SIRIUS™ 800 – H – H+

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SIRIUS™ 800 – H – H+ are three variants of a high chromium and nickel austenitic alloy which combines good corrosion and creep resistance. SIRIUS™ 800 is employed at temperature below 600°C (1112°F) while SIRIUS™ 800H and SIRIUS™ 800H+ are used above 600°C (1112°F). Industeel heats obtained by vacuum degassing feature have a tight control of the chemical analysis including residual elements in order to improve their weldability and in-service properties.

PROPERTIES

STANDARDS

> EURONORM: EN 1. 4876 X10 Ni Cr Al Ti 32 – 21

> ASTM: UNS N 08800/810/811

CHEMICAL ANALYSIS – WEIGHT %

Typical values

C	Cr	Ni	Si	S	Cu	Ti	Al	Fe	P
≤ .10	19.0/23.0	30.0/35.0	≤ 1.0	≤ 005	≤ .75	.15/.60	.15/.60	Bal	< .020

** SIRIUS™ 800H, the C content falls in the range 0.05 to 0.1%*
** SIRIUS™ 800H+, C content is between .06 and .1% and Ti+Al between .85 and 1.20%*
** Sulfur and phosphorus contents are reduced in order to improve weldability.*

PHYSICAL PROPERTIES

Density: 8.0 kg/m³

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)
0 - 100	13.5	20 (68)	100	13	502	196	73
0 - 200	14.5	200 (392)	110	15	544	186	68.5
0 - 400	15.5	400 (752)	117	16	586	173	63.5
0 - 600	17	600 (1112)	120	17	627	158	57.5
0 - 800	18	800 (1172)	125	18	710	140	50
0 - 1000	19	1000 (1832)	129	18.5	795	117	41.5

The Poisson ratio ν can be calculated from the Young's and shear moduli via the following relation:
ν = (E – 2G) / 2G
Magnetic permeability (in a field of 200 Oersted): at 20°C (68°F) µ = 1.01

MECHANICAL PROPERTIES

Tensile properties - Minimum values

	Annealing temperature		Y.S. 0.2%		UTS		Elongation
	°C	°F	MPa	ksi	MPa	ksi	%
SIRIUS™ 800	980	1796	210	31	520	75	35
SIRIUS™ 800 H*	1150	2102	170	25	450	65	35
SIRIUS™ 800 H+*	1150	2102	170	25	450	65	35

** solution annealed*

At high temperature (mean values)

	Temperature		Y.S. 0.2%		Y.S. 1%		UTS		Elongation
	°C	°F	MPa	ksi	MPa	ksi	MPa	ksi	%
SIRIUS™ 800	20	68	290	42	325	47	616	89	43
	350	662	254	37	284	41	526	76	35
	550	1022	215	31	242	35	488	71	35.5
	750	1382	160	23	185	27	232	34	82
SIRIUS™ 800H	20	68	230	33	265	38	550	80	48
	350	662	140	20	170	25	450	65	47
	550	1022	120	17	147	21	420	61	48
	750	1382	95	14	120	17	200	29	40
	950	1742	60	9	80	12	80	12	75
	1050	1922	30	4	45	6	50	7	100
SIRIUS™ 800H+	20	68	220	32	255	37	535	77	50
	350	662	135	20	165	24	450	65	48
	550	1022	115	17	142	21	420	61	48
	750	1382	95	14	120	17	200	29	40
	950	1742	60	9	80	12	80	12	75
	1050	1922	30	4	45	6	50	7	100

Creep strength

SIRIUS™ 800H and SIRIUS™ 800H+ grades are designed to improve creep strength. In some conditions (temperatures from 500 to 650 °C (932 - 1202 °F), SIRIUS™ 800, annealed at 980 °C (1796 °F) can be used for creep applications. In the range 500 - 600 °C (932 - 1112 °F), these alloys can be hardened by the precipitation of γ' phase, increasing the creep life at these temperatures, but reducing the ductility.

Temperature		Stress for 1% Elongation (MPa)				Stress for rupture (MPa)			
°C	°F	10000h		100000h		10000h		100000h	
		800H	800H+	800H	800H+	800H	800H+	800H	800H+
600	1112	90	140	66	120	160	170	115	130
700	1292	59	70	45	48	69	80	52	55
800	1472	30	35	20	22	35	40	24	26
900	1652	10	15	6.5	8.5	13	20	8	12
1000	1832	3	5.5	1.7	3.4	4.5	10	2.5	4.8

STRUCTURE STABILITY

SIRIUS™ 800, 800H and 800 H⁺ grades all have a stable austenitic structure, and are not embrittled by the precipitation of sigma phase. However, in the interval 500 - 600°C (932 - 1112°F), alloys with Ti + Al exceeding 0.50% can harden due to γ ' precipitation. This produces an increase of the creep strength in this temperature range, but also a decrease in ductility observed after long term service in this temperature range. Above 600°C (1112°F), the γ ' phase dissolves again.

IN SERVICE CONDITIONS

CORROSION RESISTANCE

Wet corrosion

SIRIUS™ 800 shows excellent resistance in numerous corrosive media. In acid solutions, its corrosion resistance is slightly better than that of 18 - 8 type stainless steels. Alloy 800 has good resistance in peroxide, chromate or sulphate containing media, and also in organic acids at moderate temperatures. SIRIUS™ 800 is highly resistant to stress corrosion cracking, particularly transgranular attack due to chlorides.

Corrosion by hot gases

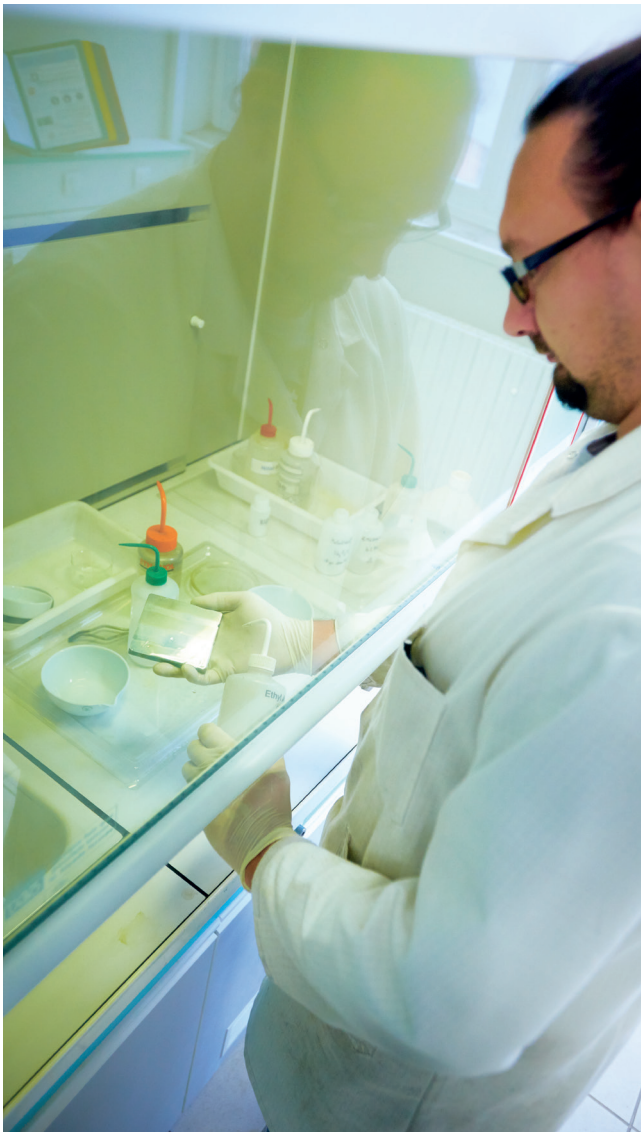
Because of their austenitic structure, free from sigma phase, SIRIUS™ 800H and SIRIUS™ 800H⁺ have excellent resistance to corrosion by hot gases.

Oxidizing, sulfur - free atmospheres	1100°C (2012°F) 1150°C (2102°F) peak temp.
Oxidizing, sulfur - rich atmospheres	~ 900°C (1652°F)
Reducing, sulfur - free atmospheres	1050°C (1922°F) 1100°C (2012°F) peak temp.
Reducing, sulfur - rich atmospheres	~ 600°C (1112°F)
Carburizing and nitriding atmospheres	1050°C (1922°F)

SIRIUS™ 800H, 800H⁺ have good resistance to reforming and cracking gases, and to coal gasification atmospheres.

Corrosion by molten salts and metals

SIRIUS™ 800, 800H and 800H⁺ have good resistance to corrosion by molten sodium and potassium up to 850°C (1562°F). They also have good resistance to fused salt baths of the chloride type.



DELIVERY CONDITIONS

SIZE RANGE

	Hot rolled plates	Clad plates
Thickness	5 to 150 mm 3/16" to 6"	6 to 150 mm 1/4" to 6"
Width	Up to 3300 mm* Up to 130"	Up to 3300 mm* Up to 130"
Length	Up to 12000 mm Up to 39.4 ft	Up to 14000 mm Up to 46 ft

For other sizes, please consult.

HOT FORMING

Depending on the equipment used, hot forming operations can be carried out in the range from 1100 to 850°C (2012 to 1562°F). Slightly oxydizing or neutral atmosphere are recommended during heat treatment. Sulfur compounds are strictly prohibited in the furnace atmosphere.

COLD FORMING

This alloy can be cold formed by all the usual processes: bending, shaping, deep drawing, drawing, wire drawing, etc... Softening is generally necessary after forming and can be obtained by annealing at 980°C for SIRIUS™ 800, and by treatment at 1150°C (2102°F) for the 800 H and 800 H⁺ grades.

HEAT TREATMENT

SIRIUS™ 800, 800H and 800H⁺ grades are fully austenitic at all temperatures and can be hardened only by cold work. When Ti + Al exceeds 0.55%, precipitation hardening by g' phase occurs in the temperature range from 500 to 600°C (932 to 1112°F), but only after several hundreds or even thousands of hours, and cannot therefore be obtained by simple heat treatment. The applicable heat treatments are therefore:

Annealing at 980°C (1796°F)	This treatment confers the best corrosion resistance and optimum tensile properties. It is therefore applied preferentially to SIRIUS™ 800 used at temperatures below 600°C (1112°F).
Annealing at 1150°C (2102°F)	This treatment leads to lower tensile strength than the 980°C (1796°F) anneal, with a coarser grain size (ASTM 5 or larger for SIRIUS™ 800H and SIRIUS™ 800H⁺). In contrast, it produces optimum creep properties at temperatures above 600°C (1112°F)

PICKLING

Pickling is usually carried out by one of the following process:

Nitric-hydrofluoric bath	By volume
Nitric acid (HNO_3)	10 to 20%
Hydrofluoric acid (HF)	1.5 to 5%
Water	remainder

The immesion time is about 1 hour at 20°C (68°F) or 20 minutes at 50°C (122°F).

DECONTAMINATION - PASSIVATION

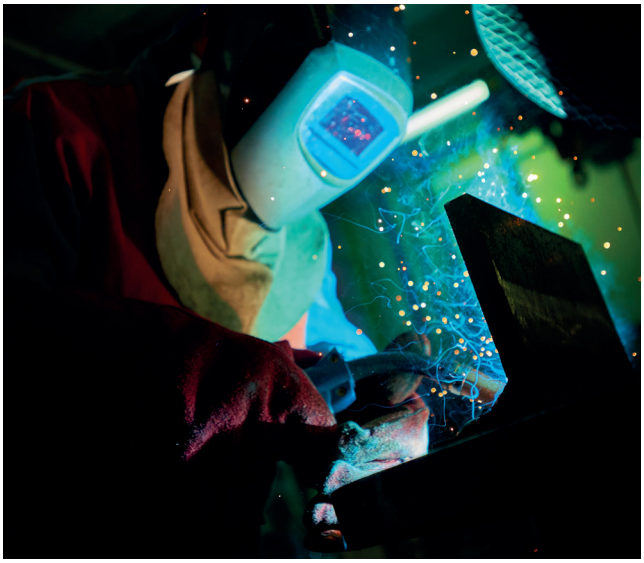
When the manufacturing operations have imbedded foreign ferrous of particles which must be removed, a decontamination - passivation treatment can be carried out in the following bath:

Nitric-hydrofluoric bath	By volume
36° B nitric acid (HNO_3)	20 to 25%
Water	remainder

The immersion time is 30 minutes at room temperature and can be reduced to 10 minutes at 50°C (122°F).

WELDING

SIRIUS™ 800, 800 H, 800H⁺ grades have improved weldability and can be readily welded by all the usual processes, particularly because Industeel guarantees extra - low sulfur and phosphorus levels. If a filler metal is required, ER Ni Cr Mo 3 or ER Ni Cr wire should be employed. A suitable material for electrodes are E Ni Cr Fe or E Ni Cr Mo 3, or an equivalent grade. All welds must be carefully cleaned. If several weld passes are necessary, the temperature should be maintained below 150°C (302°F) between passes, and the heat input should be limited below 1.5 KJ/mm.



APPLICATIONS

> Nuclear engineering (PWR, HTR and fast breeder reactor plants, etc...)

> Chemical, pharmaceutical, food and agriculture

> Petrochemical engineering (reformers, thermal and catalytic crackers, waste heat boiler, internal components for secondary reformers)

> Convection section for ethylen crackers and pyrolysis furnace

> Transfer piping, transfer line exchangers, quench pots

> Mechanical engineering

> Industrial heating: furnace components (radiant tubes, muffles, baskets, belts, etc...)

> Polysilicium production

YOUR CONTACTS

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