Industeel

ArcelorMittal

UR™ 904L

UR™ 904L: A multipurpose austenitic stainless steel with PREN ≥ 34

UR™ 904L is a multipurpose 20 Cr - 4.3 Mo high corrosion resistance austenitic stainless steel developed 40 years ago by Industeel.
Due to combined additions of chromium (20%), molybdenum (4.3%), copper (1.5%) combined with its high nickel content, the grade is recommended for most applications dealing with medium to severe corrosive solutions.
UR™ 904L has improved stress corrosion resistance properties.
UR™ 904L alloy is particularly used in sulphuric and phosphoric acids applications.

PROPERTIES

STANDARDS

> EURONORM	EN 1.4539 X1 Ni Cr Mo Cu 25-20-5
> ASTM:	B 625 - UNS N08904

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mo	Others
.020	20	25	4.3	Cu = 1.5

PREN = [Cr %] + 3.3 [Mo %] + 16 [N %] ≥ 34

PHYSICAL PROPERTIES

Density: 8.05 kg/dm³ - 0.29 lb/in³

Interval temperature (°C)	Thermal expansion (αx10^{-6} K^{-1})	T °C (°F)	Resistivity (µΩ.cm)	Thermal conductivity (W m^{-1} K^{-1})	Specific heat (J kg^{-1} K^{-1})	Young modulus E (GPa)	Shear modulus G (GPa)
20-100	15	20 (68)	80	17	500	190	75
20 - 300	16	300 (572)	100	13	550	180	70
20 - 500	17	500 (932)	120	14	650	165	66

MECHANICAL PROPERTIES

Tensile properties - minimum values for hot rolled 10 mm thick plates

°C	$R_{p0.2}$	$R_{p1.0}$	R_m	°F	YS 0.2%	YS 1.0%	UTS	A/Elongation
	MPa				ksi			%
20	313	275	520	68	45	39	75	40
100	205	230	520	212	30	33	75	40
300	145	170	490	572	21	26	71	40
500	125	150	410	932	18	22	35	40

Impact: KCV > 100J/cm² (70 ft lbs) at -196°C (-319°F)

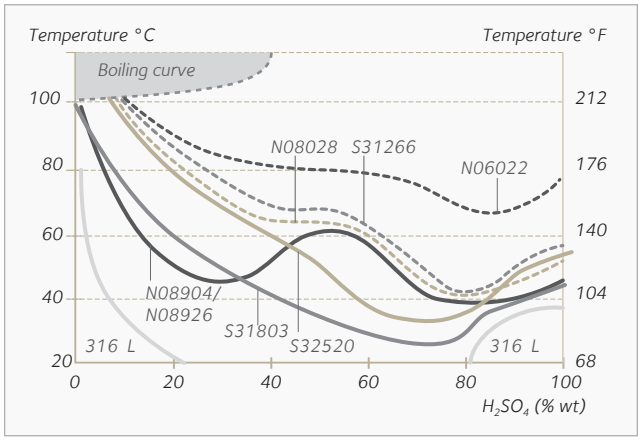
Hardness: HV_{10}: [180-220]

IN SERVICE CONDITIONS

CORROSION RESISTANCE

Sulfuric acid

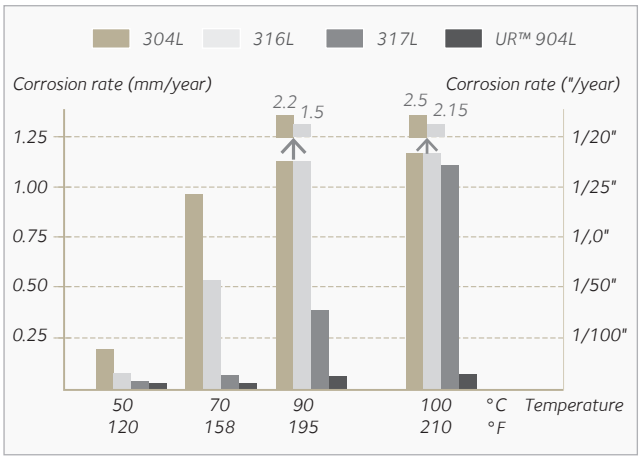
In sufuric acid environments, the range of concentrations and temperatures in which UR™ 904L can be used is much wider than the one of most of the other high corrosion resistant grades (such as UR™ 317L and UR™ 2205). This is partially explained by high content of nickel, chromium, molybdenum and also its copper addition.



ISO – Corrosion diagram in industrial H_2SO_4 (0.2 mm/y)

Phosphoric acid

General corrosion resistance properties of alloy UR™ 904L in industrial phosphoric acid solutions is excellent and much better than the one of the austenitic grades 316L and 317L. At higher temperatures, the alloy behaves also better that the duplex grade UR™ 2205. UR™ 904L is today commonly used for phosphoric acid applications. The corrosion resistance in this environment is strongly influenced by the presence of impurities (chlorides, fluorides, ...).

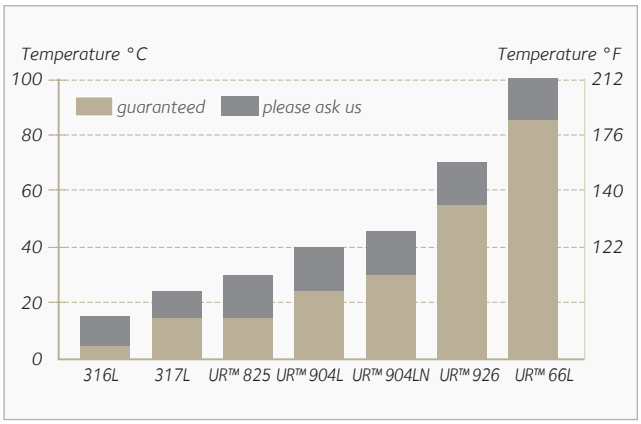


Corrosion rate of different types of stainless steels in industrial phosphoric acid (P_2O_5=48%, SO_3=2.7%, F= 0.44%)

Localized corrosion

The high chromium and molybdenum contents of UR™ 904L make its resistance to pitting and crevice corrosion superior to 316L and 317L. This has been demonstrated by laboratory tests and field experience. In the most severe conditions such as stagnant sea water, the use of super-duplex grade (UR™ 2507Cu) or a super-austenitic alloy (UR™ 926, UR™ 66) is recommended.

ASTM G48A - PITTING in Fe Cl_3 solution



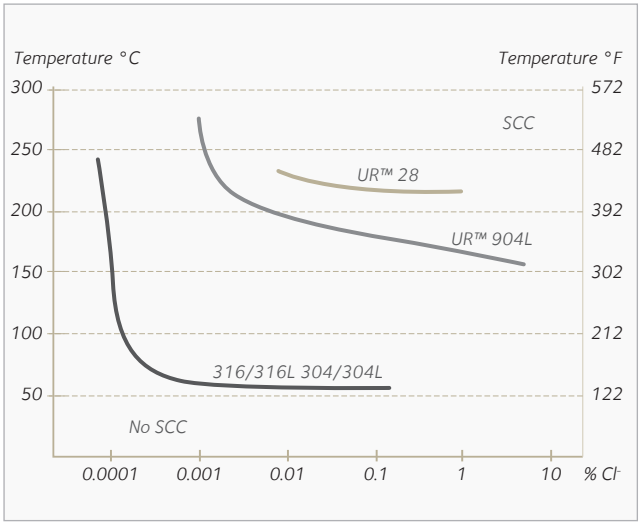
Intergranular corrosion

The very low carbon content of UR™ 904L makes this alloy resistant to this type of corrosion.

Stress corrosion cracking

Due to its high nickel and molybdenum content, UR™ 904L is more resistant to stress corrosion cracking than other standard austenitic materials. Field experience and laboratory tests show that UR™ 904L performs much better than 304L and 316L grades. This is particularly true in high temperature chloride containing solutions where early failures are often reported for 304L and 316L.

Practical experience and laboratory results of SCC in stainless steels



DELIVERY CONDITIONS

SIZE RANGE

	Plates	Cold rolled plates	Clad plates
Thickness	5 to 120 mm 3/16" to 4.7"	6 to 14 mm 5/64" to 5/8"	6 to 126 mm 1/4" to 5"
Width	Up to 3300 mm* Up to 130"	Up to 2300 mm* Up to 90.5"	Up to 3200 mm* Up to 126"
Length	Up to 12000 mm Up to 472"	Up to 8250 mm Up to 325"	Up to 14000 mm Up to 551"

Other sizes are available on request, including 4100 mm (161,4") width plates.

* Indicative dimensional program. Maximum width depends on thickness. For wider and thicker plates or other specific request, please consult. Prefabrication pieces according to drawing.

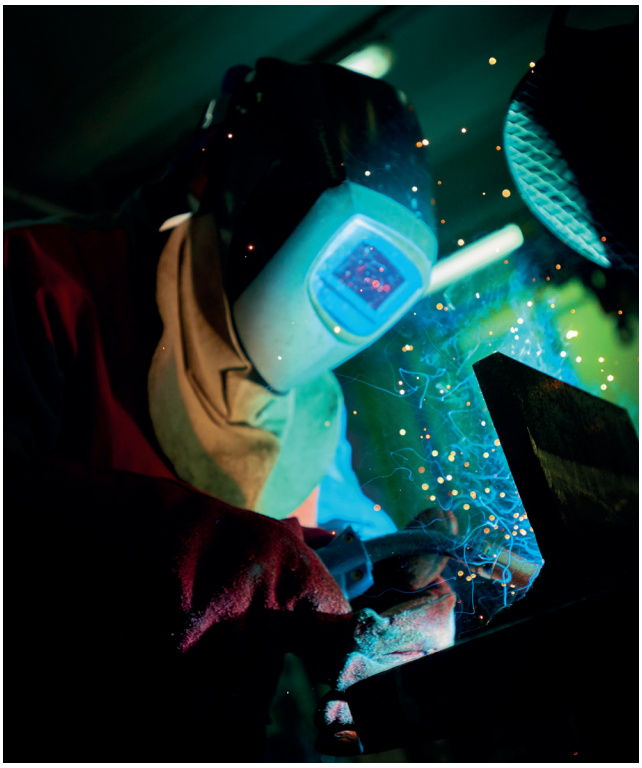
PLATE PROCESSING

WELDING

UR™ 904L can be welded by the following processes: TIG/GTAW, MIG/GMAW, SMAW, PAW and SAW.
This grade must be welded with matching filler metal or with Ni based alloys. Basic electrodes and fluxes should be used preferably to rutile ones.
Due to the fully austenitic microstructure, precautions shall be taken when welding UR™ 904L:

- **Minimize heat input (string bead, limitation of the diameter electrodes or ods). The heat input should be preferably limited to 1.5 kJ/mm.**
- **Interpass temperature must be controlled to less than 140°C (284°F).**
- **No preheating nor postheating. PWHT is not necessary except if required.**
- **Protection against weld spatter, careful cleaning and degreasing of weld area and descaling and cleaning of finished weld are highly recommended. Carefully grind strike marks and other welding defects.**
- **Use run-on and run-off plates and anti-spatter protection as praticable.**
- **Dry electrodes according to manufacturer's instructions.**

UR™ 904L must be welded with matching filler metal (type E 20 25 5 L Cu B) or nickel alloyed filler metal such as type E(R)NiCrMo-3 or PHYWELD NCW (Nb free 625). Suitable electrodes and welding wire are available from various manufacturers.



MACHINING

Operation	Tool	Lubrication	CONDITIONS				
			Depth of cut mm (inch) / Blade width mm (inch)	Feed mm (inch)	Speed m/min (feet/min)		
					18/8	18/12Mo	UR™ 904L
Parting off	High speed steel	Cutting oil	1.5 (0.06)	0.03 (0.0012)	21-26 (68.9-85.3)	17-22 (55.8-72.2)	10-13 (32.8-42.7)
			3 (0.11)	0.04 (0.0016)	22-27 (59.1-75.5)	18-23 (59.1-75.5)	11-14 (36.1-45.9)
			6 (0.23)	0.05 (0.0020)	23-28 (75.5-91.9)	19-24 (62.3-78.7)	12-15 (39.4-49.2)
			Drill Ø mm (inch)				
Drilling	High speed steel	Cutting oil	1.5 (0.06)	0.25 (0.0010)	10-14 (32.8-45.9)	10-14 (32.8-45.9)	6-10 (19.7-32.8)
			3 (0.11)	0.06 (0.0024)	11-15 (36.1-49.2)	11-15 (36.1-49.2)	7-11 (23-26.1)
			6 (0.23)	0.08 (0.0031)	11-15 (36.1-49.2)	11-15 (36.1-49.2)	7-11 (23-26.1)
			12 (0.48)	0.10 (0.0039)	11-15 (36.1-49.2)	11-15 (36.1-49.2)	7-11 (23-26.1)
Milling profiling	High speed steel	Dry or Cutting oil		0.05 - 0.10 (0.002 - 0.0039)	12 - 22 (39.4-72.2)	10-20 (32.8-65.6)	10 - 20 (32.8 - 65.6)

APPLICATIONS

> Phosphoric acid, fertilizers, phosphate industries,

> Sulphuric acid solutions and hydrometallurgy,

> Saline solutions and, with some restrictions, seawater applications,

> Sour gas applications (separators...),

> Pollution control equipments,

> Chemical plants (medium to severe conditions)

YOUR CONTACTS

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