*	*		*
	UR™ 316L	S31603	1.4404	24	580	295	45	*		*	**	*	*	*	*	*		*
	UR™ 304L	S30403	1.4307	19	580	280	45	*			**	*						*

Grades recommended for *** aggressive corrosive media, ** moderate corrosive media, * mild corrosive media

* Typical values for mechanical at room temperature.

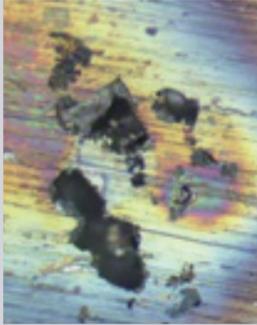
PREN=Cr + 3.3Mo + 16N

** PREN W = Cr + 3.3 (Mo + 0.5W) + 16N

Pitting and crevice corrosion properties

Our dedicated offer: a wide range of grades to fit your corrosion resistance expectations

Critical pitting temperatures (CPT) were obtained on different grades according to ASTM G48E (Figure 1). The CPT is defined as the minimum temperature to produce pitting attack deeper than 25 µm. The test consists of successive 24 hou/s immersions in a 6% FeCl₃ solution acidified with 1% HCl until formation.



Pitting corrosion

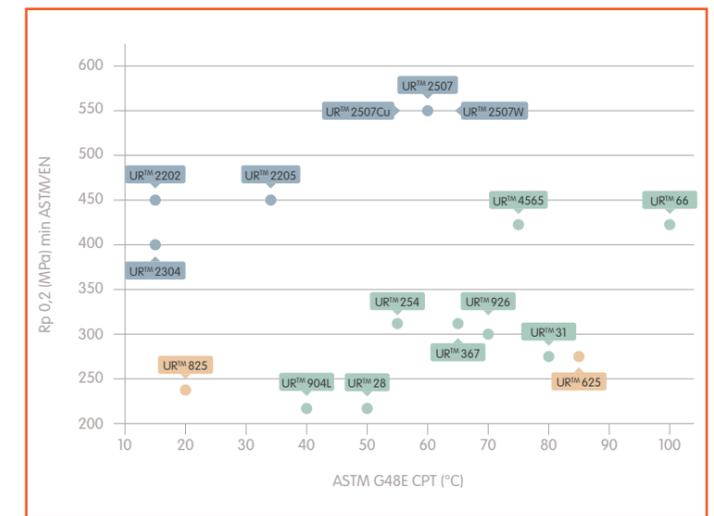


Figure 1: Pitting corrosion resistance vs yield strength.

Critical crevice temperatures (CCT) were obtained according to ASTM G48D methodology (Figure 2). The test consists in immersing samples in a 6% FeCl₃ solution acidified with 1% HCl. A PTFE crevice washer is set on the samples in order to create a confined area and simulate the crevice phenomenon (12 slots, torque 0.28 Nm).



Crevice corrosion

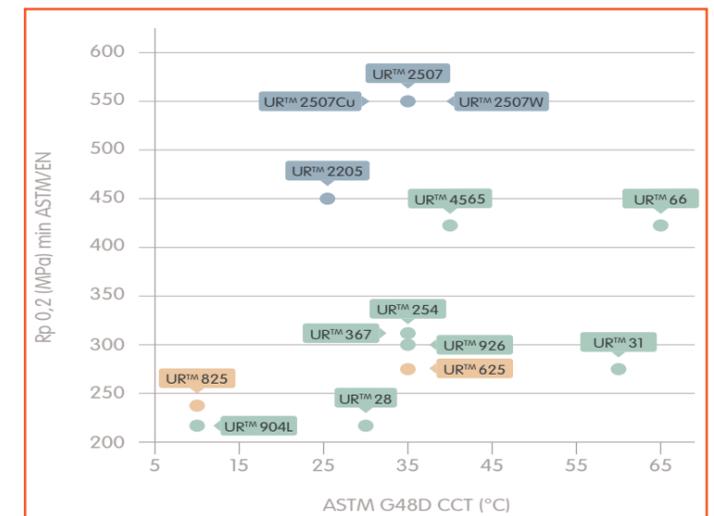


Figure 2: Crevice corrosion resistance vs yield strength.

Our high performance alloy solutions for the Chemical Industries

Our high performance alloy solutions for the Chemical Industries

NITRIC ACID

Nitric acid is strongly oxidizing and very variable in aggressivity so it requires the use of different stainless steels.

Main equipment: absorption towers, mixers, evaporators, crystallizers, piping and tanks for fertilizer, chemical processing, polymer and nuclear applications.

Main issues: intergranular and transpassive corrosion. Uniform and localized corrosion can be also observed in the presence of other chemical species such as chlorides.

Specific grades have been developed with a very low residual content and a high nickel concentration.



STEEL SOLUTIONS

UR™ 16 and UR™ 65: high homogeneity and cleanliness with a very low carbon content and non metallic residual elements.

UR™ S1: high silicon content grade, dedicated to highest nitric concentration up to boiling point.

PHOSPHORIC ACID

Phosphoric acid production process induces different types of corrosion.

Main equipment: piping, agitators, evaporators, scrappers, pre-neutralizers, storage tanks for fertilizer, beverages and animal feeds applications.

Main issues: in the purification stage: uniform, fatigue and erosion corrosion. In storage and transportation: localized corrosion by chlorides.

Specific grades have been developed with enhanced chemical compositions and a very high cleanliness and homogeneity.



STEEL SOLUTIONS

UR™ 2507Cu: high mechanical strength with good fatigue, abrasion and erosion corrosion resistance.

UR™ 66 and UR™ 28: high mechanical properties and very high uniform and localized corrosion resistance.

UR™ 904L: most popular grade in this media with good corrosion resistance.

SULFURIC ACID

Sulfuric acid is strong environment that can be either reducing or oxidizing, and is considered as a highly corrosive media. Material selection is complex and dependant on the concentration, temperature and impurities content.

Main equipment: towers and pump tanks, acid coolers, piping for fertilizer, metal processing, pulp & paper, pollution control, hydrometallurgy and polymer applications.

Main issues: intergranular and uniform corrosion.

Specific grades have been developed with enhanced chemical compositions.



STEEL SOLUTIONS

UR™ 28 and UR™ 31: high chromium and nickel content and moderate molybdenum additions provide good corrosion resistance.

UR™ 32615: high silicon content grade used in concentrated sulfuric acid.

CAUSTIC SODA

Sodium hydroxide is a strong base.

Main equipment: heat exchangers, storage tanks for pulp & paper, organic and inorganic chemicals applications.

Main issues: stress corrosion cracking when temperature and concentration increase.



STEEL SOLUTIONS

UR™ 304L and UR™ 316L can be used up to 50°C.

UR™ 2202, UR™ 2205, UR™ 2304 and UR™ 2507 are recommended for chloride containing media.

SIRIUS™ 600 and UR™ 625 can be used for high temperature.

ORGANIC ACID

Organic acids are weak and reducing media. Formic acid is considered to be more aggressive than acetic acid, followed by propionic and butyric acid.

Main equipment: crystallizers, dryers, centrifuges, stripping columns for fertilizer, beverages, biomass, animal feeds and transportation.

Main issues: uniform corrosion. Aeration, elevated temperature and the presence of chlorides induce an increase of the stress corrosion cracking and localized corrosion risks.



STEEL SOLUTIONS

UR™ 304L and lean duplex UR™ 2202, UR™ 2304 can be used for storage and application at low temperature.

UR™ 316L and UR™ 2205 should be recommended for higher temperature applications.

UR™ 66 and nickel based alloy UR™ 625 are used in severe conditions.

CHLORINE

Chlorine is an oxidizing agent.

Main equipment: dryers, coolers and storage tanks for the manufacture of PVC, PU, PTFE and water treatment; inorganic chemical applications.

Main issues: crevice, pitting and stress corrosion cracking in contact with water.



STEEL SOLUTIONS

UR™ 304L or UR™ 316L can be used for temperatures up to 350°C.

Our high performance steel solutions for the Process Industries

HYDROMETALLURGY

Hydrometallurgy is a method for obtaining metals from their ores. It is generally divided into four general steps: leaching, decantation, solution concentration, purification and metal recovery.

Main equipment: reactors, autoclaves, decanters, thickeners, clarifiers, storage tanks and agitators/blades.

Main issues: pitting, crevice, abrasion corrosion and stress corrosion cracking.

Steel Solutions

> For highly aggressive conditions (ie. high temperature, chlorides, low pH), the super austenitic grade **UR™ 66** has proven to be a good alternative to nickel based alloys.

> **UR™ 2205** and **UR™ 2507** duplex and super duplex grades can be good candidates for less aggressive hydrometallurgical applications.



UREA - CARBAMATE

Urea production process is highly corrosive and complex.

Main equipment: strippers, piping, HP condensers and reactors for fertilizer and polymer industry.

Main issues: stress corrosion cracking.

Specific grades have been developed and designed to obtain a fully austenitic stainless steel free of intermetallic phases e.g. intergranular carbide precipitations which drastically affect the corrosion resistance properties in urea.

Steel Solutions

> **UREA™ 316L** and **UREA™ 310MoLN** present low carbon and silicon content, combined with high nitrogen content.



Our high performance steel solutions for Power Generation

GEOHERMAL

Most geothermal electricity production units extract hot fluids from the ground, produce electricity using steam turbines and finally reinject the colder fluids back into the ground. The most common material problems are caused by the presence of salts in the geothermal fluids.

Main equipment: transport piping, separators, well heads, clarifiers and storage tanks.

Main issues: excessive scaling and/or corrosion of carbon steel piping leading to the usage of high performance stainless steels and nickel alloys.

Steel Solutions

> Super duplex pipe has been specified in a geothermal unit, replacing corroded carbon steel pipe: **UR™ 2507Cu** and **UR™ 2507W**.

> For highly corrosive media, **UR™ 66** and **UR™ 625** grades are recommended.



POLLUTION CONTROL

Flue Gas Desulfurization (FGD) and CO₂ capture technologies are used in electricity production, transportation, cement and petrochemical industries in order to reduce the pollution inherent to the production route.

Main equipment: FGD: shell, mist eliminators, headers, inlet ducts and piping systems. CO₂ capture: air separation units and gas cleaning systems.

Main issues: these equipment require corrosion alloys highly resistant to pitting, crevice and stress corrosion cracking.

Steel Solutions

> A specific grades has been developed by Industeel in order to ensure a high resistance to crevice corrosion in modern wet FGD with bromide: **UR™ 66**. Clad plates, **UR™ 276** can also be a solution.

> For CO₂ capture and storage, depending on the system, Industeel has developed different solutions. **UR™ 2205**, **UR™ 2507** for gas cleaning systems and regeneration columns. **UR™ 28** for syngas cooling.



Our high performance steel solutions for Water Treatment

WASTE WATER TREATMENT

Water treatments require different types of processes depending on the industry that produces the waste water.

Main equipment: clarifiers, aeration tanks and pipework.

Main issues: pitting, crevice corrosion and stress corrosion cracking.

In water treatment, corrosion is promoted by the temperature, chloride level, presence of chlorine and oxygen level.

Steel Solutions

> Duplex UR™ 2205 and super duplex UR™ 2507 can be used depending on the chloride content.

> When the level of chloride and temperature increase, super austenitic grades like UR™ 66 are recommended.



SEA WATER AND DESALINATION

Seawater is a complex environment involving the presence of a high chloride content as well as several other ions and microbial components. Chlorine may also be added to avoid biofilm formation on the surface of steel.

Main equipment: piping systems, heat exchangers, evaporators, pumps, flanges and filters.

Main issues: pitting, crevice and stress corrosion cracking. Producing potable water from seawater has the same risks.

Steel Solutions

> Lean duplex UR™ 2202, duplex UR™ 2205, UR™ 2304 and super duplex UR™ 2507 are used for higher chloride content.

> When the levels of chloride and temperature increase, super austenitic grades and nickel based alloys like UR™ 254, UR™ 367, UR™ 66 and UR™ 625 are recommended.



Our high performance steel solutions for Oil & Gas

OIL & GAS UPSTREAM

The upstream oil & gas sector known as the exploration and production (E&P) sector includes searching for potential underground or underwater crude oil and natural gas fields.

Main equipment: flowlines, risers, separators, coolers, heat exchangers, manifolds, storage tanks and structural applications on offshore platforms.

Main issues: localized corrosion and cracking induced by the combined influence of tensile stresses and the corrosive environment that contains chlorides and H₂S.

Steel Solutions

> Depending on the oil & gas field (H₂S, temperature, pH) different grades can be used such as duplex UR™ 2205, UR™ 2507, super austenitic grades UR™ 254, UR™ 66 and nickel based alloys UR™ 825, UR™ 625.



OIL & GAS DOWNSTREAM

The downstream sector commonly refers to the refining of petroleum crude oil and the processing and purifying of raw natural gas. The downstream sector reaches consumers through products such as gasoline or petrol, kerosene, jet fuel, diesel oil, heating oil, fuel oils, lubricants, waxes, asphalt, natural gas and liquefied petroleum gas (LPG) as well as hundreds of petrochemicals.

Main equipment: heat exchangers and storage tanks.

Main issues: localized corrosion and stress corrosion cracking.

Steel Solutions

> In crude units: Due to the presence of naphthenic acid UR™ 317L, 6Mo super austenitic grades or UR™ 276 are used.

> In hydroprocessing units and FCC: Due to the presence of ammonium bisulfide (NH₄HS) and cyanide (CN) materials with a PREN higher than 40 are generally required.





Quality
is our priority

Your dedicated contacts

Our sales offices worldwide

With 40 sales offices in 40 different countries around the world, Industeel stands as one of the foremost international steel makers, with an unmatched capacity for support everywhere around the world.

Check out our website <http://industeel.arcelormittal.com> for contact details.





ArcelorMittal

For more information

**Industeel France
Le Creusot plant**

56, rue Clemenceau - BP 19
F - 71201 LE CREUSOT Cedex
FRANCE

Tel : + 32 71 44 52 57
Fax : + 32 71 44 55 00

**Industeel Belgium
Charleroi plant**

266 rue de Châtelet
B - 6030 CHARLEROI
BELGIUM

Tel : + 32 71 44 15 00
Fax : + 32 71 44 19 56

<http://industeel.arcelormittal.com>



transforming
tomorrow

All information in this brochure is for the purpose of information only.
Industeel reserves the right to change its product range at any time without prior notice.