

Stainless Steels

DATA SHEET

B-51

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309Mo STAINLESS STEELS

Alloy type

23%Cr-13%Ni-2.5%Mo (309Mo) austenitic stainless steel.

Materials to be welded

Mainly used under high dilution conditions, particularly dissimilar welds between stainless and CMn steels. There are no comparable base materials.

Applications

There are 3 main areas of application:

Buffer layers and clad steels: Overlays on CMn, mild steel or low alloy steels and for joining 316L clad plate. Subsequent layers are deposited with an electrode chosen to match the cladding, eg 316L, 318. Also as a buffer layer prior to hardsurfacing with chromium carbide types.

Dissimilar joints: Tolerance to dilution is exploited in joining stainless types 410, 304L, 321 and 316L to mild and low alloy steels such as stiffeners, brackets and other attachments. Service temperatures above 300°C are normally avoided. For some of these applications a more economic alternative may be suitable, eg 309L, 307.

Hardenable steels: The high level of alloying and ferrite level tolerates dilution from a wide range of alloyed and hardenable steels to give crack-free welds.

Microstructure

Austenite with ferrite normally in the range 10-30FN.

Welding guidelines

Preheat and interpass temperatures depend on base material hardenability. For guidance, no preheat on mild steels, up to 250°C on hardenable steels.

Additional information

There is a Technical Profile available on sub-arc welding with 309Mo. There is also additional information available covering the Supercore flux cored wires.

Related Alloy Groups

The 309L consumables (B-50), 307 consumables (E-21) and 29.9 consumables (E-22) cover a similar range of applications.

Products Available


Process	Product	Specification
MMA	Supermet 309Mo	AWS E309MoL-17
	Ultramet B309Mo	AWS E309MoL-15
	Vertamet 309Mo	AWS E309MoL-17
TIG/MIG/ SAW	ER309Mo	AWS ER309Mo
SAW flux	SSB	BS EN SAFB2
	SSCr	BS EN SA FB2
	LA491	BS EN SAFB255AC
FCW	Supercore 309Mo	AWS E309LMoT0-4

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 is satisfactory for longer than a working shift of 8h. Excessive exposure of electrodes to humid conditions will cause some moisture pick-up and increase the risk of porosity.</p> <p>For electrodes that have been exposed:</p> <p>Redry 200 – 300°C/1-2h to restore to as-packed condition. Maximum 400° 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 border="1"> <thead> <tr> <th>Fe</th> <th>Mn</th> <th>Ni</th> <th>Cr</th> <th>Cu</th> <th>F *</th> <th>OES (mg/m³)</th> </tr> </thead> <tbody> <tr> <td>9</td> <td>6</td> <td>1</td> <td>7</td> <td>< 0.5</td> <td>17</td> <td>0.7</td> </tr> </tbody> </table> <p>* F=28% for basic coated Ultramet B309Mo but this does not affect the OES.</p>	Fe	Mn	Ni	Cr	Cu	F *	OES (mg/m ³)	9	6	1	7	< 0.5	17	0.7
Fe	Mn	Ni	Cr	Cu	F *	OES (mg/m ³)									
9	6	1	7	< 0.5	17	0.7									

SUPERMET 309Mo

General purpose rutile 309Mo MMA electrode

Product description	Acid rutile electrode made on nearly matching austenitic steel core wire. Moisture resistant coating gives sound porosity-free deposits. Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.										
Specifications	AWS A5.4	E309MoL-17									
	BS EN 1600	E 23 12 2 L R 32									
	BS 2926	23.12.2.AR									
	DIN 8556	E 23 12 2 R 23									
ASME IX Qualification	QW432 F-No 5, QW442 A-No 8										
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	0.5	--	--	--	22.0	12.0	2.0	--	10
	max	0.04	2.5	0.9	0.025	0.030	25.0	14.0	3.0	0.5	30
	typ	0.02	0.8	0.6	0.01	0.02	23.5	12.5	2.5	0.05	25
All-weld mechanical properties	As welded					min		typical			
	Tensile strength					MPa		560 680			
	0.2% Proof stress					MPa		350 510			
	Elongation on 4d					%		30 37			
	Elongation on 5d					%		30 35			
	Reduction of area					%		-- 40			
	Impact energy					+ 20°C J		-- 50			
	Hardness					HV		-- 220			
Operating parameters	DC +ve or AC (OCV: 50V min) 										
	∅ mm	2.5		3.2		4.0		5.0			
	min A	60		75		100		130			
	max A	90		120		155		210			
Packaging data	∅ mm	2.5		3.2		4.0		5.0			
	length mm	300		350		450		450			
	kg/carton	12.0		13.2		18.9		18.0			
	pieces/carton	609		336		261		162			

ULTRAMET B309Mo

309Mo basic coated MMA pipe-welding electrode

Product description	Basic coated electrode on high purity 304L core wire manufactured to order. Designed to give moisture resistance and hence freedom from weld porosity. Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.										
Specifications	AWS A5.4	E309MoL-15									
	BS EN 1600	E 23 12 2 L B 42									
	BS 2926	23.12.2.B									
	DIN 8556	E 23 12 2 B 20+									
ASME IX Qualification	QW432 F-No 5, QW442 A-No 8										
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	0.5	--	--	--	22.0	12.0	2.0	--	12
	max	0.04	2.5	0.90	0.025	0.030	25.0	14.0	3.0	0.50	36
	typ	0.03	0.8	0.6	0.01	0.02	23.5	13	2.6	0.1	20
All-weld mechanical properties	As welded					min		typical			
	Tensile strength					MPa		560 680			
	0.2% Proof stress					MPa		350 510			
	Elongation on 4d					%		30 37			
	Elongation on 5d					%		30 35			
	Reduction of area					%		-- 40			

ULTRAMET B309Mo (continued)

Operating parameters	DC +ve			
	∅ mm	3.2	4.0	
	min A	75	100	
	max A	120	155	
Packaging data	∅ mm	3.2	4.0	Note: Product available to order only.
	length mm	350	350	
	kg/carton	15.0	14.1	
	pieces/carton	420	396	

VERTAMET 309Mo

Rutile vertical-down electrode for dissimilar welds

Product description	<p>Rutile-aluminosilicate flux on high purity 309L core wire giving very low typical carbon levels. ‘Low hydrogen’ manufacturing technology ensures high resistance to weld metal porosity. The electrode is designed for all-positional use where the emphasis is on fast welding speeds achieved by the vertical-down welding technique (BS EN 287-1 PG position). For fillet and lap joints in thinner sheet material, an added advantage is reduced distortion resulting from the lower heat input of vertical-down welding. Although designed primarily for vertical-down it can be successfully used in all other positions.</p> <p>Recovery is about 110% with respect to core wire, 65% with respect to whole electrode.</p>										
Specifications	AWS A5.4		E309MoL-17								
	BS EN 1600		E 23 12 2 L R 11								
	BS 2926		23.12.2.AR								
	DIN 8556		E 23 12 2 R 13								
ASME IX Qualification	QW432 F-No 5, QW442 A-No 8										
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	0.5	--	--	--	22.0	12.0	2.0	--	10
	max	0.04	2.5	0.90	0.025	0.030	25.0	14.0	3.0	0.5	30
	typ	0.02	0.8	0.8	0.01	0.02	23	12	2.4	0.1	15
All-weld mechanical properties	As welded					min		typical			
	Tensile strength					MPa		560		580	
	0.2% Proof stress					MPa		350		380	
	Elongation on 4d					%		30		42	
	Elongation on 5d					%		30		38	
	Reduction of area					%		--		50	
Operating parameters	DC +ve or AC (OCV: 45V min)										
		∅ mm	2.5		3.2						
		min A	60		75						
		max A	90		120						
		Typical vertical-up	~65		~80						
		Typical vertical-down	~85		~110						
Packaging data	∅ mm	2.5		3.2							
	length mm	300		300							
	kg/carton	12.9		12.9							
	pieces/carton	837		450							

ER309Mo

Solid 309Mo wire for TIG, MIG and SAW

Product description	Solid wire for TIG, MIG and SAW.										
Specifications	AWS A5.9		(ER309LMo)								
	BS EN 12072		23 12 2 L								
	BS 2901: Pt2		(309S95)								
	DIN 8556		SG X8 XrNiMo 23 13 (1.4459)								
ASME IX Qualification	QW432 F-No 6, QW442 A-No 8										
Composition (wire wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	1.0	0.30	--	--	21.0	12.0	2.0	--	5
	max	0.03	2.5	0.65	0.02	0.030	25.0	15.0	3.0	0.3	20
	typ	0.015	1.7	0.5	0.005	0.015	22	14.5	2.7	0.2	10
All-weld mechanical properties	Typical values as welded					TIG					
	Tensile strength					MPa	610				
	0.2% Proof stress					MPa	440				
	Elongation on 4d					%	35				
	Elongation on 5d					%	31				
	Reduction of area					%	54				
	Impact energy					+ 20°C	J	> 90			
	Hardness cap/mid						HV	205/220			
Typical operating parameters		TIG			MIG			SAW			
	Shielding	Argon			Ar+2%O ₂ *			SSB **			
	Current	DC-			DC+			DC+			
	Diameter	2.4mm			1.2mm			2.4mm			
	Parameters	100A, 12V			260A, 26V			350A, 28V			
	* Proprietary Ar and Ar-He gas mixtures with <3%CO ₂ also suitable.										
	** SSCr (Cr compensating flux) and LA491 also suitable.										
Packaging data	ø mm	TIG			MIG			SAW			
	1.2	--			15kg spool			--			
	1.6	2.5kg tube			--			--			
	2.0	2.5kg tube			--			--			
	2.4	2.5kg tube			--			25kg coil			
	3.2	2.5kg tube			--			25kg coil			
Fume data	MIG fume composition (wt %) (TIG and SAW fume negligible)										
		Fe	Mn	Cr ³	Ni	Mo	Cu	OES (mg/m ³)			
		32	12	20	11	1.5	<0.5	2.5			

SUPERCORE 309Mo

Downhand rutile flux cored wire for dissimilar welding

Product description	Flux cored wire made using an austenitic stainless steel sheath and rutile flux system. The wire combines easy operability, high deposit quality and exceptional weld bead appearance for downhand and HV welding. Metal recovery is about 90% with respect to wire.										
Specifications	AWS A5.22		E309LMoT0-4								
	BS EN 12073		T 23 12 2 L R M 3								
ASME IX Qualification	QW432 F-No 6, QW442 A-No 8										
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	0.5	--	--	--	22.0	12.0	2.0	--	15
	max	0.04	2.0	1.0	0.025	0.030	25.0	14.0	3.0	0.5	25
	typ	0.03	1.3	0.7	0.01	0.02	23	12.8	2.3	0.1	20
All-weld mechanical properties	As welded					min		typical			
	Tensile strength					MPa	560	700			
	0.2% Proof stress					MPa	350	550			
	Elongation on 4d					%	25	32			
	Elongation on 5d					%	25	30			
	Reduction of area					%	--	40			
	Impact energy					+20°C	J	--	50		
Hardness						HV	--	245			
Operating parameters	Shielding gas: 80%Ar-20%CO ₂ at 20-25l/min. Proprietary gases may be used but argon should not exceed 85%. The wire is suitable for use on 100%CO ₂ .										
	Current: DC+ve parameters as below (for 100%CO ₂ increase voltage by ~3V):										
	∅ mm	amp-volt range					typical		stickout		
1.2	120A-22V to 280A-34V					180A-26V		15-20mm			
Packaging data	Spools vacuum-sealed in barrier foil with cardboard carton: 12.5kg 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)		
		16	11	3	4	6	<1	6	0.8		