

Low Alloy Steels

DATA SHEET

A-21

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T23 CONSUMABLES

Alloy type

2¼%Cr steel alloyed with W, Mo, V, Nb, and B for high temperature creep resistance.

Materials to be welded

ASTM

A 213 T23 (seamless tubes)

A 335 P23 (pipe)

BS EN

10216 X7CrWVMoNb9-6 (proposed)

Applications

These consumables are designed to weld equivalent 'type 23' 2¼%Cr steels modified with tungsten, vanadium, niobium, and a small boron addition to give improved long term creep properties. The Chromet 23L electrode is specifically designed for as-welded applications but can also be subject to PWHT; the flux cored wire will typically be used on thicker wall pipe where it is envisaged that PWHT will be applied.

The consumables are intended for high integrity service at elevated temperature so the minor alloy additions responsible for creep strength are kept within the parent material range.

The rupture strength of T23 can be up to twice that of T22 and interest in its use is growing as a candidate for components such as **waterwalls in ultra-super-critical boilers**, in fossil fuelled **power generating plants**.

Microstructure

In the as-welded condition the microstructure consists of bainite.

Welding guidelines

In many situations it is claimed that thin wall tube can be welded without preheat; if preferred, and for thicker wall sections, a preheat of 150-200°C can be applied. Maximum interpass temperature should be kept to 350°C.

For many current applications T23 tube is put into service in the as-welded condition. During production of the tube the typical tempering cycle applied is 760°C/30 minutes; the ASME code case specifies a minimum tempering temperature of 730°C for base material. When it has been applied PWHT in the range 715-740°C has been applied.

Additional information

J C Vaillant, B Vandenberghe, C Zakine, J Gabrel, W Bendick: "The T23/P23 Book" Vallourec & Mannesmann Tubes, 2006.

Products available

Process	Product	Specification
MMA	Chromet 23L	--
TIG	2CrWV	--
SAW	2CrWV (wire)	--
	LA491 (flux)	--

CHROMET 23L

MMA all-positional electrode for joining T23 creep resisting steel

Product description	Basic coated MMA electrode made on pure low carbon core wire. Moisture resistant coatings giving very low weld metal hydrogen levels. Recovery is approx 120% with respect to core wire, 65% with respect to whole electrode.																
Specifications	None applicable.																
ASME IX Qualification	QW422 P-No 5B group 2, QW432 F-No --, QW442 A-No --																
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	W	Nb	V	N	B	Al	Cu	
	min	0.04	0.10	--	--	--	1.9	--	0.05	1.45	0.02	0.20	--	0.0005	--	--	
	max	0.10	1.00	0.50	0.015	0.020	2.6	0.80	0.30	1.75	0.08	0.30	0.03	0.0060	0.03	0.15	
	typ	0.05	0.5	0.25	0.01	0.01	2.2	0.6	0.2	1.6	0.03	0.23	0.02	0.001	<0.01	<0.05	
All-weld mechanical properties							typical as-welded	typical 715°C/1									
	Tensile strength						MPa	940	700								
	0.2% Proof stress						MPa	870	625								
	Elongation on 4d						%	19	22								
	Elongation on 5d						%	16	20								
	Reduction of area						%	50	60								
	Impact energy				+ 20°C		J	22	70								
	Hardness						HV	290-350	220-260								
Operating parameters	DC +ve.			AC (OCV 70V min)													
	∅ mm	2.5		3.2		4.0											
	min A	70		80		100											
	max A	110		140		180											
Packaging data	∅ mm	2.5		3.2		4.0											
	length mm	350		380		450											
	kg/carton	12.0		15.0		16.2											
	pieces/carton	621		396		228											
Storage	<p>3 hermetically sealed ring-pull metal tins per carton, with unlimited shelf life. Direct use from tin will give hydrogen <5ml/100g weld metal during 8h working shift.</p> <p>For electrodes that have been exposed: Redry 250 – 300°C/1-2h to ensure H₂ < 10ml/100g, 300 – 350°C/1-2h to ensure H₂ < 5ml/100g. Maximum 420°C, 3 cycles, 10h total. Storage of redried electrodes at 100 – 200°C in holding oven, or 50 – 150°C in heated quivers: no limit, but maximum 6 weeks recommended.</p>																
Fume data	Fume composition (wt %)																
		Fe	Mn	Ni	Cr	Cu	Pb	F	OES (mg/m ³)								
	15	5	<0.1	<3	<0.1	<0.1	18	1.7									

2CrWV

Solid T23 wire for TIG welding

Product description	Solid wire, copper coated, for TIG welding.															
Specifications	None applicable.															
ASME IX Qualification	QW422 P-No 5B group 2, QW432 F-No --, QW442 A-No --															
Composition (wire wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	W	Nb	V	B	Al	Cu	
	min	0.04	--	--	--	--	1.9	--	0.05	1.45	0.02	0.20	0.0005	--	--	
	max	0.10	1.0	0.5	0.015	0.020	2.6	0.8	0.30	1.75	0.08	0.30	0.0060	0.03	0.25	
	Typ	0.06	0.6	0.3	0.01	0.01	2.4	0.5	0.2	1.6	0.05	0.25	0.003	<0.01	0.15	

2CrWV (continued)

All-weld mechanical properties		typical as-welded	typical 715°C/30min	typical 740°C/2h				
	Tensile strength	MPa	950	755	640			
	0.2% Proof stress	MPa	875	700	555			
	Elongation on 4d	%	21	23	28			
	Elongation on 5d	%	19	20	24			
	Reduction of area	%	55	70	80			
	Impact energy + 20°C	J	50	190	>250			
Hardness	HV (mid)	325	255	220				
Parameters		TIG						
	Shielding	Argon						
	Diameter, mm	2.4						
	Current	DC-						
	Typical parameters	100A, 12V						
Packaging data	ø mm	TIG						
	2.4	5kg tube						
Fume data	Fume composition (wt %); TIG and SAW fume is negligible:							
		Fe	Mn	Ni	Cr	Mo	Cu	OES (mg/m ³)
		55	5	1.3	<0.5	<0.5	1.2	5

LA491 FLUX

Sub-arc flux

Product description	Agglomerated fluoride-basic non-alloying flux for submerged arc welding.													
Specifications	DIN 32522		B FB 6 55455 AC 8											
	BS EN 760		SA FB 255 AC											
ASME IX Qualification	QW432 F-No -, QW442 A-No -													
Composition (typical wt%)		C	Mn	Si	S	P	Cr	Ni	Mo	W	Nb	V	Cu	B
	2CrWV wire	0.06	0.6	0.30	<0.01	0.01	2.4	0.5	0.2	1.6	0.05	0.25	0.1	0.003
	Deposit	0.05	0.6	0.35	<0.01	0.01	2.3	0.5	0.2	1.5	0.04	0.22	0.1	0.002
All-weld mechanical properties with 2CrWV wire		740°C/2h												
	Tensile strength	MPa	645											
	0.2% Proof stress	MPa	570											
	Elongation on 4d	%	22											
	Elongation on 5d	%	18											
	Reduction of area	%	55											
	Impact energy +20°C	J	175											
Hardness	HV (mid)	245												
Operating parameters	Current: DC +ve ranges as below:													
	ø mm	amp-volt range					typical				stickout			
	2.4	250-450A, 28-32V					350A, 29V				20-25mm			
Packaging data	Metrode LA491 Flux is supplied in sealed moisture resistant 20kg metal drums. Preferred storage conditions for opened drums: < 60%RH, > 18°C. If the flux has become damp or has been stored for a long period, it should be redried in the range 3000-350°C/1-3h.													