Industeel

ArcelorMittal

UR™ 2202

UR™ 2202: an alternative to 304L

UR™ 2202 is a low nickel, low molybdenum stainless steel designed to match the corrosion resistance of 304L in most environments. Its higher strength allows the designer to use thinner sections to construct containment equipment. UR™ 2202 can be used at temperatures between - 20°C and +300°C.
UR™ 2202 has been designed to replace 304/304L in most applications. This lean duplex is a cost efficient grade designed for liquor tanks for pulp and paper industry, water storage and ducting, architecture and bridges, desalination, as well as chemical, oil and gas industries...

PROPERTIES

STANDARDS

> EN10028-7: 1.4062 - X2CrNiN 22 - 2
> ASTM: A240 - UNS S32202
> ASME: SA240 - UNS S32202
> VdTUV Blatt: n°557

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mn	Mo	N
0.02	22	2	<2	<0.45	0.2

PHYSICAL PROPERTIES

Density: 7.8 kg/dm^3

Interval temperature (°C)	Thermal expansion αx10^{-6} K^{-1}	T (°C)	($\mu\Omega$.cm)	Thermal conductivity (W.m^{-1}.K^{-1})	Specific heat (J.kg^{-1}.K^{-1})	Young modulus E (GPa)	Shear modulus G (GPa)
		20	70	15	480	200	75
20 - 100	13.0	100	75	16	510	194	73
20 - 200	13.5	200	82	17	540	186	70
20 - 300	14.0	300	88	18	570	180	67

Density: 0.28Lb/in^3

Interval temperature (°F)	Thermal expansion $\alpha x10^{-6} F^{-1}$	T (°F)	(μΩ.cm)	Thermal conductivity ($Btu.hr^{-1}.ft^{-1}.°F^{-1}$)	Specific heat xIO^6 ($Btu.lb^{-1}.°F^{-1}$)	Young modulus $ExIO^6$ (psi)	Shear modulus $GxIO^6$ (psi)
		68	31.5	8.7	0.11	29	10.9
70 - 210	7.2	212	33.8	9.2	0.12	28	10.5
70 - 400	7.5	392	36.2	9.8	0.12	27	10.1
70 - 600	7.8	572	39.3	10.4	0.13	26	9.7

MECHANICAL PROPERTIES

Tensile properties - Minimum values

°C	$R_{p0.2}$ (MPa)	$R_{p1.0}$ (MPa)	R_m (MPa)	°F	YS 0.2% (ksi)	YS 1.0% (ksi)	UTS (ksi)	A/ Elongation (%)
20	> 450	> 480	> 650	68	> 66	> 70	>95	> 30
100	> 380	> 410	> 580	272	> 55	> 60	> 84	> 25
200	> 330	> 350	> 520	392	> 48	> 51	> 76	> 25
300	> 300	> 320	> 500	572	> 44	> 47	> 73	> 20

This data is valid for plates up to 60 mm thick. Consult for heavier plates.
Hardness is 210 - 250HV similar to other duplex stainless steels but higher than that of 304/304L.

Fatigue resistance in air

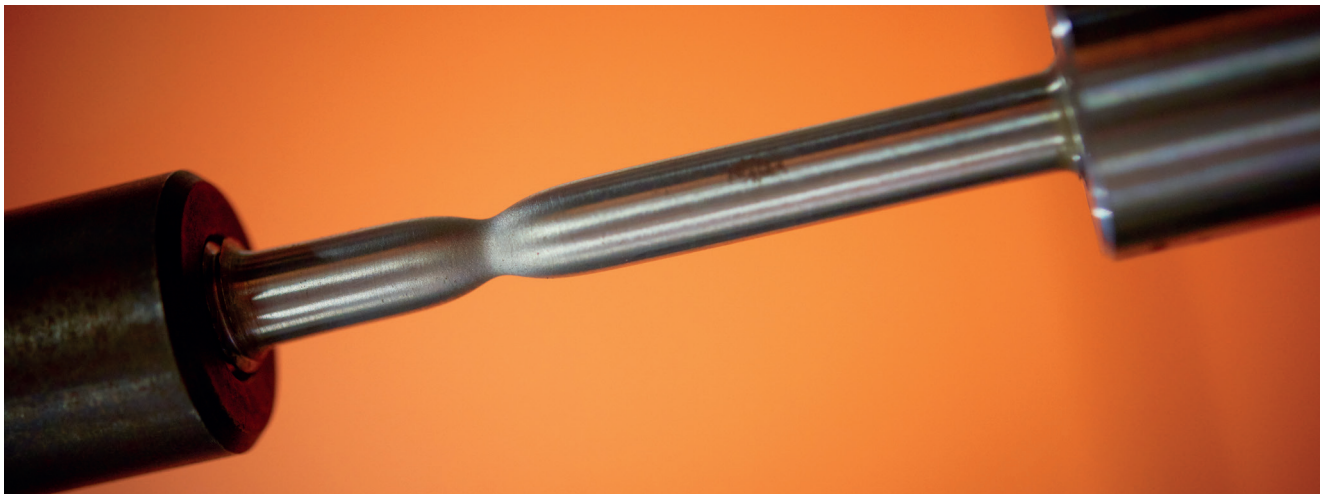
UR™ 2202 is significantly more resistant to fatigue than 304L. Its fatigue resistance is similar to that of other duplex stainless steels (UR™ 2304 and UR™ 2205). As for all high strength materials, the careful design of critical parts (smooth finish, absence of angles or shape irregularities...) is essential to take advantage of its better fatigue resistance properties.

Impact strength at low temperature (KV minimum values)

Temp.	-40°C	- 20°C	+20°C	- 40°F	- 4°F	+70°F
KV	>27J*	>27J	> 60J	19ft lbs	19ft lbs	44ft lbs

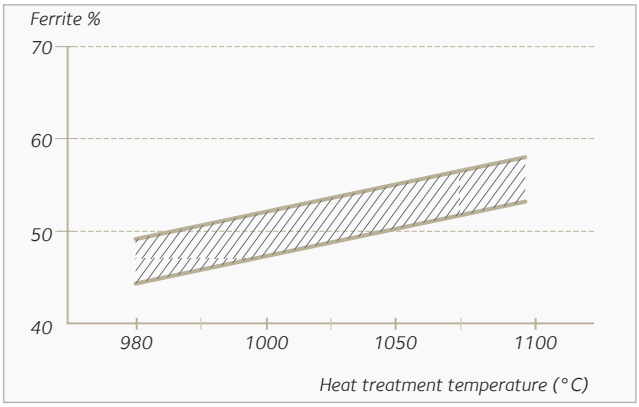
** for thickness ≤ 12 mm - 0.47"*

UR™ 2202 has lower impact strength than 304 and other higher nickel duplex stainless steel grades. Its impact toughness is similar to high quality carbon manganese steels.



STRUCTURE

UR™ 2202 can be heat treated at temperatures between 980°C and 1080°C (1796/1976°F). Rapid air cooling is acceptable up to 50 mm thick, but water quenching is normally preferred. Avoid reducing (carburizing) atmospheres. Surfaces should be free of carbon containing impurities (dirt, oil, grease). UR™ 2202 is designed to obtain a typical ferrite content of 45 to 55%. The duplex microstructure of UR™ 2202 is more stable than that of molybdenum containing duplex stainless steels and intermetallic phase precipitations occur only after several hours of high temperature sensitization.



Effect of cooling rate

Temperature	Precipitation	Ferrite hardness HV_{10}
2000°C/h	No precipitation	223
1000°C/h	No precipitation	223
500°C/h	No precipitation	224
200°C/h	No precipitation	228
50°C/h	Precipitation	233

Rapid air cooling is acceptable up to 50 mm (but faster cooling rates are preferred).

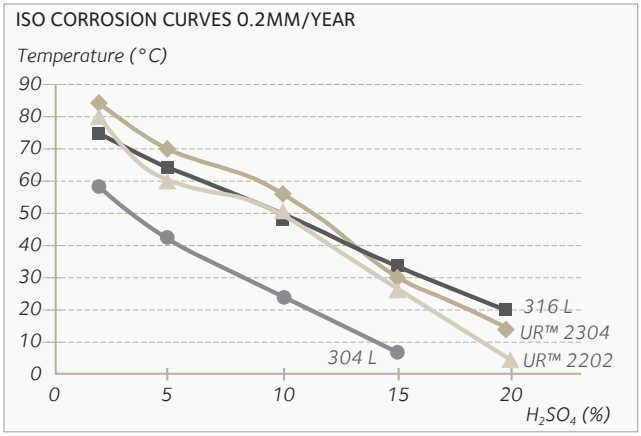
IN SERVICE CONDITIONS

CORROSION RESISTANCE

UR™ 2202 has been designed to replace 304/304L in most applications. Pure sulfuric acid is an example, where its resistance is better than that of 304L but lower than that of UR™ 2304 and 316L.

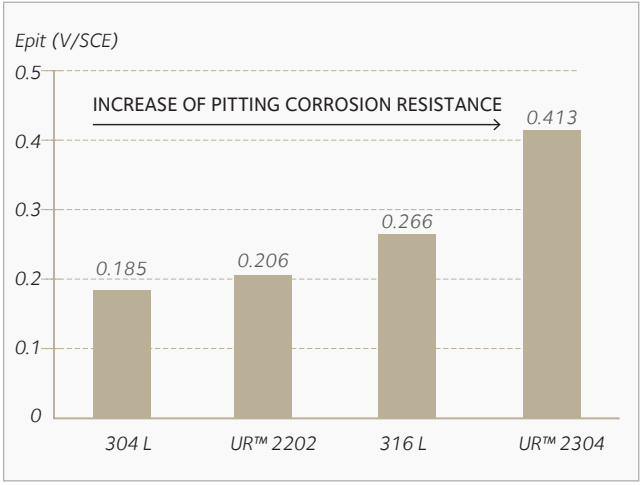
UR™ 2202 can also be used in nitric acid. It is important to check the individual conditions as even low impurity levels can play a major role in the corrosivity of acid media on stainless steels.

General corrosion



Pitting corrosion resistance

Depending on application, UR™ 2202 shows a pitting resistance in - between 304L and 316L. Its corrosion resistance in brines is better than that of 304L but slightly inferior to that of 316L.



Pitting potential (NaCl=50 g/L, T = 50°C/122°F, pH = 6.4

Intergranular corrosion resistance

As other duplex stainless steels UR™ 2202 is resistant to intergranular corrosion.

Erosion/corrosion

UR™ 2202 has better erosion corrosion resistance than other stainless steels such as 410S, 4003 and 304

Fatigue corrosion

UR™ 2202 has better fatigue corrosion resistance than 304L. As with all high strength materials, the careful design of critical parts (smooth finish, absence of angles or shape irregularities...) is essential to take advantage of its better fatigue properties.

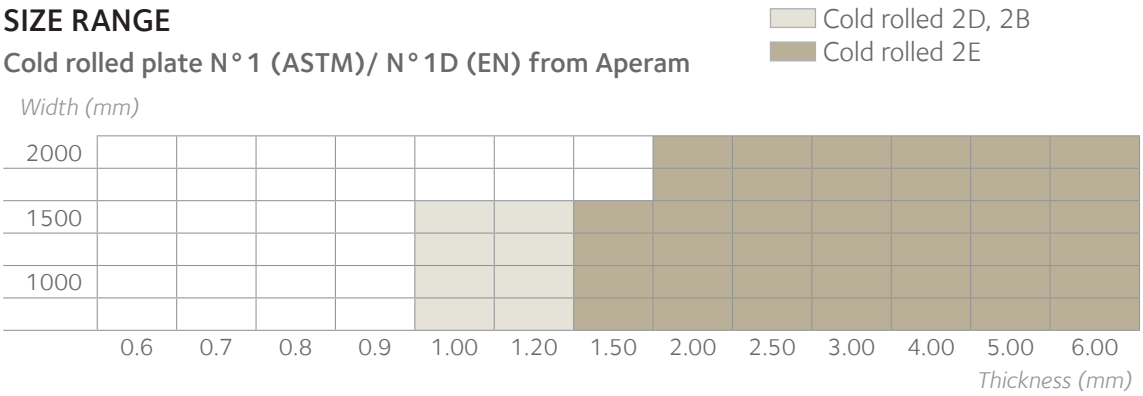
Atmospheric corrosion resistance

Initial results rank UR™ 2202 between 304L and 316L. The results show that it should not be used in marine environments.

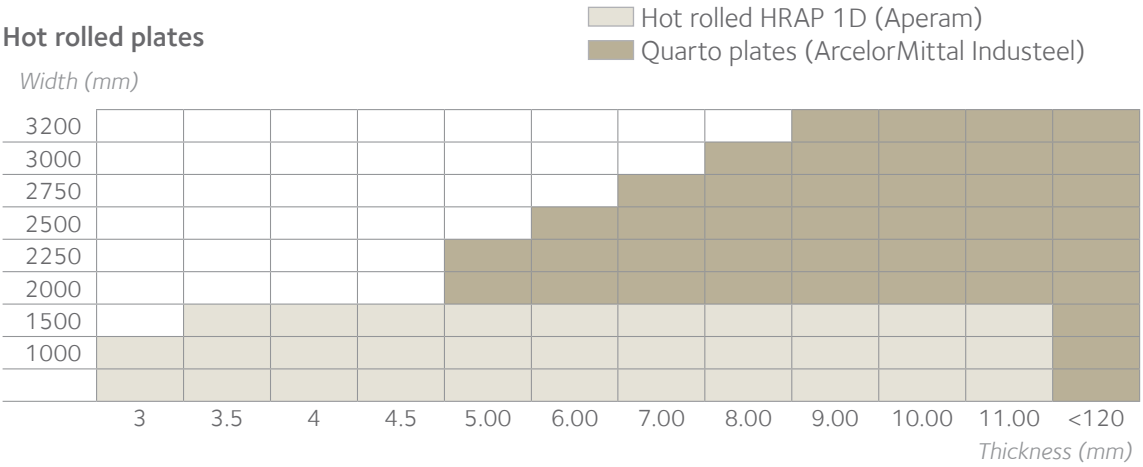
DELIVERY CONDITIONS

SIZE RANGE

Cold rolled plate N°1 (ASTM)/ N°1D (EN) from Aperam



Hot rolled plates



For coils and CMP, consult APERAM.
For Long products, consult UGITECH (Schmolz and Bickenbach Group).
UR™ 2202 is patented by INDUSTEEL and UGITECH.
For 2202 clad plates, consult INDUSTEEL CREUSOT.

HOT FORMING

UR™ 2202 can be hot formed after heating to temperatures between 950°C and 1100°C (1650°F/2012°F). If forming is finished above 950°C and cooling is fast enough (activated air or water) the final heat treatment can be avoided. When hot forming is applied to blanks welded with 2209 or 2304, a new heat treatment at 1050°C followed by rapid cooling (active air or water) is required.

COLD FORMING

UR™ 2202 can be cold formed. It is comparable to 304L but due to its higher mechanical properties and lower elongation to rupture, a minimum bending diameter must be applied.

> Minimum bending diameter = 3 x thickness for base metal

> Minimum bending diameter = 4 x thickness for welded assembly

When the cold working deformation exceeds 20% an intermediate full annealing heat treatment (980/1080°C - 1796/1975°F) must be applied. Such heat treatment is also recommended after the last cold forming pass if cold deformation exceeds 10%.

Detailed recommendations for cold forming or bending of welded and unwelded duplex and superduplex plates are available upon request.

WELDING

As indicated in the table hereafter, most of welding processes can be used to weld UR™ 2202.

	With filler metal	Without filler metal*
Industrial processes	- SMAW - SAW - FCAW - GMAW - Pulsed GMAW - GTAW - PAW	- GTAW - PAW
Processes not very used or being studied	- ESW	- LW - EBW - RW - FW

Filler materials

UR™ 2202 can be welded using 2209 or duplex fillers or similar composition (24Cr - 9Ni - N, 23Cr - 7Ni - N). For GTAW and GMAW with duplex filler metal, and especially for GTAW without filler metal, nitrogen addition in the shielding gas is recommended. When austenitic fillers such as 309L, 309L Mo or 316L are used, the tensile properties will be reduced, compared to those of the base metal, because of the lower nitrogen and ferrite content of the filler material. The use of nitrogen containing welding gase is recommended (Ar + 3%N) in order to enhance the mechanical properties.

Welding process	Maximal welding heat inputs used for UR™ 2202
SMAW	Up to 1.8 kJ/mm
Pulsed GMAW - FCAW	Up to 2.4 kJ/mm
GMAW	Up to 2.8 kJ/mm
SAW	Up to 1.5 kJ/mm
GTAW - PAW	Up to 3.0 kJ/mm

The chemical composition of UR™ 2202 has been balanced to limit structural changes in the heat affected zone and therefore there is no need to control minimal welding heat input. For plates with thickness higher than 20 mm, the table below gives the maximal heat input for different welding processes. A maximum interpass temperature of 150°C (300°F) is advised.
These conditions must be optimized taking into account the thickness of the products and welding equipments (Consult if necessary). We do not recommend pre or post - welding heat treatments. Only complete solution annealing heat treatment may be considered. Please contact Industeel for further information if required.

WATER INDUSTRY

UR™ 2202 can replace 304L in the water industry.

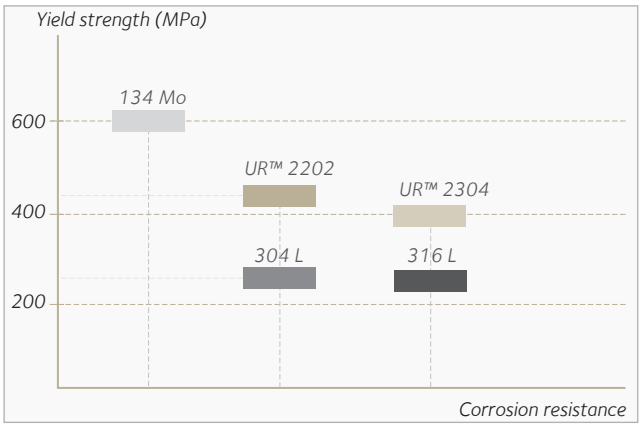
1) Hydropower plants:

> Higher corrosion resistance than 13 - 4 Mo

> Higher strength and cavitation resistance than 304L

2) Ducts, tanks and equipment for the water:

UR™ 2202 has a resistance to pit pitting at least equivalent to the one of 304L. It can be used in waters containing up to 200ppm chlorides. When microbially induced corrosion (MIC) is possible, the use of more highly alloyed grades (316L, UR™ 2304 and UR™ 2205) should be considered. These grades are also recommended when heat tints created during welding operations can't be avoided or removed.



OIL AND GAS INDUSTRIES

Tests are in progress to determine the SCC resistance of UR™ 2202 in gases containing CO_2 chlorides and limited amounts of H_2S.

PULP AND PAPER

Due to its high resistance to stress corrosion cracking, UR™ 2202 can be used for different types of storage tanks.

YOUR CONTACTS

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