

Low Alloy Steels

DATA SHEET

A-50

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MnMo HIGH STRENGTH STEELS

Alloy type

Low alloy steel consumables with MnMo additions for welding high strength steels.

Materials to be welded

These consumables are used for a variety of ferritic CMn and low alloy steels.

E9018-D1 is used for materials with a minimum tensile strength requirement of 620MPa (90ksi); eg. AISI 4130 (90ksi condition), ASTM A487 grades 2A, B & C (cast).

E10018-D2 is used for materials with a minimum tensile strength requirement of 690MPa (100ksi); eg. AISI 4130, 4140, 8630; BS970 grades 709M40 (En19); DIN 42CrMo4 (1.7225), 34CrMo4 (1.7220); ASTM A487 grades 4A, 4B, 4D & 6A (cast).

Applications

Fabrication of higher strength steels for use in the stress relieved condition.

For **offshore oil well-head process pipework and fittings**, these low nickel consumables satisfy NACE MR0175 requirements intended to ensure resistance to sulphide-induced stress corrosion cracking in sour service, combined with good sub-zero toughness.

Also finds applications for the repair of medium strength low alloy steel castings where a stress-relief only (rather than N+T) is to be applied.

Microstructure

In the stress relieved condition the microstructure consists of tempered bainite.

Welding guidelines

The actual preheat and PWHT requirements will depend on the base material being welded. Normally preheat/interpass temperatures will be in the range 100-250°C.

PWHT

The PWHT requirements will depend on a number of factors including, base material, property requirements, need to conform to NACE etc. Temperatures will normally be about 620°C but when welding 4130 using E10018-D2 temperatures up to about 645°C may be required to temper the HAZ.

Additional information

Although MnMo wire is the nearest match to the E9018-D1/E10018-D2 electrodes in terms of composition when welding base materials requiring high temperature or prolonged soak PWHT (eg. 4130) it may not retain the required strength. In these circumstances the 1CrMo or 2CrMo wires may prove useful (data sheets A-12 and A-13). See also alloy WB36 (data sheet A-23).

Products available


Process	Product	Specification
MMA	E9018-D1	AWS E9018-D1
	E10018-D2	AWS E10018-D2
TIG/MIG	MnMo	AWS ER80S-D2

General Data for all MMA Electrodes

Storage	<p>3 hermetically sealed ring-pull metal tins per carton, with unlimited shelf life. Direct use from tin will give hydrogen < 5ml/100g for longer than a working shift of 8h.</p> <p>For electrodes that have been exposed:</p> <p>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.</p> <p>Storage of redried electrodes at 50 – 200°C in holding oven or heated quiver: no limit, but maximum 6 weeks recommended. Recommended ambient storage conditions for opened tins (using plastic lid): < 60% RH, > 18°C.</p>														
Fume data	<p>Fume composition, wt % typical:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Fe</th> <th style="text-align: center;">Mn</th> <th style="text-align: center;">Ni</th> <th style="text-align: center;">Cr</th> <th style="text-align: center;">Cu</th> <th style="text-align: center;">F</th> <th style="border-left: 1px solid black; text-align: center;">OES (mg/m³)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">16</td> <td style="text-align: center;">7</td> <td style="text-align: center;"><0.1</td> <td style="text-align: center;"><0.1</td> <td style="text-align: center;"><0.2</td> <td style="text-align: center;">17</td> <td style="border-left: 1px solid black; text-align: center;">5</td> </tr> </tbody> </table>	Fe	Mn	Ni	Cr	Cu	F	OES (mg/m ³)	16	7	<0.1	<0.1	<0.2	17	5
Fe	Mn	Ni	Cr	Cu	F	OES (mg/m ³)									
16	7	<0.1	<0.1	<0.2	17	5									


E9018-D1

All-positional MnMo low alloy steel MMA electrode

Product description	<p>MMA electrode with a basic flux coating on high purity mild steel core wire. Moisture resistant coating provides very low weld metal hydrogen levels.</p> <p>Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.</p>										
Specifications	AWS A5.5		E9018-D1								
	BS 2493		MnMoBH								
	DIN 8529		(ESY 5564 MnMoB)								
ASME IX Qualification	QW432 F-No 4, QW442 A-No 11										
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	
	min	--	1.25	--	--	--	--	--	0.25	--	
	max	0.10	1.75	0.80	0.025	0.025	--	--	0.45	--	
	typ	0.07	1.5	0.4	0.01	0.015	0.15	0.15	0.35	0.05	
All-weld mechanical properties	PWHT 620°C/1h:					min	typical				
	Tensile strength					MPa	630	670			
	0.2% Proof stress					MPa	550	605			
	Elongation on 4d					%	17	25			
	Elongation on 5d					%	15	20			
	Reduction of area					%	--	50			
	Impact energy			- 30°C		J	47	90			
				- 50°C		J	30	55			
Hardness					HV	--	210				
Operating parameters	DC +ve or AC (OCV: 70V min)										
	Ø mm	2.5			3.2			4.0		5.0	
	min A	70			80			100		140	
	max A	110			140			180		240	
											
Packaging data	Ø mm	2.5			3.2			4.0		5.0	
	length mm	350			380			450		450	
	kg/carton	12.0			13.8			15.9		16.8	
	pieces/carton	621			387			228		153	

E10018-D2

MnMo low alloy steel MMA electrode

Product description	MMA electrode with a basic flux coating on high purity mild steel core wire. Moisture resistant coating provides very low weld metal hydrogen levels. Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.									
Specifications	AWS A5.5	E10018-D2								
	BS 2493	(2MnMoBH)								
	BS EN 757	(E 624 MnMoB)								
	DIN 8529	(ESY 6264 MnMoB)								
ASME IX Qualification	QW432 F-No 4, QW442 A-No 11									
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu
	min	0.07	1.65	0.20	--	--	--	--	0.25	--
	max	0.15	2.00	0.60	0.025	0.025	--	0.9	0.45	--
	typ	0.10	1.8	0.4	0.01	0.015	0.15	0.6	0.35	0.05
All-weld mechanical properties	typical after PWHT:				min	620°C/1h *		645°C/4h **		
	Tensile strength				MPa	690	760	700		
	0.2% Proof stress				MPa	620	690	620		
	Elongation on 4d				%	16	25	26		
	Elongation on 5d				%	18	21	22		
	Reduction of area				%	--	65	67		
	Impact energy	0°C			J	--	--	>100		
		- 40°C			J	27	>27	>60		
	Hardness				HV	--	250	230		
					HRC	--	--	<22		
	* PWHT according to AWS.									
	** PWHT typically applied to weldments in alloy 4130 to meet <22HRC in HAZ for oilfield sour service (NACE MR0175).									
Operating parameters	DC +ve or AC (OCV: 70V min)									
	∅ mm	2.5	3.2	4.0	5.0	6.0				
	min A	70	80	100	140	200				
	max A	110	140	180	240	300				
Packaging data	∅ mm	2.5	3.2	4.0	5.0	6.0				
	length mm	350	380	450	450	450				
	kg/carton	12.0	12.6	16.8	17.1	16.5				
	pieces/carton	633	351	243	159	105				

MnMo

Solid MnMo alloyed wire for TIG and MIG

Product description	Solid copper coated wire for TIG and MIG.										
Specifications	AWS A5.28		ER80S-D2, ER90S-D2								
	BS EN ISO 16834-B		4M31								
	BS EN 440		(G4Mo)								
	BS 2901: Pt1		A31								
ASME IX Qualification	QW432 F-No 6, QW442 A-No 11										
Composition (wire wt %)		C	Mn	Si	S	P	Ni	Mo	Cu		
	min	0.07	1.60	0.50	--	--	--	0.40	--		
	max	0.12	2.10	0.80	0.025	0.025	0.15	0.60	0.4		
	typ	0.1	1.9	0.6	0.005	0.01	0.05	0.5	0.1		
All-weld mechanical properties	Typical values as-welded (AW) & PWHT				TIG			MAG Ar + 5%CO ₂		MAG Ar + 20%CO ₂	
				min *	AW	620°C/1	645°C/4	AW	620°C/1	AW	620°C/1
	Tensile strength		MPa	550	720	640	610	725	>635	625	605
	0.2% Proof stress		MPa	470	610	530	530	625	>525	510	490
	Elongation on 4d		%	17	27	32	31	29	>25	28	25
	Impact energy	-30°C	J	27	>80	>200	--	>100	--	>55	>100
		-45°C	J	--	>50	>100	>130	>70	>110	--	--
	Hardness		HV	--	250	220	220	235	220	215	205
	* Minimum as-welded values are for AWS ER80S-D2 . As shown MAG welds using more oxidising shielding gas (higher CO ₂ + O ₂) have lower strength. The AWS classification for ER80S-D2 is based on 100%CO ₂ which is seldom used; alternatively this wire can also be classified as ER90S-D2 using low CO ₂ gas mixtures. Maximum strength is found with Ar + 5%CO ₂ , an economic procedure to obtain as-welded properties equivalent to AWS ER100S-G (and the closest approximation to electrode E10018-D2).										
Typical operating parameters		TIG			MIG						
	Shielding	Argon			Ar + 5-20%CO ₂ *						
	Current	DC-			DC+						
	Diameter	2.4mm			1.2mm						
	Parameters	120A, 14V			280A, 26V						
	* Ar + 5%CO ₂ provides the highest strength and best impact properties, see above. Other proprietary gas mixtures also suitable.										
Packaging data	ø mm	TIG			MIG						
	1.2	--			15kg spool						
	1.6	5kg tube			--						
	2.0	5kg tube			--						
	2.4	5kg tube			--						
	3.2	5kg tube			--						
Fume data	MIG fume composition (wt %) (TIG fume negligible)										
		Fe	Mn	Cr ³	Ni	Mo	Cu	OES (mg/m ³)			
		55	10	<0.1	<0.1	<0.5	1.2	5			