Nicrofer® 3127 hMo – alloy 31

Material Data Sheet No. 4031
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Corrosion-resistant alloy

A company of ThyssenKrupp Stainless

ThyssenKrupp VDM

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ThyssenKrupp

Nicrofer® 3127 hMo – alloy 31

Nicrofer 3127 hMo is an iron-nickel-chromium-molybdenum alloy with nitrogen addition. Developed by ThyssenKrupp VDM, it was designed to fill the gap between existing superaustenitic stainless steels and nickel-base alloys. Nicrofer 3127 hMo is particularly well suited to applications in chemical and petrochemical industries, environmental engineering, and oil and gas production.

Nicrofer 3127 hMo is characterized by:

- outstanding resistance to corrosion in halide media, both acidic and basic;
- outstanding resistance to sulphuric acid, even highly concentrated;
- outstanding resistance to corrosion and erosion-corrosion in phosphoric acid media;
- excellent resistance to both localised corrosion and general corrosion in chlorine dioxide bleach media;
- excellent resistance to both reducing and oxidizing media;
- ease of fabrication and welding;
- approval for pressure-vessel use involving wall temperatures from -196 to 550 °C (-320 to 1020 °F)

Designations and standards

Country National standards	Material designation	Specification							
		Chemical composition	Tube and pipe		Sheet and plate	Rod and bar	Strip	Wire	Forgings
			seamless	welded					
D SEW VdTÜV-Wbl.	W.-Nr. 1.4562 X1NiCrMoCu32-28-7	 400 509	 400	 400	 400 509	 400	 400	 400	 400
USA ASTM ASME	UNS N08031		 B 622 SB 622	 B 619/626 SB 619/626	 B 625 SB 625	 B 581 (Rod) B 649 (Bar) SB 581 (Rod) SB 649 (Bar)	 B 625 SB 625	 B 649 SB 649	 B 564 SB 564
ASME Code Case Section VIII Div. I			2139	2139	2139	2139 (Rod only)	2139		2139

Table 1 – Designations and standards.

Chemical composition

	Ni	Cr	Fe	C	Mn	Si	Cu	Mo	N	P	S
min.	30.0	26.0	bal.				1.0	6.0	0.15		
max.	32.0	28.0		0.015	2.0	0.3	1.4	7.0	0.25	0.020	0.010

Table 2 – Chemical composition (wt.-%).

Physical properties

Density	8.1 g/cm³	0.293 lb/in.³
Melting range	1350 – 1370 °C	2460 – 2500 °F
Permeability at 20 °C/68 °F (RT)	1.001	

Temperature (T)		Specific heat		Thermal conductivity		Electrical resistivity		Modulus of elasticity		Coefficient of thermal expansion between room temperature and T	
°C	°F	J / kg K	Btu / lb °F	W / m K	Btu in. / ft² h °F	μ Ω cm	Ω circ mil / ft	kN / mm²	10^3 ksi	10^{-6} / K	10^{-6} / °F
0	32										
20	68	452	0.108	11.7	81	103	620	198	28.7		
93	200		0.111		90		635		27.6		7.9
100	212	463		13.2		106		189		14.3	
200	392	474		15.0		110		183		14.7	
204	400		0.113		105		662		26.5		8.2
300	572	483		16.8		113		176		15.1	
316	600		0.116		118		683		25.4		8.5
400	752	491		18.5		116		170		15.5	
427	800		0.118		132		702		24.2		8.6
500	932	500		20.2		118		163		15.7	
538	1000		0.127		144		716		23.3		8.8
600	1112	508		(21.9)		(120)		158		15.9	

Table 3 – Typical physical properties at room and elevated temperatures.

Mechanical properties

The following properties are applicable to indicated Nicrofer 3127 hMo product forms in the solution-treated condition and in the indicated size ranges. Specified properties of material outside these size ranges are subject to special enquiry.

Strip	up to 3 mm	up to 0.12 in.
Sheet & plate	up to 50 mm	up to 2 in.
Rod & bar	up to 300 mm	up to 12 in.
Wire	up to 12 mm	0.47 in.

Tensile strength R_m N/mm²	ksi	Yield strength $R_{p\,0.2}$ N/mm²	ksi	Elongation A_{50} %	Brinell hardness HB
650	94	276	40	40	max. 220 (For information only)

Table 4 – Minimum mechanical properties for all product forms at room temperature of Nicrofer 3127 hMo, according to ASTM.

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Temperature °C	Temperature °F	Yield strength $R_{p0.2}$ N/mm²	Yield strength $R_{p0.2}$ ksi	Yield strength $R_{p1.0}$ N/mm²	Yield strength $R_{p1.0}$ ksi	Tensile strength R_m N/mm²	Tensile strength R_m ksi	Elongation A_5 %
20	68	276	40	310	45.0	650	min. 94	40
93	200		30.6		35.5		90.6	50
100	212	210	30.5	240	34.8	630	91	50
200	392	180	26.1	210	30.5	580	84.1	50
204	400		27.5		30.5		83.4	50
300	572	165	23.9	195	28.3	530	76.9	50
316	600		23.3		27.6		76.0	50
400	752	150	21.8	180	26.1	500	72.5	50
427	800		21.3		25.5		71.3	50
500	932	135	19.6	165	23.9	470	68.2	50
538	1000		18.5		23.0		66.7	50
550	1022	125	18.1	155	22.5	450	65.3	50

Table 5 – Minimum short-time mechanical properties for sheet & plate products ≤ 25 mm (1 in.) at elevated temperatures according to VdTÜV -Wbl. 509.

Temperature °C	Temperature °F	Maximum allowable stress N/mm² [1]	Maximum allowable stress N/mm² [1] [2]	Maximum allowable stress ksi	Maximum allowable stress ksi [2]	Temperature °C	Temperature °F	Maximum allowable stress N/mm² [1]	Maximum allowable stress N/mm² [1] [2]	Maximum allowable stress ksi	Maximum allowable stress ksi [2]
38	100			23.5	23.5	260	500			17.2	20.4
93	200			22.0	23.5	300	572	114	136		
100	212	150	162			316	600			16.4	19.5
149	300			19.7	22.6	371	700			15.7	18.9
200	392	126	148			400	752	106	129		
204	400			18.3	21.5	427	800			15.2	18.5

[1] values determined by interpolation [2] 'conditional' stress values

Table 6 – Maximum allowable stress values in tension according to ASME, Section VIII, Division 1 UNF-23.3. SB 564, 581, 619, 622, 625, 626.

ISO V-notch impact toughness

Average values at RT: ≥ 185 J/cm²
at -196 °C (-320 °F): ≥ 140 J/cm²

The higher 'conditional' stress values of up to 90 % of the yield strength at temperature may be used for applications in which slightly greater deformation is acceptable.

These stresses may result in dimensional changes due to permanent strain and are not recommended for flanges of gasketed joints.

Comparison of typical short-time data for
Nicrofer 3127 hMo – alloy 31 ▬▬ with similar alloys as:

Nicrofer 3127 LC – alloy 28 ••••••••
Cronifer 1713 LCN – alloy 317 LN ▬ ▬ ▬

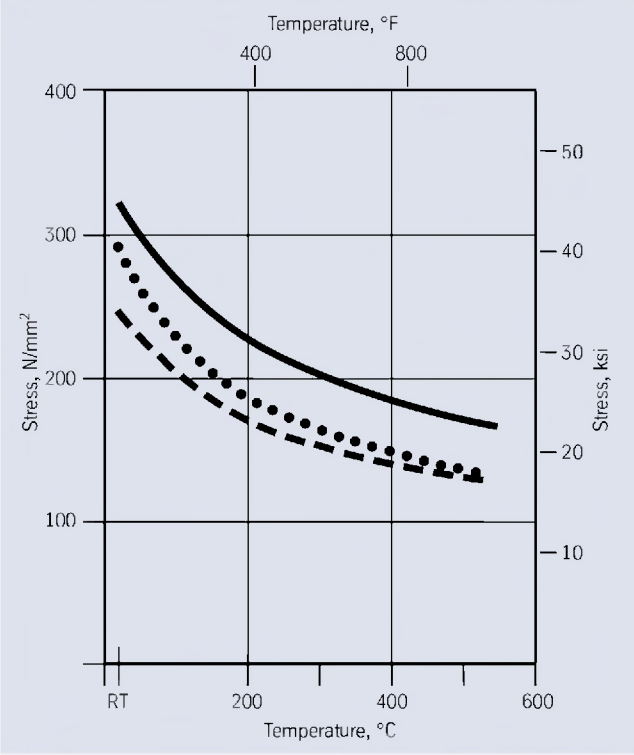

Fig. 1 – Typical short-time 0.2 % yield strength at room and elevated temperatures.

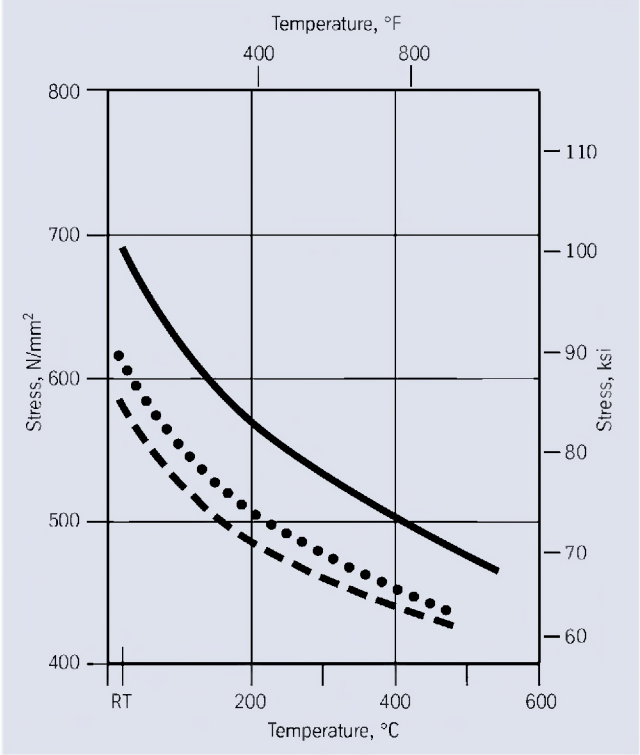

Fig. 2 – Typical short-time tensile strength at room and elevated temperatures.

Metallurgical structure

Nicrofer 3127 hMo has a face-centered-cubic structure. The 0.2 % nitrogen content stabilizes the austenite and reduces the tendency to precipitation of intermetallic phases.

Corrosion resistance

The chemical composition of Nicrofer 3127 hMo is designed to give it particularly high resistance to corrosion in halide media. The alloy also shows outstanding resistance to sulphuric acid, both pure and contaminated, over a wide range of concentrations and temperatures. Its corrosion resistance in lightly aerated, technical grade sulphuric acid is shown in Fig. 3.

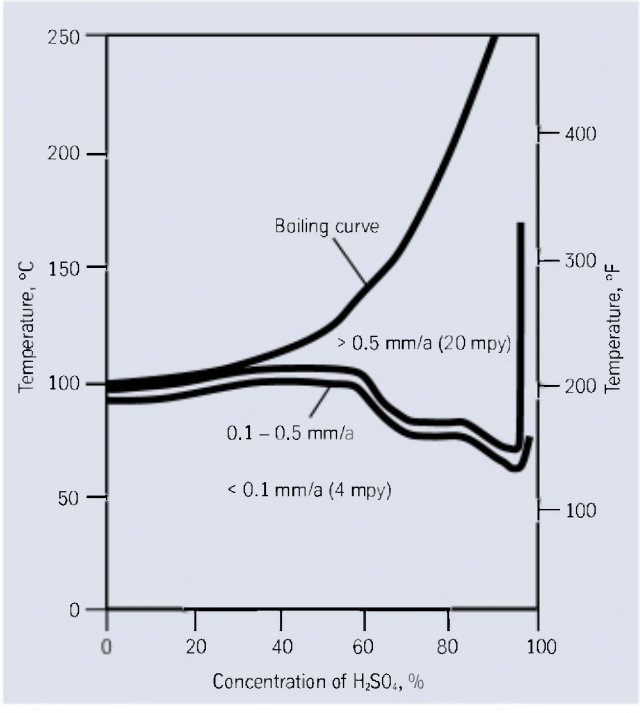

Fig. 3 – Isocorrosion diagram of Nicrofer 3127 hMo – alloy 31 in lightly aerated, technical grade sulphuric acid based on immersion test results over at least 120 h.

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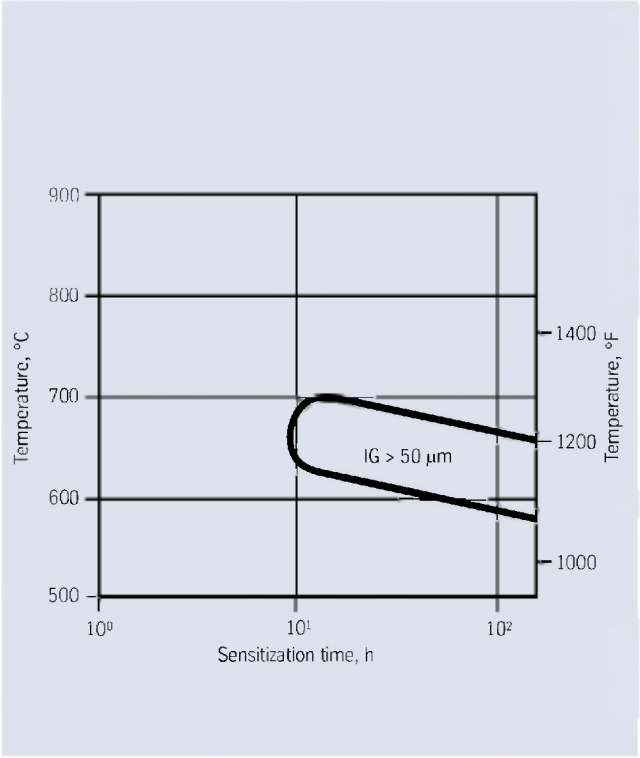

Fig. 4 – Time-temperature-sensitization diagramm (TTS), IG according to the ASTM G-28 A test.

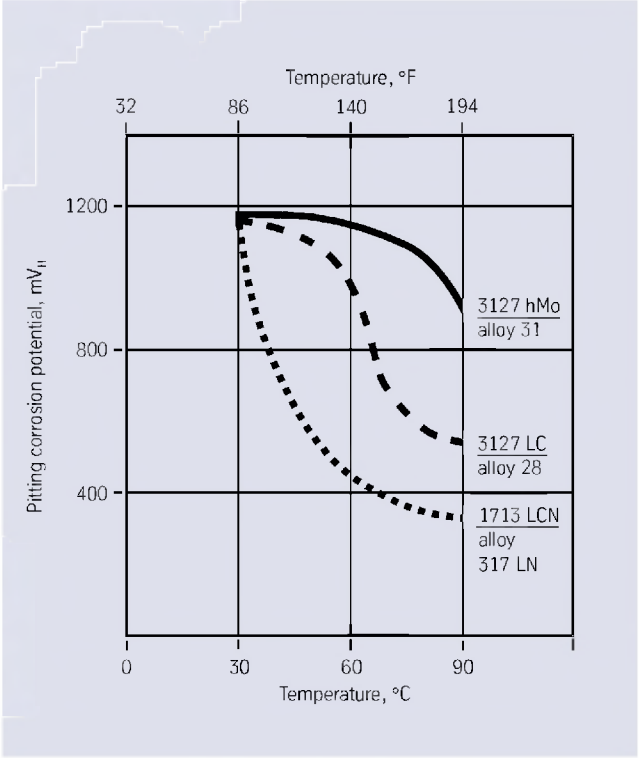

Fig. 5 – Pitting corrosion potential in relation to temperature (ASTM seawater, agitated and air-saturated).

In the severe erosion-corrosion conditions of wet-process phosphoric acid production, Nicrofer 3127 hMo has demonstrated that it is a true alternative to nickel-base alloys. Extensive testing in chlorine-dioxide bleach media in the pulp and paper industry has shown that Nicrofer 3127 hMo withstands extremely severe service conditions.

Resistance to intergranular corrosion (IG) has been determined according to the ASTM G-28 A test as well as to German Standard Test SEP 1877 II. Fig. 4 shows that Nicrofer 3127 hMo only becomes sensitized after a considerable time period.

Pitting resistance has been determined by potential measurements and by the ASTM G-28 A test. Fig. 5 and 6 show the results in comparison to other materials.

Optimum corrosion resistance can be obtained only if the material is in the correct metallurgical condition and clean.

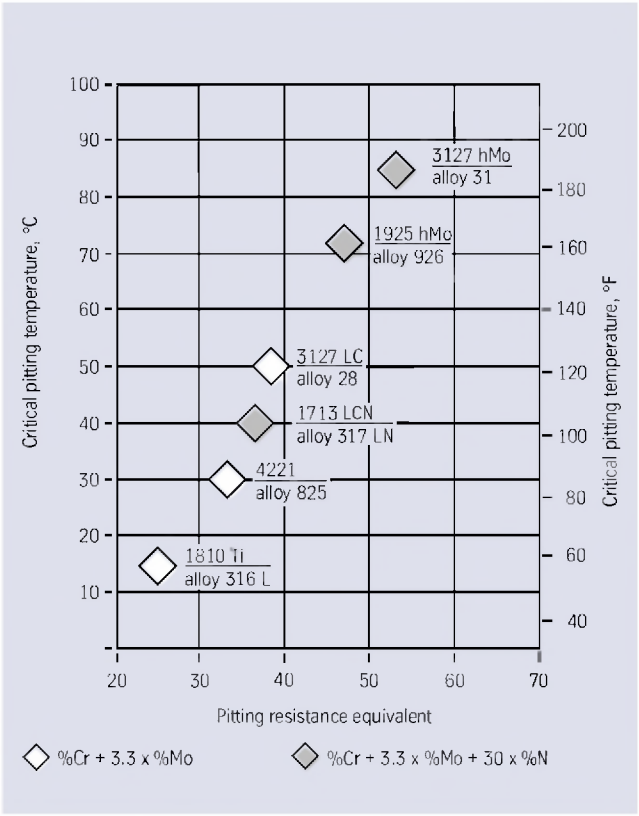

Fig. 6 – Critical pitting temperatures (CPT) in 10 % $FeCl_3$ x $6H_2O$ solution as a function of pitting resistance equivalent (PRE).

Nicrofer 3127 hMo shows outstanding corrosion resistance in sulphuric acid in the range 20 to 80 % and at temperatures up to 80 °C (176 °F), see. Fig. 7.

In a variety of corrosive media Nicrofer 3127 hMo shows clear advantages, as Fig. 8 indicates.

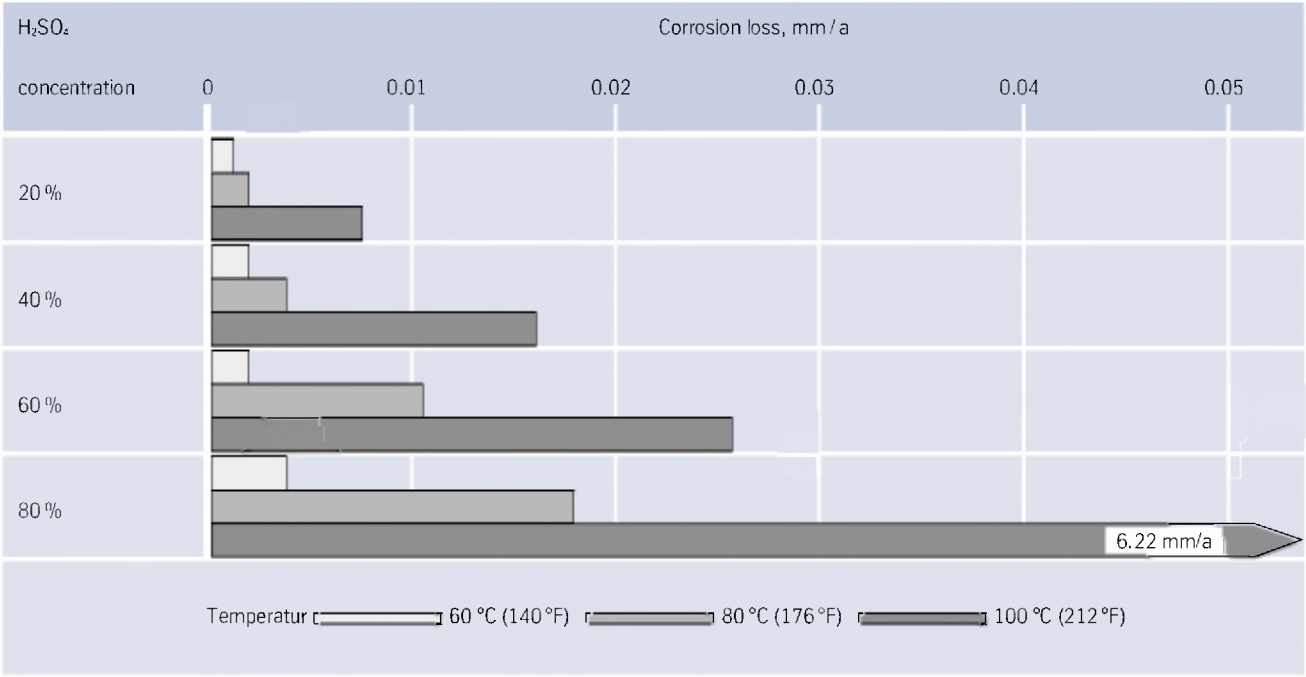

Fig. 7 – Linear corrosion loss of Nicrofer 3127 hMo in sulphuric acid of various concentrations and at elevated temperatures.

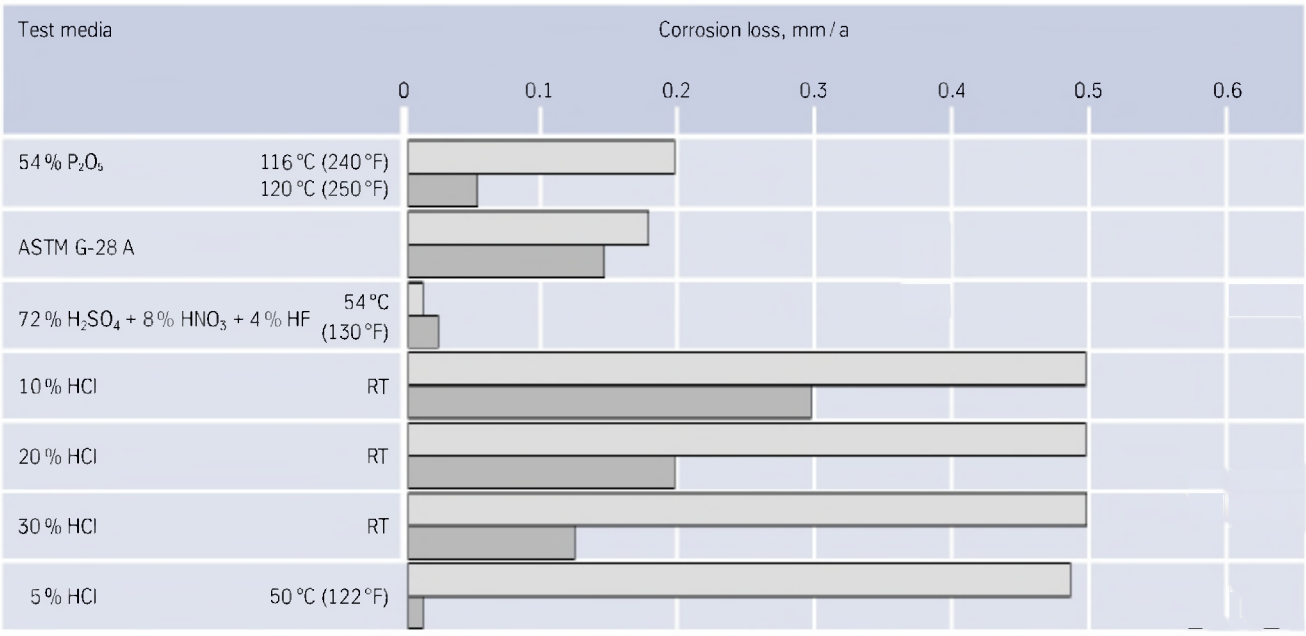

Fig. 8 – Comparision of corrosion loss of alloy G-30 and Nicrofer 3127 hMo – alloy 31 in various media and at different temperatures.

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Test media	Critical pitting temperature (CPT)	
	Alloy G-30	Nicrofer 3127 hMo – alloy 31
ASTM G-48 A and MTI 2	75 – 80 °C (167 – 176 °F)	82.5 °C (180 °F)
4 % NaCl + 0.1 % $Fe_2(SO_4)_3$ + 0.04 % HCl	75 °C (167 °F)	105.5 °C (220 °F)

Table 7 – Critical pitting temperature (CPT) of alloy G-30 and Nicrofer 3127 hMo – alloy 31.

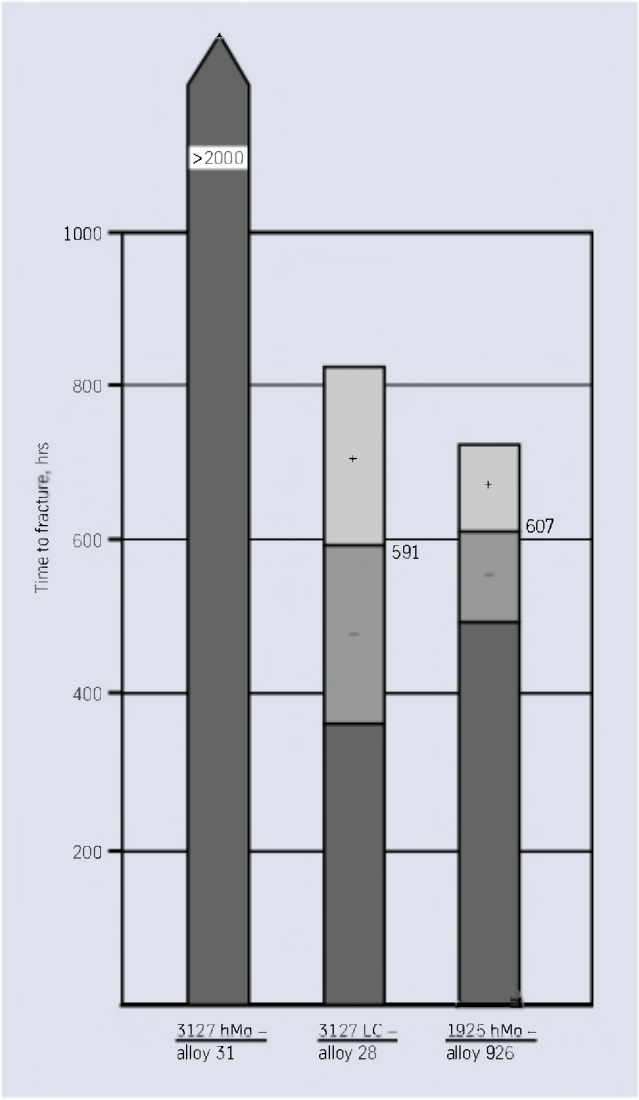

Fig. 9 – Stress corrosion cracking test with U-bend specimens in boiling 62 % $CaCl_2$-solution.

Austenitic stainless steels are susceptible to stress corrosion cracking (SCC). In the ASTM G-30-72 SCC test, however, Nicrofer 3127 hMo shows excellent resistance to stress corrosion cracking, also in comparison with other alloys.

Applications

Typical applications are:

- FGD systems
- pulp and paper industry
- fine chemicals synthesis
- phosphoric acid production
- organic acids and esters synthesis
- waste sulphuric acid recovery
- sea water or brackish water heat exchangers
- ore processing, e.g. HIPAL (high pressure acid leaching technology) of laterite ores
- petroleum production and refining
- pickling plant (H_2SO_4)
- sulphuric acid coolers
- evaporation and crystallization of salt
- sour gas environment (listed in NACE Standard MR0175: ´Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment` as acceptable up to Level VI)

Fabrication and heat treatment

Nicrofer 3127 hMo can readily be hot- and cold worked and machined.

Heating

Workpieces must be clean and free from all kinds of contaminants before and during any heat treatment.

Nicrofer 3127 hMo may become embrittled if heated in the presence of contaminants such as sulphur, phosphorus, lead and other low-melting-point metals. Sources of such contaminants include marking and temperature-indicating paints and crayons, lubricating grease, fluids and fuels.

Fuels must be as low in sulphur as possible. Natural gas should contain less than 0.1 wt.-% sulphur. Fuel oils with a sulphur content not exceeding 0.5 wt.-% are suitable.

Due to their close control of temperature and freedom from contamination, thermal treatments in electric furnaces under vacuum or an inert gas atmosphere are to be preferred. Treatments in an air atmosphere and alternatively in gas-fired furnaces are acceptable though, if contaminants are at low levels so that a neutral or slightly oxidizing furnace atmosphere is attained. A furnace atmosphere fluctuating between oxidizing and reducing must be avoided as well as direct flame impingement on the metal.

Hot working

Nicrofer 3127 hMo may be hot worked in the temperature range 1200 to 1050 °C (2190 to 1920 °F), following by water quenching or rapid air cooling.

For heating up, workpieces may be charged into the furnace at maximum working temperature. When the furnace has returned to temperature, the workpieces should be soaked for 60 minutes per 100 mm (4 in.) of thickness. At the end of this period it should be withdraw immediately and worked within the above temperature range. If the metal temperature falls below 1080 °C (1980 °F), it should be reheated.

Heat treatment after hot working is recommended in order to achieve optimum properties and to ensure maximum corrosion resistance.

Cold working

For cold working the material should be in the annealed condition. Nicrofer 3127 hMo has a higher work-hardening rate than austenitic stainless steels. This should be taken into account when selecting forming equipment.

Interstage annealing may be necessary with high degrees of cold forming. After cold working with more than 15 % deformation solution annealing is required before use.

Heat treatment

Solution annealing of Nicrofer 3127 hMo should be carried out in the temperature range 1150 to 1180 °C (2100 to 2160 °F), followed by water quenching or rapid air cooling for material thicknesses below about 1.5 mm (0.06 in.).

For maximum corrosion resistance, the workpiece must be rapidly cooled from a temperature of at least 1100 °C (2000 °F) down to 500 °C (930 °F) using a cooling rate > 150 °C (300 °F)/min from the heat treatment temperature.

For any thermal treatment the material should be charged into the furnace at maximum working temperature. Also for any thermal treatment operation the precautions concerning cleanliness mentioned earlier under 'Heating' must be observed.

Descaling and pickling

Oxides of Nicrofer 3127 hMo and discoloration adjacent to welds are more adherent than on stainless steels. Grinding with very fine abrasive belts or discs is recommended. Care should be taken to prevent tarnishing.

Before pickling which may be performed in a nitric/hydroflouric acid mixture with proper control of pickling time and temperature, the surface oxide layer must be broken up by abrasive blasting or by carefully performed grinding or by pretreatment in a fused salt bath.

Machining

Nicrofer 3127 hMo should be machined in the heat-treated condition. As the alloy exhibits a high work-hardening rate only low cutting speeds should be used compared with low-alloyed standard austenitic stainless steels. Tools should be engaged at all times. An adequate depth of cut is important in order to cut below the previously formed work-hardened zone.

Welding

When welding nickel-base alloys and high-alloyed special stainless steels, the following instructions should be adhered to:

Workplace

The workplace should be in a separate location, well away from the areas where carbon steel fabrication takes place. Maximum cleanliness and avoidance of draughts are paramount.

Auxiliaries, clothing

Clean fine leather gloves and clean working clothes should be used.

Tools and machinery

Tools used for nickel-base alloys and stainless steels must not be used for other materials. Brushes should be made of stainless material. Fabricating and working machinery such as shears, presses or rollers should be fitted with means (felt, cardboard, plastic sheet) of avoiding contamination of the metal with ferrous particles, which can be pressed into the surface and thus lead to corrosion.

Cleaning

Cleaning of the base metal in the weld area (both sides) and of the filler metal (e. g. welding rod) should be carried out with acetone.

Trichlorethylene (TRI), perchlorethylene (PER), and carbon tetrachloride (TETRA) must not be used.

Edge preparation
This should preferably be done by mechanical means, i. e. turning, milling or planing; abrasive water jet or plasma cutting is also possible. However, in the latter case the cut edge (the face to be welded) must be finished off cleanly. Careful grinding without overheating is permissible.

Included angle
The different physical characteristics of nickel-base alloys and special stainless steels compared with carbon steel generally manifest themselves in a lower thermal conductivity and a higher rate of thermal expansion. This should be allowed for by means of, among other things, wider root gaps or openings (1 – 3 mm), while larger included angles (60 – 70°), as shown in Fig. 10, should be used for individual butt joints owing to the viscous nature of the molten weld metal and to counteract the pronounced shrinkage tendency.

Striking the arc
The arc should only be struck in the weld area, i. e. on the faces to be welded or on a run-out piece. Striking marks lead to corrosion.

Welding process
Nicrofer 3127 hMo can be joined to itself and to many other metals by conventional welding processes. These include GTAW (TIG), plasma arc, GMAW (MIG/MAG) and SMAW (MMA). Pulsed arc welding is the preferred technique. For the MAG processes the use of a multi-component shielding gas ($Ar+He+H_2+CO_2$) is recommended.

For welding, Nicrofer 3127 hMo should be in the annealed condition and be free from scale, grease and markings. When welding the root, care should be taken to achieve best-quality root backing (argon 99.99), so that the weld is free from oxides after welding the root. Root backing is also recommended for the first intermediate pass following the initial root pass and in some cases even for the second pass depending on the weld set-up. Any heat tint should be removed preferably by brushing with a stainless steel wire brush while the weld metal is still hot.

Filler metal
For the gas-shielded welding processes, the following filler metals are recommended:

Bare electrodes:	Nicrofer S 5923 – FM 59 W.-Nr. 2.4607 SG-NiCr23Mo16 AWS A5.14: ERNiCrMo-13
	or
	Nicrofer S 3127 – FM 31 W.-Nr. 1.4562 X1-NiCrMoCu32-28-7
Covered electrodes:	W.-Nr. 2.4609 EL-NiCr22Mo16 AWS A5.11: ENiCrMo-13
	or matching electrode

For overlay welding by the electro-slag method (RES):

Weld strip:	Nicrofer B 5923 – WS 59 W.-Nr. 2.4607 UP-NiCr23Mo16 AWS A5.14: ERNiCrMo-13

Welding parameters and influences (heat input)
Care should be taken that the work is performed with a deliberately chosen, low heat input as indicated in Table 8 by way of example. Use of the stringer bead technique should be aimed at. Interpass temperature should be kept below 150 °C (300 °F).

The welding parameters should be monitored as a matter of principle.

The heat input Q may be calculated as follows:

$$Q = \frac{U \times I \times 60}{v \times 1000}\ (kJ/cm)$$

U = arc voltage, volts
I = welding current, amps
v = welding speed, cm/min.

Consultation with ThyssenKrupp VDM's Welding Laboratory is recommended.

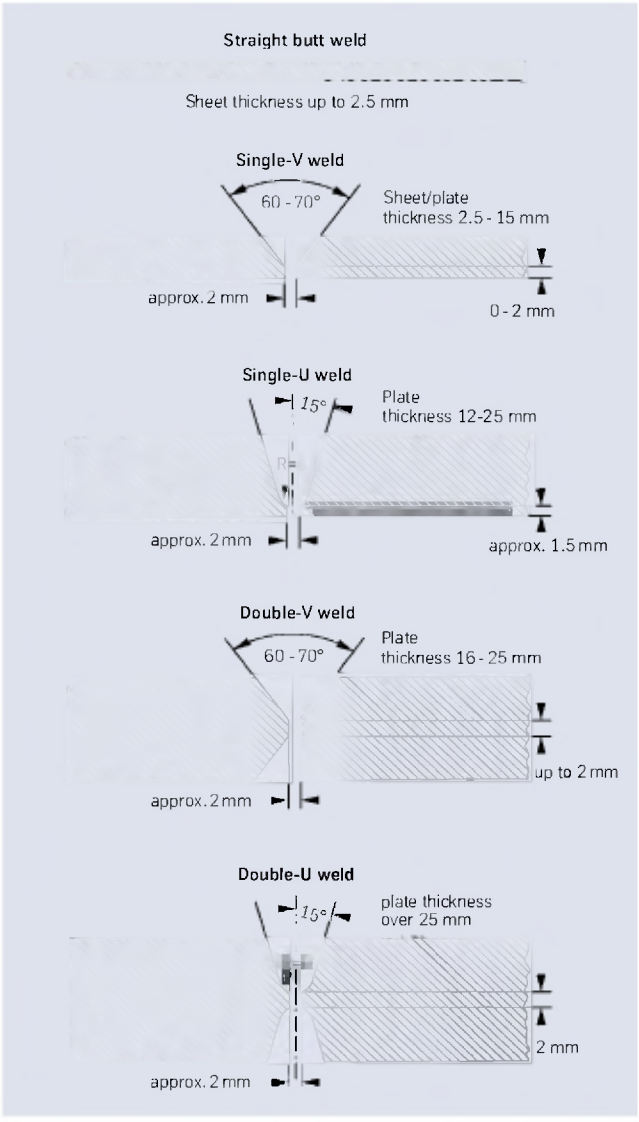

Fig. 10 – Edge preparation for welding of nickel-base alloys and special stainless steels.

Sheet/ plate thick-ness mm	Welding process	Filler metal Diameter mm	Speed m/min.	Welding parameters Root pass A	V	Intermediate and final passes A	V	Welding speed cm/min.	Flux/ shielding gas rate l/min.	Plasma-gas rate l/min.	Plasma-nozzle diameter mm
3.0	Manual GTAW	2.0		90	10	110 – 120	11	10 – 15	Ar W3[1] 8 – 10		
6.0	Manual GTAW	2.0 – 2.4		100 – 110	10	120 – 130	12	10 – 15	Ar W3[1] 8 – 10		
8.0	Manual GTAW	2.4		110 – 120	11	130 – 140	12	10 – 15	Ar W3[1] 8 – 10		
10.0	Manual GTAW	2.4		110 – 120	11	130 – 140	12	10 – 15	Ar W3[1] 8 – 10		
3.0	Autom. GTAW	1.2	0.5	manual		150	10	25	Ar W3[1] 15 – 20		
5.0	Autom. GTAW	1.2	0.5	manual		150	10	25	Ar W3[1] 15 – 20		
2.0	Hot wire GTAW	1.0	0.3			180	10	80	Ar W3[1] 15 – 20		
10.0	Hot wire GTAW	1.2	0.45	manual		250	12	40	Ar W3[1] 15 – 20		
4.0	Plasma arc	1.2	0.5	165	25			25	Ar W3[1] 30	Ar W3[1] 3.0	3.2
6.0	Plasma arc	1.2	0.5	190 – 200	25			25	Ar W3[1] 30	Ar W3[1] 3.5	3.2
8.0	MIG/MAG GMAW	1.0	approx. 8	GTAW		130 – 140	23 – 27	24 – 30	MAG[2] MIG: argon 18 – 20		
10.0	MIG/MAG GMAW	1.2	approx. 5	GTAW		130 – 150	23 – 27	20 – 26	MAG[2] MIG: argon 18 – 20		
6.0	SMAW	2.5		40 – 70	approx. 21	40 – 70	approx. 21				
8.0	SMAW	2.5–3.25		40 – 70	approx. 21	70 – 100	aprrox. 22				
16.0	SMAW	4.0				90 – 130	approx. 22				

[1] Argon or argon + max. 3 % hydrogen
[2] For MAG welding use of the shielding gas Cronigon He30S or Argomag-Ni, for example, is recommended.
In all gas-shielded welding operations, ensure adequate back shielding.
These figures are only a guide and are intended to facilitate setting of the welding machines.

Table 8 – Welding parameters (guide values).

Welding process	Heat input per unit length kJ/cm	Welding process	Heat input per unit length kJ/cm
GTAW, manual, fully mechanised	max. 8	GMAW, MIG/MAG, manual, fully mechanised	max. 11
Hot wire GTAW	max. 6	SMAW, manual metal arc (MMA)	max. 7
Plasma arc	max. 10		

Table 9 – Heat input per unit length (guide values).

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Postweld treatment
(brushing, pickling and thermal treatments)

Brushing with a stainless steel wire brush immediately after welding, i.e. while the metal is still hot generally results in removal of heat tint and produces the desired surface condition without additional pickling.

Pickling, if required or prescribed, however, would generally be the last operation performed on the weldment. Also refer to the information under 'Descaling and pickling'.

Neither pre- nor postweld thermal treatments are required.

Availability
Nicrofer 3127 hMo is available in the following standard product forms:

Sheet & plate
(for cut-to-length availability, refer to strip)

Conditions:
hot or cold rolled (hr, cr),
thermally treated and pickled

Thickness mm	hr / cr	Width[1] mm	Length[1] mm
1.10 – < 1.50	cr	2000	8000
1.50 – < 3.00	cr	2500	8000
3.00 – < 7.50	cr / hr	2500	8000
7.50 – ≤ 25.00	hr	2500	8000[2]
> 25.00[1]	hr	2500[2]	8000[2]

inches		inches	inches
0.043 – < 0.060	cr	80	320
0.060 – < 0.120	cr	100	320
0.120 – < 0.300	cr / hr	100	320
0.300 – ≤ 1.000	hr	100	320[2]
> 1.000[1]	hr	100[2]	320[2]

[1] other sizes subject to special enquiry
[2] depending on piece weight

Discs and rings
Conditions:
hot rolled or forged,
thermally treated,
descaled or pickled or machined

Product	Weight kg	Thickness mm	O. D.[1] mm	I. D.[1] mm
Disc	≤ 10000	≤ 300	≤ 3000	
Ring	≤ 3000	≤ 200	≤ 2500	on request

	lbs	inches	inches	inches
Disc	≤ 22000	≤ 12	≤ 120	
Ring	≤ 6600	≤ 8	≤ 100	on request

[1] other sizes subject to special enquiry

Rod & bar
Conditions:
forged, rolled, drawn,
thermally treated,
descaled or pickled, machined, peeled or ground

Product	Forged[1] mm	Rolled[1] mm	Drawn[1] mm
Rod (o. d.)	≤ 600	8 – 100	12 – 65
Bar, square (a)	40 – 600	15 – 280	not standard
Bar, flat (a x b)	(40 – 80) x (200 – 600)	(5 – 20) x (120 – 600)	(10 – 20) x (30 – 80)
Bar, hexagonal (s)	40 – 80	13 – 41	≤ 50

	inches	inches	inches
Rod (o. d.)	≤ 24	$^{5}/_{16}$ – 4	$^{1}/_{2}$ – 2 $^{1}/_{2}$
Bar, square (a)	$1^{5}/_{8}$ – 24	$^{10}/_{16}$ – 11	not standard
Bar, flat (a x b)	($1^{5}/_{8}$ – $3^{1}/_{8}$) x (8 – 24)	($^{3}/_{16}$ – $^{3}/_{4}$) x ($4^{3}/_{4}$ – 24)	($^{3}/_{8}$ – $^{3}/_{4}$) x ($1^{1}/_{2}$ – $3^{1}/_{8}$)
Bar, hexagonal (s)	$1^{5}/_{8}$ – $3^{1}/_{8}$	$^{1}/_{2}$ – $1^{5}/_{8}$	≤ 2

[1] other sizes and conditions subject to special enquiry

Forgings
Shapes other than discs, rings, rod and bar are subject to special enquiry. Flanges and hollow shafts may be available up to a piece weight of 10 t.

Strip[1]
Conditions:
cold rolled,
thermally treated and pickled or bright annealed[2]

Thickness mm	Width[3] mm	Coil I. D. mm			
0.04 – ≤ 0.10	4 – 200	300	400		
> 0.10 – ≤ 0.20	4 – 350	300	400	500	
> 0.20 – ≤ 0.25	4 – 750		400	500	600
> 0.25 – ≤ 0.60	6 – 750		400	500	600
> 0.60 – ≤ 1.0	8 – 750		400	500	600
> 1.0 – ≤ 2.0	15 – 750		400	500	600
> 2.0 – ≤ 3.0	25 – 750		400	500	600

inches	inches	inches			
0.0016 – ≤ 0.004	0.16 – 8	12	16		
> 0.004 – ≤ 0.008	0.16 – 14	12	16	20	
> 0.008 – ≤ 0.010	0.16 – 30		16	20	24
> 0.010 – ≤ 0.024	0.20 – 30		16	20	24
> 0.024 – ≤ 0.040	0.32 – 30		16	20	24
> 0.040 – ≤ 0.080	0.60 – 30		16	20	24
> 0.080 – ≤ 0.120	1.0 – 30		16	20	24

[1] Cut-to-length available in lengths from 250 to 4000 mm (10 to 158 in.)
[2] Maximum thickness 3 mm (0.125 in.)
[3] Wider widths subject to special enquiry

Wire
Conditions:
bright drawn, ¼ hard to hard,
bright annealed or oxidized

Dimensions:
0.01 – 12.0 mm (0.0004 – 0.47 in.) diameter,
in coils, pay-off packs, on spools and spiders

Welding filler metals
Suitable welding rods, wire, strip electrodes and electrode core wire are available in all standard sizes.

Seamless tube and pipe
Using ThyssenKrupp VDM cast materials seamless tubes and pipes are produced and available from DMV STAINLESS Int. Sales, Tour Neptune, F-92086 Paris, La Défense Cedex (Fax: +33-1-4796 8126; Tel.: +33-1-4796 8128).

Welded tube and pipe
Welded tubes and pipes are obtainable from qualified manufacturers using ThyssenKrupp VDM semi-fabricated products.

Technical publications
The following publications concerning Nicrofer 3127 hMo may be obtained from ThyssenKrupp VDM GmbH:

U. Heubner, M. Rockel, E. Wallis:
Ein neuer hochlegierter Nickel-Chrom-Molybdän-Werkstoff für den Chemie-Apparatebau,
Werkstoffe und Korrosion 40 (1989), pp. 418 – 426

U. Heubner, R. Kirchheiner, M. Rockel:
Alloy 31, A New high-Alloyed Nickel-Chromium-Molybdenum Steel for the Refinery Industry and Related Applications,
CORROSION '91, Paper No. 321, NACE International,
Houston, Texas, 1992

M. Rockel und W. Herda:
Zwei neue hochlegierte austenitische Sonderstähle mit höherem Molybdängehalt und Stickstoffzusätzen,
Reprint from Stahl '92, Vol. 1, March 1992

F. White:
Superaustenitic stainless steels,
Reprint from Stainless Steel Europe, October 1992

U. Heubner:
Neue Werkstoffe für den Apparatebau,
Chemische Produktion, Vol. 11, November 1992

M. Jasner, U. Heubner:
Alloy 31, a New 6 Moly Stainless Steel with Improved Corrosion Resistance in Seawater,
CORROSION '95, Paper No. 279, NACE International,
Houston, Texas, 1995

M. Rockel:
Nicrofer 3127 hMo – alloy 31 (N08031) a new, high alloy special stainless steel for chemical process technology and other process industries,
VDM Case History 6, August, 2002

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