Industeel

ArcelorMittal

SIRIUS™ 4828

SIRIUS™ 4828: A 20% Cr - 1.8% Si Heat Resistant Steel

SIRIUS™ 4828 (SIRIUS™ S12) grade is an austenitic stainless steel containing 20% Cr, 12% Ni and 1.8% Si. The low nickel content combined with high chromium and high silicon contents provide good resistance to high temperature oxidation, even in sulphur containing gases. The structure stability of the grade is enhanced compared to other more alloyed heat resistant steels.

PROPERTIES

STANDARDS

> EURONORM: EN 1.4828 X15 Cr Ni Si 20 - 12

> ASTM: SUS 309TB

CHEMICAL ANALYSIS - WEIGHT %

Typical values

C	Cr	Ni	Si	Others
< .1	20	12	1.8	-

Specific analysis may be specified when order is placed.

PHYSICAL PROPERTIES

Density: 7.9 kg/dm³

Interval temperature (°C)	Thermal expansion (α x10^{-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	16	20 (68)	90	15	500	200	75
20 - 200	17	200 (392)	105	17	550	185	70
20 - 400	18	400 (752)	120	20	590	170	64
20 - 600	18.5	600 (1112)	130	23	620	155	58
20 - 800	19	800 (1472)	140	25	650	135	53
20 - 1000	19.5	1000 (1832)	145	28	670	120	48

MECHANICAL PROPERTIES

Temperature		Y.S. 0.2%		Y.S. 1%		UTS		Elongation
°C	°F	MPa	ksi	MPa	ksi	MPa	ksi	%
20	68	245	35	265	38	540	78	40
100	212	210	30	220	32	510	74	40
200	392	190	27	200	29	480	70	40
400	572	165	24	175	25	450	65	40
600	752	155	22	165	24	400	58	40
800	1472	115	17	120	17	(220)	(32)	40

Typical tensile properties after solution annealing heat treatment. Results obtained on 10 mm (.39") hot rolled plates

CREEP PROPERTIES

Typical creep properties

Temperature		Creep strain MPa			Creep rupture MPa		
°C	°F	1000h	10000h	100000h	1000h	10000h	100000h
600	1112	140	100	40	210	140	75
700	1292	60	35	20	80	40	20
800	1472	20	10	5.5	40	20	9
900	1652	8	4	1.5	15	9	3

For minimum values, take a safety margin of about 20% on typical values

STRUCTURE

SIRIUS™ 4828 heat resistant steel is austenitic, and carbon content is optimised for creep resistance. Some carbide precipitations may occur at grain boundaries.. The alloy is subject to phase precipitations after long time exposure in the 650° - 950°C (1202 - 1742°F) temperature range. Solution annealing heat treatment at 1050 - 1120°C (1922 - 2048°F) restore ductility and toughness.

IN SERVICE CONDITIONS

CORROSION RESISTANCE

Wet corrosion resistance

The alloy is not designed for wet corrosion resistance purposes. Intergranular corrosion testings that are used for standard austenitic stainless steels are not applicable to SIRIUS™ 4828 grade.

High temperature corrosion resistance

The austenitic microstructure combined with the high silicon (1.8%) and chromium (20%) additions improve the high temperature corrosion resistance properties of the alloy, when compared to 304H, 321 or 316H grades. Typical working temperatures are as follow:

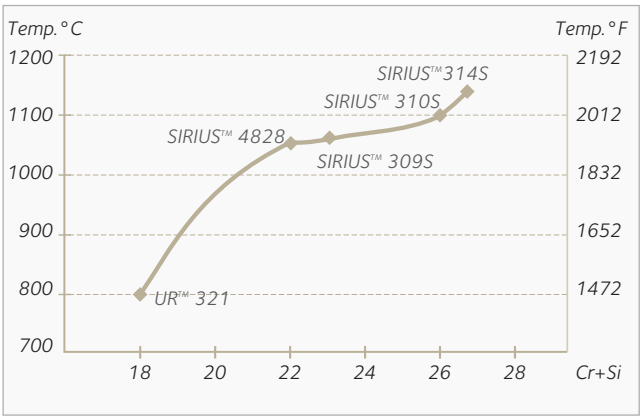
> **Oxidating atmospheres** with maximum sulphur content of 2 g/m³: 1000°C (1832°F) maximum continuous service, and 950°C (1742°F) with thermal cycles.

> **Oxidating atmospheres** with sulphur content: > 2 g/m³ 850°C (1562°F) maximum.

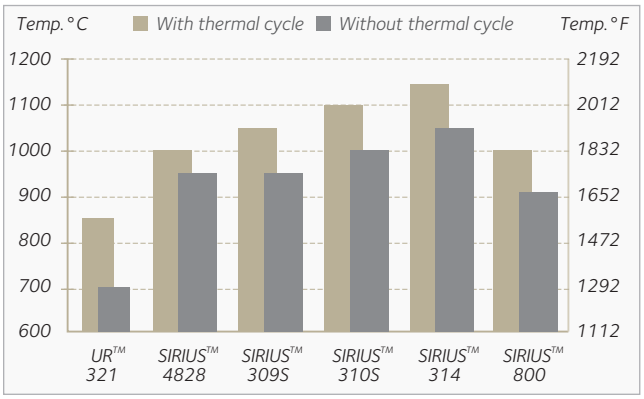
> **Low oxygen containing atmosphere** with sulphur content lower than 2 g/m³: 850°C (1562°F) maximum.

> **Low oxygen containing atmospheres** with sulphur content higher than 2 g/m³: 700°C (1290°F) maximum.

> **Nitriding or carburizing atmospheres:** The maximum temperatures are reduced. The alloy is not designed for service in reducing nitriding or carburizing atmospheres.



Effect of chromium and silicium additions on the peak temperature when considering the resistance to high temperature oxydation.



Limits of uses for high temperature corrosion resistance grades in air without and with thermal cycles

DELIVERY CONDITIONS

SIZE RANGE

	Quarto plates	Clad plates
Thickness	5 to 150 mm 3/16" to 6"	6 to 150 mm 1/4" to 6"
Width	Up to 3200 mm* Up to 126"	Up to 3300 mm* Up to 130"
Length	Up to 12300 mm Up to 40 ft	Up to 16000 mm Up to 52.5 ft

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

HOT FORMING

Hot forming should be carried out in a temperature range of 1150 - 900°C (2102 - 1652°F) after the piece has been uniformely heated. Final full annealing heat treatment at 1020 - 1090°C (1868 - 1994°F) may be performed. Quenched annealing heat treatment is nevertheless not generally required since the material is designed for high temperature applications.

COLD FORMING

SIRIUS™ 4828 grade can be cold formed without any problem. Its austenitic microstructure makes the alloy very ductile. Long term high temperature service may reduce the ductility of the steel. Cold worked and aged structures may require a preliminary solution annealing heat treatment to restore the ductility of the steel.

PICKLING

Residual high temperature oxides improve the resistance of the steel to scaling. If the oxides must be removed, use sand blasting or controlled pickling solutions. Don't use strong pickling paste or solution even to clean up the welds due to possible intergranular corrosion.

WELDING

SIRIUS™ 4828 grade is easily welded by following processes TIG welding - both normal and automatic, MIG welding, SAW, SMAW, FCAW, Plasma welding. Use SIRIUS™ 4828 type products or as an alternative 309 type products. Nickel based filler materials containing Nb additions are not recommended since intermetallic intergranular precipitations may occur at fusion line. The SIRIUS™ 4828 alloy is less sensitive to hot cracking phenomena than high nickel heat resistant steels. No pre or postwelding heat treatments are required. Limit interpass temperature to 150°C (302°F). If necessary, stress relieve in the 900 - 1000°C (1652 - 1832°F) temperature range. Usual precautions for stainless steels welds including cleaning and degreasing of weld areas, protection against weld spatters must be taken. Grind the start and finish of each filler pass before to start with the next filler pass. Mechanical methods, including fine grinding and polishing, will be prefered to pikling to remove oxide, slag, incrustations, heat tint or other surface contaminations. Strong pickling pastes should be avoided since the as welded alloy is susceptible to intergranular corrosion.

MACHINING

Operation	Tool	Lubrication	CONDITIONS		
			Depth of cut 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 - 17 (37 - 50)
			3 (0.11)	0.4 (0.016)	19 - 24 (62 - 80)
			1 (0.04)	0.2 (0.008)	25 - 30 (83 - 100)
	Carbide	Dry or cutting oil	6 (0.23)	0.5 (0.019)	72 - 82 (236 - 269)
			3 (0.11)	0.4 (0.016)	87 - 97 (285 - 318)
			1 (0.04)	0.2 (0.008)	105 - 115 (344 - 377)
			Blade width mm (inch)	Feed mm/t (inch/t)	Speed m/min (feet/min)
Cutting	High speed steel	Cutting oil	1.5 (0.06)	0.03 (0.0012)	19 - 24 (62 - 79)
			3 (0.11)	0.04 (0.0016)	20 - 25 (66 - 82)
			6 (0.23)	0.05 (0.0020)	21 - 26 (69 - 85)
			Drill Ø mm (inch)	Feed mm/t (inch/t)	Speed m/min (feet/min)
Drilling	High speed steel	Cutting oil	1.5 (0.06)	0.025 (0.0010)	10 - 14 (32.8 - 45.9)
			3 (0.11)	0.06 (0.0024)	11 - 15 (36.1 - 49.2)
			6 (0.23)	0.08 (0.0031)	11 - 15 (36.1 - 49.2)
			12 (0.48)	0.10 (0.0039)	11 - 15 (36.1 - 49.2)
				Feed mm/t (inch/t)	Speed m/min (feet/min)
Milling profiling	High speed steel	Cutting oil		0.05 - 0.10 (0.002 - 0.0039)	11 - 21 (36 - 69)

APPLICATIONS

> **Sintering plants:** grids, burners, suction boxes

> **Blast furnaces and cooling ovens:** heat recuperators, charging mechanisms, circulation and pipering

> **Steel melting, smelters:** extraction hoods, flue gas ducts, dampers...

> **Continuous casting plants:** rollers, pre - heaters for ladles...

> **Rolling mills:** flue gas ducts, burners, electrical resistance components for furnace, rollers...

> **Heat treatment furnaces:** working beams, doors, burners, heat recuperators...

> **Cement plants:** feeding and discharging systems, rotary kilns, refractory anchors, burners and burner shields, gates, plates, wind boxes...

YOUR CONTACTS

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