



UR™ 321

UR™ 321: A Ti stabilized 18Cr - 10Ni austenitic stainless steel

UR™ 321 is an austenitic stainless steel with a stabilizing titanium addition.

The properties of UR™ 321 are:

- > Good general corrosion resistance
- > Excellent resistance to intergranular corrosion in the as - welded condition
- > Easy to weld and form
- > Good low temperature toughness
- > Attractive creep resistance

This grade is austenitic in the solution annealed condition (1000 - 1100°C / 1832 - 2012°F) and rapid cooling by air or water. It contains a small amount of ferrite and titanium carbonitrides.

PROPERTIES

STANDARDS

- > EURONORM: EN 1.4541 X6CrNiTi 18 - 10
- > ASTM: A 240 - TP 321 - UNS S32100

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Mo	N	Ti
.04	17.5	9.5	-	-	5x(C+N)

321H also available upon request.

PHYSICAL PROPERTIES

Density: 7900 kg/m³

Interval temperature (°C)	Thermal expansion $\alpha \times 10^{-6} K^{-1}$	T °C (°F)	Resistivity ($\mu\Omega \cdot cm$)	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)	Specific heat ($J \cdot kg^{-1} \cdot K^{-1}$)	Young modulus E (GPa)	Shear modulus G (GPa)
20 - 100	16	20 (68)	73	15	500	200	77
20 - 200	16.5	100 (212)	77	16	500	194	75
20 - 300	17	200 (392)	84	17.5	520	186	71
20 - 400	17.5	300 (572)	91	19	530	179	68
20 - 500	18	400 (752)	97	20.5	540	172	65
		500 (932)	102	22	540	165	62

MECHANICAL PROPERTIES

Tensile properties

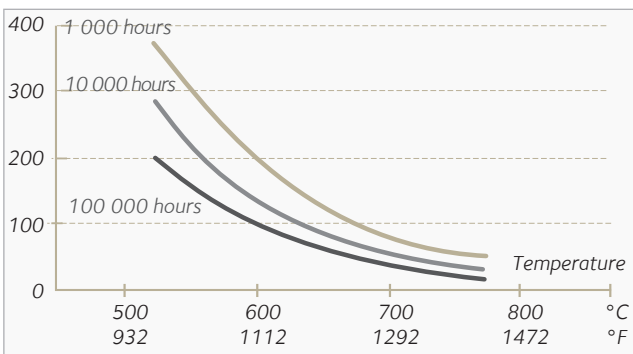
°C	°F	Minimum guaranteed values*							Typical values (10 mm plates)					
		YS 0.2%		YS 1%		UTS		Elongation	YS 0.2%		YS 1%		UTS	
		MPa	ksi	MPa	ksi	MPa	ksi		%	MPa	ksi	MPa	ksi	MPa
20	68	200	29	240	35	500/700	73/102	45	280	40	310	45	600	89
100	212	176	25	208	30	460	67	40	236	34	260	38	550	82
200	392	157	23	186	27	410	60	35	200	29	230	33	450	66
300	572	136	20	167	24	390	57	35	186	26	210	30	435	64
400	752	125	18	156	23	390	57	30	175	25	200	29	420	61
500	932	119	17	149	22	310	45	30	168	24	195	28	340	50

* Following EN 10088 hot rolled plates. The EN guaranteed values are valid for a thickness from 5 up to 75 mm (0.20" up to 2.95")

Impact values

°C (°F)	- 196 (- 321)	+20 (68)
KCV (J/cm ²) typical	160	180
KCV (J/cm ²) minimum	100	120

Typical creep strength values



IN SERVICE CONDITIONS

CORROSION RESISTANCE

Standardized corrosion tests (special request may be discussed)

TEST	OTHER NAME	CORROSION	RESULTS
ASTM A262 A	-	Intergranular	Step or dual structure
ASTM A262 B	STREICHER	Intergranular	Not recommended
ASTM A262 C	HUEY	Intergranular	Not recommended
ASTM A262 E DIN 50914 RCCM	STRAUSS	Intergranular	No cracking after bending

DELIVERY CONDITIONS

SIZE RANGE

	Quarto plates	Clad plate
Thickness	5 to 150 mm 3/16" to 6"	6 to 150 mm 1/4" to 6"
Width	Up to 3800 mm* Up to 150"	Up to 3900 mm Up to 154"
Length	Up to 16000 mm Up to 52.5 ft	Up to 16000 mm Up to 52.5 ft

Indicative dimensional programme. * Width related to thickness; please consult for specific request. Cut to length plates available from Aperam.

PLATE PROCESSING

HOT FORMING

Hot forming should be carried out in a temperature range of 1150 - 750°C (2102 - 1652°F). Due to the low thermal conductivity, the holding time of temperature may be longer (about 50%) than for CMn steels. The quenching must be fast after forming. The cleanliness of the surface is very important (avoid oil contamination). A neutral or slightly oxidizing atmosphere is required.

COLD FORMING

The alloy can be cold formed without problem. The cold hardening behaviour of the steel explains why it may require more powerful equipments than for a structural steel.

PICKLING

A nitric hydrofluoric acid bath (10 - 20% HNO₃ - 1.5 - 5% HF) at 20 - 60°C (68 - 142°F) is used for the pickling treatment.

A 10 - 20% H₂SO₄ - 1.5 - 5% HF pickling bath may also be used. Decontamination treatments may be performed with a 10 - 20% weight nitric acid solution. Rinsing is necessary after pickling.

MACHINING

Due to its cold work hardening, the alloy is less machinable than a 13% Cr martensitic stainless steel.

Operation	Tool	Lubrication	CONDITIONS		
			Depth mm (inch)	Feed mm/t (inch/t)	Speed m/min (feet/min)
Turning	High speed steel	Cutting oil	6 (0.23)	0.5 (0.019)	12 - 16 (39 - 52)
			3 (0.11)	0.4 (0.016)	18 - 23 (59 - 75)
			1 (0.04)	0.2 (0.008)	23 - 28 (75 - 92)
	Carbide	Dry or cutting oil	6 (0.23)	0.5 (0.019)	67 - 76 (220 - 249)
			3 (0.11)	0.4 (0.016)	81 - 90 (266 - 295)
			1 (0.04)	0.2 (0.008)	99 - 108 (325 - 354)

CUTTING

> Thermal cutting (plasma, thermal sawing...)

After cutting, pickling or grinding are necessary to eliminate the oxide formed layer.

> Mechanical cutting (shearing, stamping, cold sawing...)

WELDING

The alloy, stabilized by titanium addition, can be easily welded without hot cracking, using an adequate filler metal (5 to 15% δ ferrite).

The alloy is not sensitive to cold cracking. All welding processes can be used, including filler processes.

Filler materials

Electrode	E308L - 15 or E308L - 16 (ASME Sect II - Part C SFA5 - 4)
Wire	ER 308L (ASME Sect II - Part C SFA 5 - 9)

Filler materials, stabilized with Niobium may also be used:

Electrode	E347 - 15 or E347 - 16
Wire	ER 347

A post - weld heat treatment is not necessary.

Preheating and postheating are not necessary.

200°C (392°F) is the maximum interpass temperature.

Post - weld pickling is necessary to restore the corrosion resistance of the welded joint.

PLATE PROCESSING

Operation	Tool	Lubrication	Depth of cut mm (inch)	Feed mm/t (inch/t)	Speed m/min (feet/min)
Cutting	High speed steel	Cutting oil	1.5 (0.06)	0.03 - 0.05 (0.0012 - 0.0020)	16 - 21 (52 - 69)
			3 (0.11)	0.04 - 0.06 (0.0016 - 0.0024)	17 - 22 (56 - 72)
			6 (0.23)	0.05 - 0.07 (0.0020 - 0.0027)	18 - 23 (59 - 75)
Operation	Tool	Lubrication	Drill Ø mm (inch)	Feed	Speed
Drilling	High speed steel	Cutting oil	1.5 (0.06)	0.02 - 0.03 (0.0007 - 0.0012)	9 - 13 (29 - 42)
			3 (0.11)	0.05 - 0.06 (0.0020 - 0.0024)	11 - 15 (36 - 49)
			6 (0.23)	0.08 - 0.09 (0.0031 - 0.0035)	11 - 15 (36 - 49)
			12 (0.48)	0.09 - 0.10 (0.0035 - 0.0039)	11 - 15 (36 - 49)
Operation	Tool	Lubrication		Feed	Speed
Milling profiling	High speed steel	Cutting oil		0.05 - 0.10 (0.002 - 0.004)	11 - 21 (36 - 69)

APPLICATIONS

UR™ 321 is corrosion resistant in:

- > Most of diluted organic acids at moderate temperatures
- > Most of food and pharmaceutical products
- > Pure phosphoric acid
 - whatever concentration in cold solution
 - up to 10% diluted hot solution
- > Caustic solutions free of chlorides or fluorides at medium temperatures

It has only limited corrosion resistance in chloride containing solutions, even diluted, and in sulphuric acid media. So, the main applications are:

- > Food processing and storing
- > Chemical industry
- > High temperature equipment

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Technical data and information are to the best of our knowledge at the time of printing. However, they may be subject to some slight variations due to our ongoing research programme on steels. Therefore, we suggest that information be verified at time of enquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here are only for the purpose of description, and considered as guarantees when written formal approval has been delivered by our company. Further information may be obtained from the address opposite.