

High Temperature Alloys

DATA SHEET

C-10

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308H CONSUMABLES

Alloy type

For 304/304H materials used at elevated temperatures.

Materials to be welded

	wrought	cast
ASTM / UNS	304H/S30409	CF10, CF8
DIN	1.4948	
BS	304S51	302C25, 304C15

Applications

The 308H consumables are designed to match unstabilised 18Cr-10Ni austenitic stainless steels for elevated temperature strength and oxidation resistance. These steels and the weld metal have carbon content controlled to 0.04-0.08%.

Composition limits of the MMA electrodes and FCAW wires are tightened above those of BS/AWS specifications in order to meet requirements of *Shell* and other operators of refinery equipment. Weld metal Cr and Ni are kept low and ferrite is controlled to minimise embrittlement by sigma phase. Beneficial and detrimental minor elements and residuals are also controlled to optimise high temperature properties. No bismuth-bearing constituents are allowed in these consumables, to ensure <0.002%Bi as required by API 582.

The 308H consumables should also be considered for welding thick (>12mm) stabilised grades 321H or 347H to avoid in-service HAZ cracking and low creep rupture ductility associated with 347 weld metal. Note that some authorities recommend the use of type 16-8-2 types for these steels, including 304H.

308H is widely used in **petrochemical** and **chemical process plant**, particularly for the fabrication of **cyclones**, **transfer lines** used to re-circulate the catalyst in **catalytic crackers** (cat crackers) operating in the range 400-815°C.

Microstructure

Austenite with delta ferrite controlled 2-8FN.

Welding guidelines

Preheat not required; maximum interpass temperature 250°C. No PWHT required.

Additional information

Farrar J.C.M. and Marshall A.W.: 'Type '300H' austenitic stainless steel weld metals for high temperature service'

Marshall A.W. and Farrar J.C.M.: 'Influence of residuals on properties of austenitic stainless steel weld metal, with particular reference to energy industries' (Conference) Stainless Steels '84, pp 271-285, Metals Society, London 1985.

There is also a Metrode Technical Profile covering the use of these products in the petrochemical industry on cat crackers.

Related alloy groups

See also the consumables in the related alloy groups of 347H (C-11), 16.8.2 (C-12) and 316H (C-13).

Products available

Process	Product	Specification
MMA	Ultramet 308H	AWS E308H-16
	Ultramet B308H	AWS E308H-15
TIG/MIG	308S96	AWS ER308H
SAW	308S96	AWS ER308H
	SS300	BS EN SA AF2
	SSB	BS EN SA AF2
FCW	Supercore 308H	AWS E308HT0-1/4
	Supercore 308HP	AWS E308HT1-1/4


ULTRAMET 308H

Rutile electrode for 304H stainless steel

Product description	<p>MMA electrode with rutile flux on matching core wire.</p> <p>Recovery is about 110% with respect to core wire, 65% with respect to whole electrode.</p> <p>Ultramet 308H gives both welder and weld metal all the benefits of advanced rutile electrode design. These features include optimum versatility for downhand and positional welding, combined with high cosmetic finish and full volumetric weld metal integrity.</p> <p>The smaller sizes are particularly suited to vertical and overhead welding applications including fixed pipework. In addition, the 2.5mm diameter is specifically designed to enable the root pass to be deposited in single side butt welds using standard MMA equipment without a gas purge.</p>																																																																					
Specifications	<table border="0"> <tr> <td>AWS A5.4</td> <td>E308H-16</td> </tr> <tr> <td>BS EN 1600</td> <td>E 19 9 H R 3 2</td> </tr> <tr> <td>BS 2926</td> <td>19.9.R</td> </tr> <tr> <td>DIN 8556</td> <td>(E 19 9 R 23)</td> </tr> </table>											AWS A5.4	E308H-16	BS EN 1600	E 19 9 H R 3 2	BS 2926	19.9.R	DIN 8556	(E 19 9 R 23)																																																			
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Storage	<p>3 hermetically sealed ring-pull metal tins per carton, with unlimited shelf life. Direct use from tin is satisfactory for much 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>																																																																					
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ULTRAMET B308H

Basic pipe welding electrode for 304H stainless steel

Product description	<p>MMA electrode with basic carbonate-fluoride flux on matching core wire.</p> <p>Recovery is about 110% with respect to core wire, 65% with respect to whole electrode.</p> <p>Ultramet B308H is particularly suited to positional welding, including fixed pipework qualified in the ASME 6G position, in materials thickness from 3mm up to the heaviest sections.</p>																								
Specifications	AWS A5.4		E308H-15																						
	BS EN 1600		E 19 9 H B 4 2																						
	BS 2926		19.9.B																						
	DIN 8556		(E 19 9 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	0.04	0.5	--	--	--	18.0	9.0	--	--	2														
	max	0.08	2.0	0.9	0.025	0.030	21.0	11.0	0.25	0.5	8														
	typ	0.05	1	0.4	0.01	0.02	18.5	9.5	0.1	0.05	3														
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All-weld mechanical properties	As welded					min	typical	High Temperature																	
								650°C	732°C	816°C															
	Tensile strength	MPa				560	650	298	225	154															
	0.2% Proof stress	MPa				350	460	223	168	111															
	Elongation on 4d	%				35	41	--	--	--															
	Elongation on 5d	%				30	38	24	48	47															
	Reduction of area	%				--	48	60	63	54															
	Impact energy	+ 20°C				J	--	100	--	--	--														
Hardness					HV	--	210	--	--	--															
Operating parameters	DC +ve. 																								
	∅ 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																	
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	pieces/carton	726		414		261		159																	
Storage	<p>3 hermetically sealed ring-pull metal tins per carton, with unlimited shelf life. Direct use from tin is satisfactory for much 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>																								
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Fe	Mn	Ni	Cr	Cu	F	OES (mg/m ³)																			
8	5	0.8	5	< 0.2	28	1																			

308S96

Solid wire for 304H stainless steel

Product description	Solid wire for TIG, MIG and SAW.											
Specifications	AWS A5.9		ER308H (ER19-10H on request)									
	BS EN ISO 14343-A		19 9 H									
	BS EN ISO 14343-B		SS308H									
	BS 2901: Pt2		308S96									
	DIN 8556		(SG X5CrNi 19 9 (1.4302))									
ASME IX Qualification	QW432 F-No 6, QW442 A-No 8											
Composition (wire wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu		
	min	0.04	1.0	0.30	--	--	19.5	9.0	--	--		
	max	0.08	2.0	0.65	0.020	0.030	20.5	10.0	0.25	0.25		
	typ	0.05	1.8	0.4	0.002	0.015	19.9	9.5	0.1	0.1		
Typical ferrite level of undiluted weld metal is in the range 3-8FN. ER19-10H (on request) has Cr ≤ 20.0, Mo ≤ 0.25, Nb ≤ 0.05, Ti ≤ 0.05.												
All-weld mechanical properties	Typical values as welded					TIG						
	Tensile strength					MPa	630					
	0.2% Proof stress					MPa	450					
	Elongation on 4d					%	43					
	Impact energy					+ 20°C	J	> 100				
	Hardness cap/mid					HV	195/215					
Typical operating parameters		TIG			MIG			SAW				
	Shielding	Argon			Ar/2%O ₂ or Ar/1-3%CO ₂			SS300 or SSB flux				
	Diameter	2.4mm			1.2mm			2.4mm				
	Current	100A, DC-			260A, DC+			350A, DC+				
	Voltage	12V			28V			30V				
Packaging data	ø mm	TIG			MIG			SAW				
	0.8	--			To order			--				
	1.0	--			To order			--				
	1.2	To order			15 kg spool			--				
	1.6	2.5kg tube			--			25kg coil				
	2.0	To order			--			--				
	2.4	2.5kg tube			--			25kg coil				
	3.2	2.5kg tube			--			To order				
Fume data	MIG fume composition (wt %) (TIG fume negligible):											
		Fe	Mn	Cr ³	Ni	Mo	Cu	OES (mg/m ³)				
		32	12	16	8	<0.5	<0.5	3.1				

SUPERCORE 308H / 308HP

Downhand and positional FCW for 304H stainless steel

Product description	<p>Flux cored wires made with an austenitic stainless steel sheath and rutile flux system.</p> <p>Supercore 308H is designed for ease of use, exceptional weld bead appearance and high weld metal integrity, primarily in downhand and H-V welding situations with plate and material of a 6mm thickness or greater. Supercore 308HP designed for all-positional welding from 1G/2G up to 5G/6G pipework.</p> <p>Metal recovery is about 90% with respect to wire.</p>																										
Specifications	AWS A5.22 BS EN ISO 17633-B			Supercore 308H E308HT0-1/4 TS308H-FB0				Supercore 308HP (1.2mm only) E308HT1-1/4 TS308H-FB1																			
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		0.04	1.0	--	--	--	18.0	9.0	--	--	3																
max		0.08	2.0	1.0	0.03	0.04	20.0	11.0	0.5	0.5	8																
typ		0.05	1.3	0.5	0.01	0.02	18.8	9.5	0.1	0.1	5																
All-weld mechanical properties	As welded					min	typical	High Temperature																			
								650°C	732°C	816°C																	
Tensile strength						MPa	550	620	287	222	163																
0.2% Proof stress						MPa	--	420	213	177	140																
Elongation on 4d						%	35	40	--	--	--																
Elongation on 5d						%	30	36	30	46	40																
Reduction of area						%	--	50	58	69	74																
Impact energy	+ 20°C					J	--	100	--	--	--																
Aged at 730°C/1000h						J	--	90	--	--	--																
Operating parameters	<p>Shielding gas: 80%Ar-20%CO₂ or 100% CO₂ at 20-25l/min. Proprietary gases may be used but argon should not exceed 85%.</p> <p>Current: DC+ve ranges as below for Ar-20%CO₂. Welding with 100%CO₂ requires approx 3V higher:</p> <table border="1"> <thead> <tr> <th>ø mm</th> <th>amp-volt range</th> <th>typical</th> <th>stickout</th> </tr> </thead> <tbody> <tr> <td>1.2</td> <td>120A-22V to 280A-34V</td> <td>180A-29V</td> <td>12 – 20mm</td> </tr> <tr> <td>1.2 (positional)</td> <td>120A-22V to 250A-32V</td> <td>150A-25V</td> <td>12 – 20mm</td> </tr> <tr> <td>1.6</td> <td>200A-28V to 330A-34V</td> <td>230A-30V</td> <td>15 – 25mm</td> </tr> </tbody> </table>											ø mm	amp-volt range	typical	stickout	1.2	120A-22V to 280A-34V	180A-29V	12 – 20mm	1.2 (positional)	120A-22V to 250A-32V	150A-25V	12 – 20mm	1.6	200A-28V to 330A-34V	230A-30V	15 – 25mm
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1.6	200A-28V to 330A-34V	230A-30V	15 – 25mm																								
Packaging data	<p>Spools vacuum-sealed in barrier foil with cardboard carton: 15kg</p> <p>The as-packed shelf life is virtually indefinite.</p> <p>Resistance to moisture absorption is high, but to 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 maximum, 18°C minimum.</p>																										
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17	11	2	4	5	<1	5	1																				