

# Stainless Steels

DATA SHEET

B-37

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## CRYOGENIC 308LCF CONSUMABLES

### Alloy type

Controlled ferrite 308L austenitic stainless steels for joining 304L base materials used in cryogenic applications.

### Materials to be welded

ASTM	BS EN & DIN
304L	1.4306
304	1.4301
304LN	1.4311
CF3	1.4308
CF8	

BS	UNS
304S11	S 30403
304S15/16/31	S 30400
304S61	S 30453
304C12	
304C15	

### Applications

Used to weld 18/8 stainless steels with service temperatures down to  $-196^{\circ}\text{C}$ . The controlled ferrite SMAW electrodes and flux cored wires are specifically designed for cryogenic service; they are not batch selected consumables.

Applications include **pipework** and **vessels** subject to **cryogenic service** ( $-196^{\circ}\text{C}$ ) eg **LNG**.

Standard 308L consumables for general purpose fabrication can be found in data sheet B-30. The 308L consumables covered here are not suitable for 304/304H in elevated temperature structural applications, see data sheets C-10 and C-12.

### Microstructure

Austenite with a controlled level of ferrite, 2-5FN (3-8FN for solid wires).

### Welding guidelines

No preheat, maximum interpass temperature  $250^{\circ}\text{C}$  ( $300^{\circ}\text{C}$  may be acceptable on thicker section material); no PWHT required.

For optimum impact properties use heat inputs at the higher end of the allowable ranges.

### Additional information

There is a Technical Profile covering the use of the controlled ferrite consumables for LNG applications.

G B Holloway et al 'Stainless steel arc welding consumables for cryogenic applications.' Stainless Steel World America 2004 Conference, Houston, 2004.

### Related alloy groups

General purpose 308L stainless steel consumables are in data sheet B-30. Stainless steel consumables for high temperature applications on 304H can be found in data sheets C-10 or C-12.

### Products available


Process	Product	Specification
MMA	<b>Ultramet 308LCF</b>	AWS E308L-16
	<b>Ultramet B308LCF</b>	AWS E308L-15
TIG	<b>ER308LCF</b>	AWS ER308L
SAW	<b>ER308LCF</b>	AWS ER308L
	<b>LA491</b>	BS EN SA FB255
FCW	<b>Supercore 308LCF</b>	AWS E308LT1-1/4J

## General Data for all 308L MMA Electrodes

<b>Storage</b>	<p><b>3 hermetically sealed ring-pull metal tins</b> 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:  <b>Redry</b> 200 – 300°C/1-2h to restore to as-packed condition. Maximum 400° C, 3 cycles, 10h total.  <b>Storage</b> 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): &lt; 60% RH, &gt; 18°C.</p>																
<b>Fume data</b>	<p>Fume composition, wt % typical:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Fe</th> <th>Mn</th> <th>Cr</th> <th>Ni</th> <th>Mo</th> <th>Cu</th> <th>F *</th> <th>OES (mg/m<sup>3</sup>)</th> </tr> </thead> <tbody> <tr> <td>8</td> <td>5</td> <td>5</td> <td>0.8</td> <td>-</td> <td>&lt; 0.2</td> <td>16</td> <td>1</td> </tr> </tbody> </table> <p>* F=28% for basic coated Ultramet B308LCF but this does not affect the OES.</p>	Fe	Mn	Cr	Ni	Mo	Cu	F *	OES (mg/m <sup>3</sup> )	8	5	5	0.8	-	< 0.2	16	1
Fe	Mn	Cr	Ni	Mo	Cu	F *	OES (mg/m <sup>3</sup> )										
8	5	5	0.8	-	< 0.2	16	1										


### ULTRAMET 308LCF

Rutile MMA electrode for cryogenic 304L applications

<b>Product description</b>	<p>MMA electrode – special rutile flux coated 308L electrode on high purity 304L core wire. Versatile downhand and positional capability, <b>Ultramet 308LCF</b> has a controlled composition and ferrite content designed for cryogenic service requiring &gt;0.38mm lateral expansion at minus 130-196°C. Also suitable for unusual occasions when 304L is specified for service up to 550°C and corrosion conditions preclude the use of 308H.</p> <p>Recovery is about 110% with respect to core wire, 65% with respect to whole electrode.</p>										
<b>Specifications</b>	<b>AWS A5.4</b>		E308L-16								
	<b>BS EN 1600</b>		E 19 9 L R 3 2								
	<b>BS 2926</b>		19.9.LR								
	<b>DIN 8556</b>		19 9 L R 2 3								
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 5, <b>QW442</b> A-No 8										
<b>Composition (weld metal wt %)</b>		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	0.5	--	--	--	18.0	9.0	--	--	2
	max	0.04	2.0	0.90	0.025	0.030	21.0	11.0	0.50	0.5	5
	typ	<0.025	1	0.6	0.01	0.02	18.5	10	0.1	<0.1	3
<b>All-weld mechanical properties</b>	As welded					min		typical			
	Tensile strength					MPa		520      600			
	0.2% Proof stress					MPa		320      445			
	Elongation on 4d					%		35      50			
	Elongation on 5d					%		30      46			
	Reduction of area					%		--      43			
	Impact energy					-100°C		J      45			
						-196°C		J      35			
	Lateral expansion *					-196°C		mm      0.38      0.50			
	* Batch tested for Charpy lateral expansion >0.38mm at -196°C.										
<b>Operating parameters</b>	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			
<b>Packaging data</b>	∅ mm	2.5		3.2		4.0		5.0			
	length mm	300		350		350		450			
	kg/carton	11.4		13.5		13.5		16.2			
	pieces/carton	618		396		261		159			

# ULTRAMET B308LCF

Basic coated MMA pipe-welding electrode for 304L

<b>Product description</b>	MMA electrode – designed and manufactured to give high moisture resistance using a basic flux system and high purity 304L core wire. <b>Ultramet B308LCF</b> 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. Recovery is about 110% with respect to core wire, 65% with respect to whole electrode.										
<b>Specifications</b>	<b>AWS A5.4</b>	E308L-15									
	<b>BS EN 1600</b>	E 19 9 L B 4 2									
	<b>BS 2926</b>	19.9.LB									
	<b>DIN 8556</b>	E 19 9 L B 20+									
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 5, <b>QW442</b> A-No 8										
<b>Composition (weld metal wt %)</b>		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	0.5	--	--	--	18.0	9.0	--	--	2
	max	0.04	2.0	0.90	0.025	0.030	21.0	11.0	0.50	0.5	5
	typ	0.03	1.2	0.3	0.01	0.015	18.5	10	0.05	<0.1	3
<b>All-weld mechanical properties</b>	As welded					min		typical			
	Tensile strength				MPa	520	600				
	0.2% Proof stress				MPa	320	440				
	Elongation on 4d				%	35	44				
	Elongation on 5d				%	30	40				
	Reduction of area				%	--	60				
	Impact energy	+20°C			J	--	80-120				
		-196°C			J	--	35-50				
	Lateral expansion *	-196°C			mm	0.38	0.55				
	* Batch tested for Charpy lateral expansion >0.38mm at -196°C.										
<b>Operating parameters</b>	DC +ve only.										
	∅ mm	2.5		3.2		4.0					
	min A	60		75		100					
	max A	90		120		155					
<b>Packaging data</b>	∅ mm	2.5		3.2		4.0					
	length mm	300		350		350					
	kg/carton	12.0		13.5		13.5					
	pieces/carton	681		396		261					

# ER308LCF

308L solid wire for cryogenic 304L applications

<b>Product description</b>	Batch selected solid wire for TIG and sub-arc welding.										
<b>Specifications</b>	<b>AWS A5.9</b>		ER308L								
	<b>BS EN ISO 14343-A</b>		19 9 L								
	<b>BS EN ISO 14343-B</b>		SS308L								
	<b>BS 2901: Pt2</b>		308S92								
	<b>DIN 8556</b>		SG X2CrNi 19 9 (1.4316)								
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 6, <b>QW442</b> A-No 8										
<b>Composition (wire wt %)</b>		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN
	min	--	1.0	0.30	--	--	19.5	9.0	--	--	3
	max	0.025	2.0	0.65	0.020	0.030	21.0	11.0	0.3	0.3	8
	typ	0.01	1.7	0.4	0.01	0.015	20	10	0.1	0.15	7
<b>All-weld mechanical properties</b>	As welded					min	typical				
							TIG	SAW + LA491			
	Tensile strength					MPa	510	605	570		
	0.2% Proof stress					MPa	320	465	450		
	Elongation on 4d					%	30	35	41		
	Elongation on 5d					%	30	33	37		
	Impact energy					-130°C	J	--	110	50	
						-196°C	J	--	80	30	
	Lateral expansion *					-196°C	mm	0.38	1.0	0.5	
* ER308LCF SAW wire batch tested, with LA491 flux, for Charpy lateral expansion >0.38mm at -196°C.											
<b>Typical operating parameters</b>		TIG		SAW							
	Shielding	Argon		LA491							
	Current	DC-		DC+							
	Diameter	2.4mm		2.4mm							
	Parameters	100A, 12V		350A, 30V							
<b>Packaging data</b>	ø mm	TIG		SAW							
	1.6	2.5kg tube		--							
	2.4	2.5kg tube		25kg coil							
	3.2	2.5kg tube		25kg coil							
<b>Fume data</b>	MIG fume composition (wt %) (TIG and SAW fume negligible)										
		Fe	Mn	Cr <sup>3</sup>	Ni	Mo	Cu	OES (mg/m <sup>3</sup> )			
		32	12	16	8	< 0.5	< 0.5	3.1			

## SUPERCORE 308LCF Rutile all positional flux cored wire for cryogenic 304L applications

<b>Product description</b>	<p><b>Supercore 308LCF</b> has a controlled composition and ferrite content designed for cryogenic service requiring &gt;0.38mm lateral expansion at minus 130-196°C.</p> <p><b>Supercore 308LCF</b> is designed for all-positional welding including fixed pipework. Metal recovery is about 90% with respect to the wire.</p>											
<b>Specifications</b>	<b>AWS A5.22</b>		E308LT1-1/4J									
	<b>BS EN ISO 17633-A</b>		T 19 9 L P C/M 2									
	<b>BS EN ISO 17633-B</b>		TS308L-FB1									
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 6, <b>QW442</b> A-No 8											
<b>Composition (weld metal wt %)</b>		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	FN	
	min	--	0.5	0.2	--	--	18.0	9.0	--	--	2	
	max	0.04	2.0	1.0	0.025	0.030	21.0	11.0	0.3	0.3	5	
	typ	0.03	1.4	0.6	0.01	0.02	18.6	10.5	0.1	0.1	3	
<b>All-weld mechanical properties</b>	As welded						min	typical				
	Tensile strength				MPa		520	540				
	0.2% Proof stress				MPa		320	400				
	Elongation on 4d				%		30	50				
	Elongation on 5d				%		30	46				
	Reduction of area				%		--	50				
	Impact energy				+ 20°C	J	--	74				
					-130°C	J	--	40				
				-196°C	J	--	36					
Lateral expansion *				-196°C	mm	0.38	0.70					
* Batch tested for Charpy lateral expansion >0.38mm at -196°C.												
<b>Operating parameters</b>	<b>Shielding gas:</b> 80%Ar-20%CO <sub>2</sub> or 100% CO <sub>2</sub> at 20-25l/min. Proprietary gases may be used but argon should not exceed 85%.											
	<b>Current:</b> DC+ve ranges as below for Ar-20%CO <sub>2</sub> . Welding with 100%CO <sub>2</sub> requires approx 3V higher:											
	ø mm	amp-volt range					typical			stickout		
1.2	120 – 280A, 22 – 34V					180A, 29V (downhand) 150A, 25V (positional)			15 – 20mm			
<b>Packaging data</b>	<p>Spools vacuum-sealed in barrier foil with cardboard carton: 15kg (33 lbs)</p> <p>The as-packed shelf life is virtually indefinite.</p> <p>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.</p> <p>Where possible, preferred storage conditions are 60% RH max, 18°C min.</p>											
<b>Fume data</b>	Fume composition (wt %)											
		Fe	Mn	Ni	Cr <sup>3</sup>	Cr <sup>6</sup>	Cu	F	OES (mg/m <sup>3</sup> )			
		17	10	1.5	3	5	< 1	5	1			