

Stainless Steels

DATA SHEET

B-50

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309L STAINLESS STEELS

Alloy type

24%Cr-13%Ni (309L) austenitic stainless for dissimilar joint buffer layers etc.

Materials to be welded

Mainly used under high dilution conditions, particularly dissimilar welds between stainless and CMn steels.

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 304L/321 clad plate. Subsequent layers are deposited with an electrode chosen to match the cladding, eg 308L, 347.

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 400°C are normally avoided. It is also used for welding 12%Cr 'utility ferritics' such as Cromweld 3CR12, to itself and other steels.

Similar metal joints: Wrought and cast steels of 23Cr-12Ni type (eg ASTM 309 and CH8, BS 309S24 and 309C30) can be welded if the service requirement is corrosion resistance below 400°C. However, for high temperature structural service, weld metal with controlled higher carbon and lower ferrite should be used (**Thermet 309CF** – data sheet C-21).

Microstructure

Austenite with ferrite in the range 8-20FN. The solid wires tend to have lower ferrite than the MMA and FCW consumables, the ferrite falling in the range 8-15FN for the solid wires.

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 on sub-arc welding with 309S92 and also additional information covering the Supercore flux cored wires.

Related alloy groups

The 309Mo consumables (B-51), 307 (E-21) and 29.9 types (E-22) cover similar applications. For high temperature applications refer to the controlled ferrite 309 types (C-21) and high carbon 309H (C-22) for matching high carbon cast alloys.

Products available

Process	Product	Specification
MMA	Supermet 309L	AWS E309L-17
	Ultramet 309L	AWS E309L-16
	Ultramet B309L	AWS E309L-15
	Ultramet 309LP	AWS E309L-16
TIG	309S92	AWS ER309L
MIG	Supermig 309LSi	AWS ER309LSi
SAW	309S92	AWS ER309L
	SS300	BS EN SA AF2
	SSB	BS EN SA AF2
	LA491	BS EN SAFB255
FCW	Supercore 309L	AWS E309LT0-1/4
	Supercore 309LP	AWS E309LT1-1/4

General Data for all 309L 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: Redry 200 – 300°C/1-2h to restore to as-packed condition. Maximum 400° C, 3 cycles, 10h total. 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="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="border: none; padding: 0 10px;">Fe</td> <td style="border: none; padding: 0 10px;">Mn</td> <td style="border: none; padding: 0 10px;">Cr</td> <td style="border: none; padding: 0 10px;">Ni</td> <td style="border: none; padding: 0 10px;">Mo</td> <td style="border: none; padding: 0 10px;">Cu</td> <td style="border: none; padding: 0 10px;">F*</td> <td style="border: none; padding: 0 10px;">OES (mg/m³)</td> </tr> <tr> <td style="border: none; text-align: center;">9</td> <td style="border: none; text-align: center;">6</td> <td style="border: none; text-align: center;">7</td> <td style="border: none; text-align: center;">1</td> <td style="border: none; text-align: center;">0.1</td> <td style="border: none; text-align: center;"><0.2</td> <td style="border: none; text-align: center;">17</td> <td style="border: none; text-align: center;">0.7</td> </tr> </table> <p>* F=28% for basic coated Ultramet B309L but this does not affect the OES.</p>	Fe	Mn	Cr	Ni	Mo	Cu	F*	OES (mg/m ³)	9	6	7	1	0.1	<0.2	17	0.7
Fe	Mn	Cr	Ni	Mo	Cu	F*	OES (mg/m ³)										
9	6	7	1	0.1	<0.2	17	0.7										

SUPERMET 309L


General purpose rutile 309L MMA electrode

Product description	<p>MMA electrode – rutile aluminosilicate flux on high purity 304L core wire giving very low typical carbon level. 'Low hydrogen' manufacturing technology ensures high resistance to weld metal porosity. 'Supermet Technology' gives acid rutile operability combined with controlled silicon content for maximum cracking/corrosion resistance. Designed for ease of use, exceptional weld bead appearance and high weld metal integrity, primarily in the downhand and HV positions; smaller sizes offer all-positional operability.</p> <p>Recovery is about 115% with respect to core wire, 65% with respect to whole electrode.</p>												
Specifications	AWS A5.4		E309L-17										
	BS EN 1600		E 23 12 LR 32										
	BS 2926		23.12. L.AR										
	DIN 8556		E 23 12 LR 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	--	--	8		
	max	0.04	2.5	0.90	0.025	0.030	25.0	14.0	0.5	0.5	20		
	typ	0.02	0.8	0.6	0.01	0.02	24	13	0.05	0.1	15		
All-weld mechanical properties	As-welded						min	typical					
	Tensile strength						MPa	560	620				
	0.2% Proof stress						MPa	320	500				
	Elongation on 4d						%	30	40				
	Elongation on 5d						%	30	36				
	Reduction of area						%	--	50				
	Impact energy						+ 20°C	J	--	55			
	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	11.4			13.5			18.3			18.0		
	pieces/carton	579			354			258			156		



ULTRAMET 309L

All-positional rutile MMA electrode for 309L

Product description	<p>MMA electrode – rutile flux coated 309L electrode on high purity 304L core wire. Ultramet has all the benefits of an advanced rutile flux design – this includes optimum versatility for downhand welding with high cosmetic finish and weld metal integrity; and all-positional welding with the 2.5/3.2mm electrodes including fixed pipework. The 2.5mm electrodes are also designed for open butt root welding.</p> <p>Recovery is about 110% with respect to core wire, 65% with respect to whole electrode.</p>											
Specifications	AWS A5.4		E309L-16									
	BS EN 1600		E 23 12 L R 32									
	BS 2926		23.12.LR									
	DIN 8556		E 23 12 L R 23									
	Approvals		Germanischer Lloyd									
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	--	--	8	
	max	0.04	2.5	0.90	0.025	0.030	25.0	14.0	0.50	0.5	20	
	typ	0.03	0.8	0.6	0.01	0.02	23.5	13	0.1	0.1	15	
All-weld mechanical properties	As welded					min	typical					
	Tensile strength					MPa	560	595				
	0.2% Proof stress					MPa	320	495				
	Elongation on 4d					%	30	41				
	Elongation on 5d					%	30	38				
	Reduction of area					%	--	59				
	Impact energy					- 20°C	J	--	45			
Hardness					HV	--	230					
Operating parameters	DC +ve or AC (OCV: 50V min)											
												
	ø mm	2.5		3.2		4.0		5.0				
	min A	60		75		100		130				
	max A	90		120		155		210				
Packaging data	ø mm	2.5		3.2		4.0		5.0				
	length mm	300		350		350		450				
	kg/carton	12.6		13.5		13.5		18.0				
	pieces/carton	687		393		252		165				

ULTRAMET B309L

Basic coated 309L MMA electrode for pipe-welding

Product description	<p>MMA electrode – designed and manufactured to give high moisture resistance using a basic flux system and high purity 304L core wire. Ultramet B309L is particularly suited to the most demanding vertical and overhead welding applications including fixed pipework in the ASME 5G/6G position. Under site conditions it is tolerant to adverse wind and drafts.</p> <p>Recovery is about 110% with respect to core wire, 65% with respect to whole electrode.</p>										
Specifications	AWS A5.4		E309L-15								
	BS EN 1600		E 23 12 L B 42								
	BS 2926		23.12.LB								
	DIN 8556		E 23 12 L 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	--	--	8
	max	0.04	2.5	0.90	0.025	0.030	25.0	14.0	0.50	0.5	20
	typ	0.03	1.2	0.3	0.01	0.02	23.5	13	0.1	0.1	15

ULTRAMET B309L (continued)

All-weld mechanical properties	As welded		min	typical	
	Tensile strength	MPa	560	630	
	0.2% Proof stress	MPa	320	490	
	Elongation on 4d	%	30	36	
	Elongation on 5d	%	30	34	
	Reduction of area	%	--	45	
Impact energy	+20°C	J	--	75	
	-50°C	J	--	50	
Operating parameters	DC +ve only.				
	∅ 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	350/450	450
	kg/carton	12.0	13.8	14.1/17.4	17.1
	pieces/carton	678	402	267/267	159
	* 350mm is the standard length for 4.0mm diameter; 450mm is available to order. ** 5.0mm diameter made to order.				

ULTRAMET 309LP

All-positional pipe welding and root welding electrode

Product description	<p>MMA electrode – rutile flux on high purity 309L core wire giving very low typical carbon level. Ultramet 309LP is a fully all-positional electrode capable of the most demanding fixed pipework applications including ASME 5G/6G. The Ultramet 309LP electrode has also been designed to deposit single-side root runs without the need for a gas purge. The electrode is also suitable for vertical-down welding on thin sheet material.</p> <p>Recovery is about 105% with respect to core wire, 65% with respect to whole electrode.</p>										
Specifications	AWS A5.4		E309L-16								
	BS EN 1600		E 23 12 L R 1 1								
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	--	--	8
	max	0.04	2.5	0.90	0.025	0.030	25.0	14.0	0.50	0.5	20
	typ	0.03	0.8	0.6	0.01	0.02	23.5	13	0.1	0.1	15
All-weld mechanical properties	As welded		min	typical							
	Tensile strength	MPa	560	635							
	0.2% Proof stress	MPa	320	525							
	Elongation on 4d	%	30	41							
	Elongation on 5d	%	30	38							
	Reduction of area	%	--	45							
	Hardness	HV	--	230							
Operating parameters	DC +ve or AC (OCV: 50V min)										
	∅ mm	2.0	2.5	3.2							
	min A	50	60	75							
	max A	80	90	120							
Packaging data	∅ mm	2.0	2.5	3.2							
	length mm	300	300	350							
	kg/carton	11.7	12.3	12.0							
	pieces/carton	1090	747	453							

309S92, SUPERMIG 309LSi

309L solid wire

Product description	Solid wires for TIG, MIG and sub-arc welding.											
Specifications		309S92 (TIG & sub-arc)					Supermig 309LSi (MIG)					
	AWS A5.9 BS EN ISO 14343-A BS EN ISO 14343-B BS 2901: Pt2 DIN 8556	ER309L 23 12 L SS309L 309S92 SG X2CrNi 24 12 (1.4332)					ER309L Si G 23 12 L Si SS309L Si 309S93 SG X2CrNi 24 12 (1.4332)					
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	--	--	23.0	12.0	--	--	8	
	max	0.03	2.5	0.65	0.020	0.030	25.0	14.0	0.3	0.3	20	
	typ	0.015	1.7	0.5	0.005	0.015	23.5	13	0.1	0.15	12	
	* Supermig 309LSi : Si range is 0.65 – 1.0%, typically 0.8%.											
All-weld mechanical properties	As welded						typical					
							TIG	MIG				
	Tensile strength	MPa					590	560				
	0.2% Proof stress	MPa					450	430				
	Elongation on 4d	%					43	42				
	Elongation on 5d	%					41	39				
	Reduction of area	%					55	56				
	Impact energy		+ 20°C	J			>200	100				
		- 20°C	J			--	80					
		- 75°C	J			>150	--					
Hardness cap/mid			HV			205/225	175/215					
Typical operating parameters		TIG			MIG			SAW				
	Shielding	Argon *			Ar+2%O ₂ **			SS300***				
	Current	DC-			DC+			DC+				
	Diameter	2.4mm			1.2mm			2.4mm				
	Voltage	100A, 12V			260A, 26V			350A, 28V				
	* Also required as a purge for root runs.											
	** Also proprietary Ar and Ar-He gas mixtures with < 3%CO ₂ .											
	*** SSB and LA491 also suitable.											
Packaging data		TIG			MIG			SAW				
	ø mm	309S92			Supermig 309LSi			309S92				
	0.8	--			15kg spool			--				
	1.0	--			15kg spool			--				
	1.2	--			15kg spool			--				
	1.6	2.5kg tube			--			25kg coil				
	2.0	To order			--			--				
	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	< 0.5	< 0.5	2.5				

SUPERCORE 309L, 309LP

Rutile flux cored wires

Product description	Flux cored wires – the wires are made with an austenitic stainless steel sheath and rutile flux system. Supercore 309L combines easy operability, high deposit quality and exceptional weld bead appearance for downhand and HV welding. Supercore 309LP is designed for all-positional welding including fixed pipework. Metal recovery is about 90% with respect to the wire.												
Specifications & Approvals	AWS A5.22			Supercore 309L				Supercore 309LP					
	BS EN ISO 17633-A			E309LT0-1/4				E309LT1-1/4					
	BS EN ISO 17633-B			T 23 12 L R C/M 3				T 23 12 L P C/M 2					
	Approvals			TS309L-FB0				TS309L-FB1					
				TÜV, Germanischer Lloyd				TÜV, Germanischer Lloyd					
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	--	--	12		
	max	0.04	2.0	1.0	0.025	0.030	25.0	14.0	0.3	0.3	22		
	typ	0.03	1.3	0.6	0.02	0.02	24	12.5	0.1	0.1	15		
All-weld mechanical properties	As welded						min	typical					
	Tensile strength						MPa	520	560				
	0.2% Proof stress						MPa	320	445				
	Elongation on 4d						%	30	40				
	Elongation on 5d						%	25	36				
	Reduction of area						%	--	52				
	Impact energy						+ 20°C	J	--	65 *			
							- 20°C	J	--	55 *			
	Hardness						HV	--	205				
	* These values are for Supercore 309LP. Values for Supercore 309L are 45J at +20°C, 40J at -20°C.												
Operating parameters	Shielding gas: Either 80%Ar-20%CO ₂ or 100% CO ₂ shielding gas 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 . Welding with 100%CO ₂ requires approx 3V higher:												
	ø mm	amp-volt range				typical	stickout						
	1.2	120 – 280A, 22 – 34V				180A, 29V	15 – 20mm						
	1.2P	120 – 250A, 22 – 32V				150A, 25V	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	11	2	5	4	< 1	6	1.2				