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Supercore Z100XP

Superduplex Flux Cored Wire

1. Introduction

The Zeron 100 superduplex ferritic-austenitic stainless steel (UNS S32760) has been available for a number of years now and it has been used in many applications including offshore oil production. For fabrication purposes there have been suitable welding consumables available for the TIG (GTAW), MIG (GMAW), sub-arc and MMA (SMAW) processes for almost as long as the material has been available but Metrode can now also offer a flux cored wire which matches the Zeron 100 alloy.

Compared to other manual arc welding processes flux cored wires can provide significant productivity benefits enabling enormous cost savings to be made during fabrication. The Supercore Z100XP is a rutile all-positional wire providing excellent operability and the capability to produce welds in all positions including pipework.



The productivity and operability advantages of gas-shielded flux cored wires have been well established for austenitic stainless steels for many years now and more recently for standard 22%Cr duplex stainless steels; the same benefits can now be obtained when welding UNS S32760 superduplex stainless steel. The TIG (GTAW) process will still be preferred for many applications and SAW offers the highest productivity for welds that can be positioned in the flat but the Supercore Z100XP wire will be suitable for many of the applications currently carried out using the MMA (SMAW) and solid wire MIG (GMAW) processes.

The welding parameters for Supercore Z100XP are 140-250A, 23-32V but the preferred condition is 160A, 26V for positional welding and 200A, 28V when welding in the flat. The electrode stickout should be about 15-20mm and an Ar-20%CO₂ shielding gas should be used with a flow rate of about 20 l/min. When welding pipe Supercore Z100XP can be used if the pipe is above about 250mm diameter and 15mm wall thickness.

The following sections provide more detailed information on the mechanical and corrosion properties of Supercore Z100XP.

2.0 Batch analysis

The following table lists the analysis limits for the Supercore Z100XP, which are essentially the same as for the consumables for the other processes. Also listed are examples of some actual batch analyses.

	C	Mn	Si	S	P	Cr	Ni	Mo	Cu	W	N	PRE _N	PRE _W
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Specification

Minimum	--	--	--	--	--	24.0	8.5	3.5	0.5	0.5	0.2	40	40
Maximum	0.04	1.5	1.0	0.01	0.03	26.0	10.0	4.0	1.0	1.0	0.3	--	--

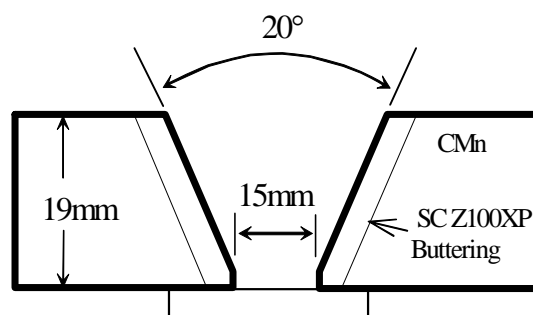
Actual batch analyses

WO17493	0.024	1.06	0.47	0.006	0.026	24.7	9.1	3.7	0.65	0.63	0.22	40.4	41.5
WO17832	0.026	1.06	0.44	0.005	0.026	24.9	9.0	3.6	0.57	0.58	0.22	40.3	41.3

3.0 All-weld metal tensile & charpy data as-welded

3.1 Welding procedure used for the all-weld metal tensile and charpy tests

Joint preparation:



Bead sequence:

Two bead per layer.

Welding position:

Flat (ASME 1G; BSEN PA) and vertical-up (ASME 3G; BSEN PF).

Preheat:

None.

Interpass:

150°C maximum.

Shielding gas:

Ar-20%CO₂-2%O₂ at 20l/min.

Nominal parameters:

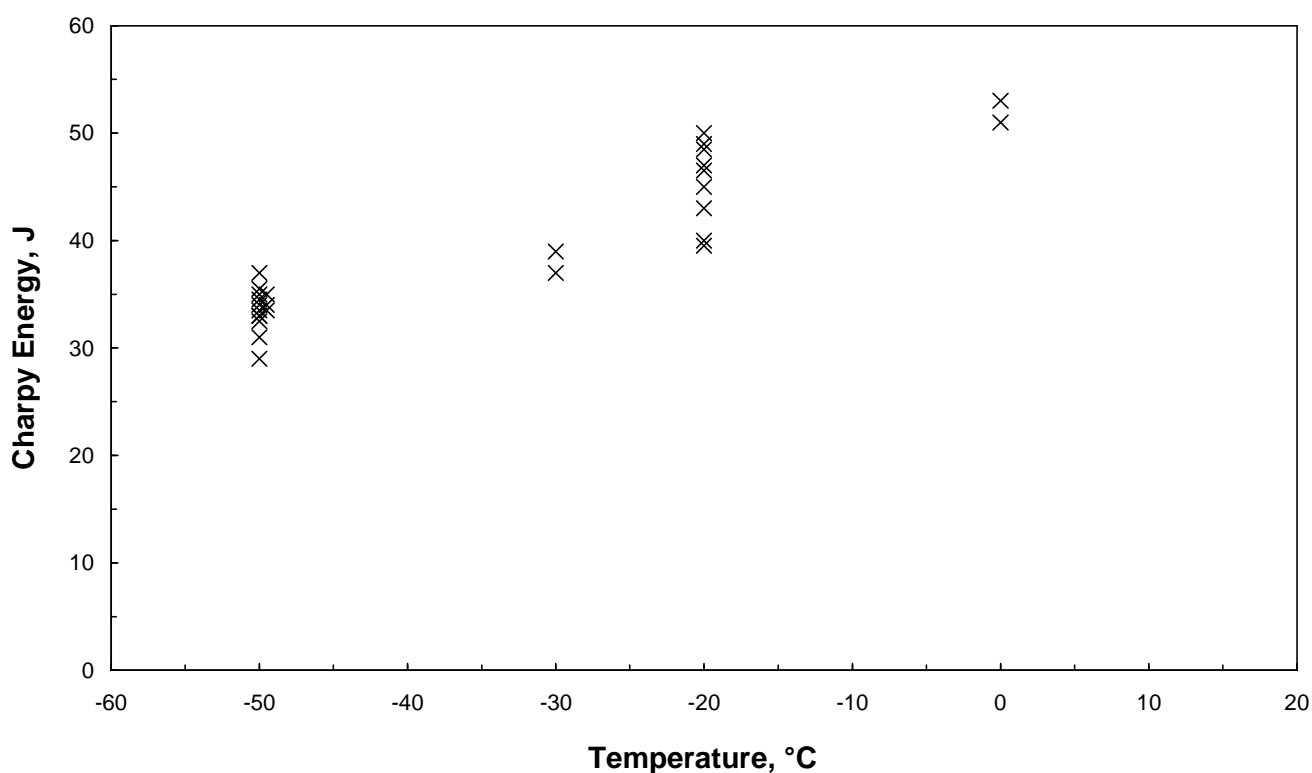
Flat: 180A, 28V, heat input ~1.4kJ/mm.

Vertical-up: 160A, 26V, heat input ~1.6kJ/mm.

3.2 All-weld metal batch testing tensile results

Batch	Welding position	0.2% proof stress MPa	UTS MPa	Elongation, %		Reduction of area %	Maximum hardness	
				4d	5d		HV(10)	HRC
WO17493	3G	670	878	25.5	23.5	31	351	-
WO17832	1G	672	872	30.5	27.5	37	304	27.5
FZE831	1G	694	878	27	25	33	281	-

3.3 All-weld metal charpy results



4.0 G48A corrosion tests as-welded

4.1 Welding procedure used for the G48A corrosion tests

G48A corrosion tests were carried out on a weld joint made in superduplex pipe (UNS S32760) welded using Metrode Zeron 100X TIG wire for the root and Supercore Z100XP flux cored wire for the fill and cap.

Joint preparation:	60° included angle, 2-4mm root gap, 1-2mm root face.
Welding position:	Flat (ASME 1G; BSEN PA) pipe rotated.
Pipe:	UNS S32760 16mm wall thickness, 350mm diameter.
Root:	2.4mm diameter Zeron 100X. Pure argon shield and purge.
Fill & cap:	1.2mm diameter Supercore Z100XP (batch WO17832). Ar-20%CO ₂ -2%O ₂ shielding gas at 20l/min. Nominally 180A, 28V, ~1.4kJ/mm.
Preheat:	None.
Interpass:	150°C maximum.

4.2 G48A corrosion test details

G48A specimen preparation:	Cut faces finished to 1200 grit. Specimen pickled according to NORSOK M601.
Specimen dimensions:	Specimen dimensions were approximately 50x20x16mm.
Testing:	G48A corrosion testing was then carried out at increasing temperatures until pitting was observed.

4.3 G48A corrosion test results

Test temperature °C	Weight loss mg	Weight loss g/m ²	Pitting
30	3	0.61	No
35	14	2.69	No
40	2	0.39	No
42.5	1	0.19	No
45	0	0	No
47.5	0	0	No
50	233	45.69	Yes

5.0 G48A corrosion test solution annealed

The Supercore Z100XP wire has been shown to be capable of passing a G48A corrosion test at +50°C following solution annealing (1120°C + WQ).

Stainless Steels

DATA SHEET

B-61

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25%Cr SUPERDUPLEX - ZERON[®] 100

Alloy type

25%Cr superduplex ferritic-austenitic stainless steels matching the proprietary Zeron[®] 100 alloy.

Materials to be welded

Matching

wrought:	cast:
UNS S32760	UNS J93380, DIN 1.4508
DIN 1.4501	ASTM A890 6A,
ASTM A182 F55	ACI CD3MWCuN

Other superduplex, including

wrought:
UNS S32750, 2507 (Sandvik/Avesta), UR47N (CLI)
UNS S32550, S32520, UR52N+ (CLI), Ferralium SD40 (Meighs)
UNS S39274, DP3W (Sumitomo), UNS S32950, 7-Mo Plus (Carpenter)

cast:
UNS J93404, DIN 1.4469
ASTM A890 5A, ACI CE3MN

Applications

Zeron[®] 100 has an exceptional combination of strength and resistance to corrosion and erosion in a wide range of aggressive media. The presence of Cu+W provides superior resistance to sulphuric and hydrochloric acids when compared to similar alloys without these additions. Offshore applications exploit the high resistance to pitting and stress-corrosion cracking in seawater. It is also highly resistant to caustic alkalis and phosphoric acid. Service temperature range is usually limited to -50°C to 280°C, the upper limit owing to thermal instability ("450°C" and sigma embrittlement).

It is widely used in **oil and gas production** and **process pipework, risers, manifolds, pressure vessels, valves, pumps, desalination plant**, systems for **flue-gas desulphurisation (FGD)** and also in the **mining, chemical and pharmaceutical** industries. Zeron[®] 100 wires are also used for joining supermartensitic stainless steels.

Microstructure

Multipass welds in the as-welded condition consist of a duplex austenite-ferrite microstructure with an approximate 30-60% ferrite level, depending on heat input/cooling conditions.

Welding guidelines

Preheat not generally required. Interpass temperature 150°C max. Heat input in the range 1.0–2.0 kJ/min (depending on material thickness) should be acceptable but most codes restrict the max to 1.5 or 1.75kJ/mm.

PWHT

Although welds in wrought duplex stainless steels are almost always left in the as-welded condition, major repairs to castings are generally specified in the solution treated condition. Experience has indicated good properties following 1120°C/3-6h + water quench.

Additional information

Further information on the welding of Zeron[®] 100 is available in the Metrode Technical Profile on duplex and superduplex.

Related alloy groups

2507 superduplex (data sheet B-62) and matching consumables for casting repair (solution annealed) applications.

Products available

Process	Product	Specification
MMA	Zeron[®] 100XKS	BS EN E25 9 4 NLB
TIG/MIG/SAW	Zeron[®] 100X	BS EN 25 9 4 NL
SAW flux	SSB LA491	BS EN SA AF2 DC BS EN SA FB 255AC
FCW	Supercore Z100XP	--

SUPERCORE Z100XP

Rutile flux cored wire for superduplex stainless steel

Product description	Flux cored wire made with an alloyed stainless steel sheath and rutile flux system. Supercore Z100XP combines easy operability, high deposit quality for both positional pipework and downhand welding. Metal recovery is about 90% with respect to the wire.														
Specifications	There are no national specifications for this wire.														
ASME IX Qualification	QW432 F-No --, QW442 A-No --														
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	W	N	PRE _N	PRE _W	
	min	--	--	--	--	--	24.0	8.5	3.5	0.5	0.5	0.2	40	40	
	max	0.04	1.5	1.0	0.01	0.03	26.0	10.0	4.0	1.0	1.0	0.3	--	--	
	typ	0.03	1.0	0.5	0.005	0.02	24.5	9.1	3.7	0.6	0.6	0.22	41	41	
	Pitting resistance equivalent PRE _N = Cr + 3.3Mo + 16N Pitting resistance equivalent PRE _W = Cr + 3.3Mo + 1.65W + 16N														
All-weld mechanical properties	As welded						min	typical							
	Tensile strength						MPa	750	880						
	0.2% Proof stress						MPa	550	690						
	Elongation on 4d						%	--	27						
	Elongation on 5d						%	20	25						
	Reduction of area						%	--	33						
	Impact energy			-20°C			J	--	40						
				-50°C			J	--	32						
Hardness						HV	--	280							
						HRC	--	26							
Operating parameters	Shielding gas: 80%Ar-20%CO ₂ at 20-25l/min. Proprietary gases may be used but argon should not exceed 85%.														
	Current: DC+ve ranges as below for Ar-20%CO ₂ :														
	∅ mm	amp-volt range					typical				stickout				
1.2	120 – 250A, 20 – 32V					180A, 26V				15 – 20mm					
Packaging data	Spools vacuum-sealed in barrier foil with cardboard carton: 15kg The as-packed shelf life is virtually indefinite. Resistance to moisture absorption is high, but to maintain the high integrity of the wire surface and prevent any possibility of porosity, it is advised that part-used spools are returned to polythene wrappers. Where possible, preferred storage conditions are 60% RH max, 18°C min.														
Fume data	Fume composition (wt %)														
		Fe	Mn	Ni	Cr ³	Cr ⁶	Cu	F	OES (mg/m ³)						
		14	10	1.5	5	5	< 1	5	1.0						

See Data sheet section for full Z Zeron® 100 product data sheet