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ZERON 100

Technical Data Sheet

Super Duplex Stainless Steel

ZERON◊ 100 is a highly alloyed duplex stainless steel for use in aggressive environments. Its properties include:-

- Guaranteed corrosion performance (PREN≥ 40)
- High resistance to pitting and crevice corrosion
- Excellent resistance to stress corrosion cracking in both chloride and sour environments
- High resistance to erosion corrosion and corrosion fatigue
- Excellent mechanical properties
- Possibilities for weight reduction over austenitic, standard duplex and nickel base alloys
- Good weldability

The combination of the above properties makes ZERON 100 the optimum choice in a range of industries. Oil and gas industry applications include process, seawater, firewater, and subsea pipework systems, with associated risers, manifolds, pressure vessels, valves and heat exchangers. Applications of ZERON 100 in other industries include pipework systems and associated engineering equipment for pollution control, pulp and paper, power generation, flue gas desulphurisation, chemical, pharmaceutical, desalination, mining, metallurgical and marine industries.

CHEMICAL COMPOSITION

	C	Si	Mn	S	P	Cr	Ni	Mo	W	Cu	N	Fe
MIN	–	–	–	–	–	24.0	6.0	3.0	0.5	0.5	0.2	BAL
MAX (S32760) WROUGHT	0.03	1.0	1.0	0.01	0.03	26.0	8.0	4.0	1.0	1.0	0.3	
MAX (J93380) CAST	0.03	1.0	1.0	0.025	0.03	26.0	8.5	4.0	1.0	1.0	0.3	

PREN = % Cr + 3.3% Mo + 16% N

PREN ≥ 40

PHASE BALANCE = 50 ± 15% FERRITE

It should be noted that the UNS S32760 designation merely specifies a broad compositional range, whereas the composition of Zeron 100 is tightly controlled in strict accordance with the requirements of our in house 'MDS' specifications. This ensures a consistent quality product is produced, and the stated corrosion, mechanical and physical properties are maintained.

STANDARDS

	UNS	EN No./W-Nr.	EN Name/DIN Name	ACI
Wrought	S32760	1.4501	X2CrNiMoCuWN 25-7-4	
Cast	J93380	1.4508	G-X2CrNiMoCuWN 25-8-4	CD3 MWCuN

NACE MR0175

PD5500 (formerly B.S. 5500) Enquiry Case 5500/111

ASME VIII Division 1 Cases 2244-1 and 2245-1, ASME III Division 1 Case N-564-1.

ASME B16.5, ASME B16.34, ASME B16.47

ASME B31.3

API 5LC

Pipe and Tube:	ASTM A790, A789, A928
Forged Flanges, Fittings, etc:	ASTM A182 (Grade F55)
HIP Flanges, Fittings etc:	ASTM A988
Plate and Sheet:	ASTM A240, BS EN 10028-7, BS EN 10088-2
Bars and Shapes:	ASTM A276, A479, BS EN 10088-3, BS EN 10273
Forgings:	ASTM A473
Forging Stock:	ASTM A314
Fittings:	ASTM A815
Castings:	ASTM A351, A890, A995
Fasteners:	ASTM A320*

**Currently available in accordance with the above standards. Formal applications for inclusion in the standards are awaiting approval.*

Thermal Expansion

The typical thermal expansion coefficient of wrought and cast ZERON 100 is much lower than that of austenitic stainless steel and reasonably close to that of carbon steel, as follows:

SI (METRIC) UNITS

	LINEAR THERMAL EXPANSION COEFF (10^{-6} K^{-1})		
Temperature, °C	20-100	20-200	20-300
ZERON 100	12.8	13.3	13.8
CARBON STEEL	11.5	12.2	12.9
AUSTENITIC STAINLESS STEEL	16.8	17.2	17.6

INCH-POUND UNITS

	LINEAR THERMAL EXPANSION COEFF (10^{-6}in/in°F)		
Temperature, °F	70-200	70-400	70-600
ZERON 100	7.0	7.4	7.7
CARBON STEEL	6.4	6.8	7.2
AUSTENITIC STAINLESS STEEL	9.3	9.6	9.8

Resistivity

Typical values of resistivity are shown below.

		RESISTIVITY (10^{-6} ohm m)	
TEMP (°C)	TEMP (°F)	WROUGHT ZERON 100	CAST ZERON 100
20	68	0.851	0.916
100	212	0.897	0.955
150	302	0.927	0.980
200	392	0.956	1.005
250	482	0.985	1.030
300	572	1.014	1.055

Magnetic Permeability

At room temperature the peak relative magnetic permeability of ZERON 100 is typically 29.

Young's Modulus

The modulus is a function of austenite/ferrite ratio and production route. Variations of ± 5% are found with both wrought and cast products. The typical value for ZERON 100 at room temperature is 190 GPa (27600 ksi).

Poisson's Ratio

The typical value for ZERON 100 at room temperature is 0.32

CORROSION RESISTANCE

General Corrosion

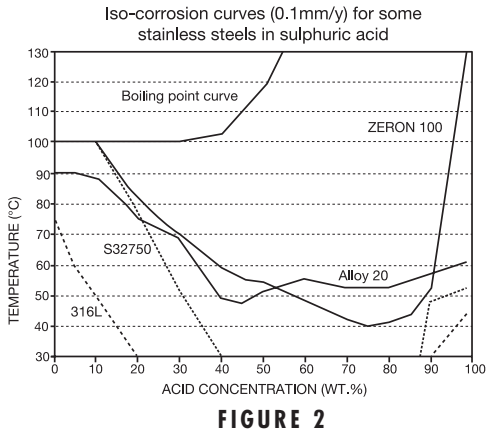

FIGURE 2

ZERON 100 is highly resistant to corrosion in a wide range of organic and inorganic acids. The copper content gives excellent resistance to corrosion in many non-oxidising acids. Figure 2 shows the typical performance for ZERON 100 in sulphuric acid compared to some other stainless steels. Figure 3 shows similar data for hydrochloric acid. Commercial acid applications often contain chlorides and other impurities which can cause corrosion of some stainless steels. ZERON 100 offers much improved corrosion performance in these environments.

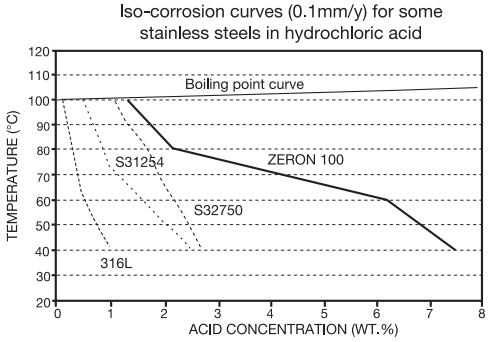

FIGURE 3

Zeron 100 is also highly resistant to strong alkalis. The production of caustic soda results in hot, strong solutions and even in 60wt% caustic soda, Zeron 100 has very low corrosion rates (<0.1mm/y). Caustic soda is often found with chlorides in extraction processes and even with 10g/l chloride, Zeron 100 has excellent corrosion resistance. Three years service experience of fabricated Zeron 100 pipework in 2M caustic soda with chlorides at 230°C has been excellent.

Pitting Corrosion

Exposure to 6% $FeCl_3$ for 24 hours in accordance with ASTM G48 method A to determine the maximum temperature at which no pitting occurs (the critical pitting temperature, CPT), has given the following results:

Solution annealed wrought and cast ZERON 100: 70-80°C (158-176°F) depending on product form and manufacturing route.

ZERON 100 welded with ZERON 100X filler metal: 35-60°C (95-140°F), depending on the welding variables, i.e. process, joint geometry, procedure etc.

These values are for single exposure testing; testing a single specimen at a series of increasing temperatures gives a higher CPT value.

Crevice Corrosion

The resistance to localised corrosion is often assessed by use of the PREN number (%Cr + 3.3%Mo + 16%N). ZERON 100 is made to a minimum PREN of 40, ensuring a guaranteed and high resistance to pitting and crevice corrosion. ZERON 100 has been in service in sea water since 1986 as castings, and since 1989 as wrought pipes and fittings giving satisfactory performance.

At sea water temperatures above ambient (20°C) the risk of crevice corrosion increases. ZERON 100 resists crevice corrosion up to 55°C but is limited by the pitting resistance of the welds to about 40°C. With the application of post weld treatments sea-water temperatures up to 65°C have been handled successfully. Short term elevated temperature upsets are not uncommon in cooling water circuits. Laboratory tests have shown that ZERON 100 does not suffer crevice corrosion easily during short upsets to 70°C, and when corrosion does initiate, repassivation occurs rapidly on cooling, from 42° C upwards.

Material	Material No.	CPT	CCP	PREN (pitting resistance equivalent number)[1)]
316 Ti	1.4571	15	<0	24
904 L	1.4539	45	25	37
VDM® Alloy 926	1.4529	70	40	47
VDM® Alloy 33	1.4591	85	40	50
VDM® Alloy 625	2.4856	75	55	51

[1)] PRE = 1 (% Cr) + 3,3 (% Mo) + 20 (% N)

Table 7 – Critical pitting temperature (CPT) and critical crevice temperature (CCT) of VDM® Alloy 625 (grade 1) in comparison to high alloyed stainless steels in 10 % $FeCl_3$, x 6 H_2O

Applications

The soft annealed version of VDM® Alloy 625 (grade 1) is used in the oil and gas industry, the chemical process industry, marine engineering and environmental engineering. Typical applications include:

- Equipment for the production of super phosphoric acid
- Plants for the treatment of radioactive waste
- Production pipe systems and linings of risers in oil production
- Offshore industry and seawater exposed equipment
- Sea water piping in shipbuilding
- Stress corrosion cracking resistant compensators
- Furnace linings

For high temperature applications up to 1,000 °C (1,832 °F), the solution treated variant (grade 2) acc. to ASME Code for Pressure Vessels is used. Typical applications include:

- Flaring systems in refineries and offshore platforms
- Recuperators and compensators for hot exhaust gases

VDM® FM 625 is used as a matching filler metal for corrosion-resistant coatings of less resistant steels (overlay welding). Typical applications include:

- Components in the oil and gas extraction
- Superheater tubes in waste incineration plants