

# High Temperature Alloys

## DATA SHEET

## C-11

METRODE PRODUCTS LTD  
 HANWORTH LANE, CHERTSEY  
 SURREY, KT16 9LL  
 Tel: +44(0)1932 566721  
 Fax: +44(0)1932 565168 Sales  
 Fax: +44(0)1932 569449 Technical  
 Fax: +44(0)1932 566199 Export  
 Email: info@metrode.com  
 Internet: http://www.metrode.com

## 347H STAINLESS STEEL

### Alloy type

Controlled, high carbon Nb stabilised stainless steel for elevated temperature service.

### Materials to be welded

ASTM-ASME	BS EN & DIN
321H	1.4941
347H	1.4961

BS	UNS
321S51	S32109
347S51	S34709

### Applications

Used to weld titanium and niobium stabilised 18/8 high carbon stainless steel types 321H and 347H.

Applications include **catalytic crackers (cat crackers), cyclones, transfer lines, furnace parts, steam piping, superheater headers**, some **gas and steam turbine components**, used in **petrochemical, chemical process plants** and in **power generation industries**.

Note that the alloy 16.8.2 (data sheet C-12) was developed as a more ductile alternative to 347H consumables to avoid in-service HAZ failure in 347H base material of >12mm thickness. For this reason when joining thicker section 321H/347H the 16.8.2 consumables are considered a preferable alternative.

For welding 321/347 for general corrosion resisting applications at temperatures up to about 400°C use 347 (data sheet B-31) or 308L (data sheet B-30) consumables.

For cryogenic applications requiring >0.38mm (15mils) charpy lateral expansion at -196°C, use unstabilised weld metal with low carbon and controlled ferrite (B-37).

### Microstructure

Austenite with 2-9FN, typically 4FN (solid wire typically 8FN).

### Welding guidelines

No preheat or PWHT required; maximum interpass temperature 250°C.

### Related alloy groups

The 308H (data sheet C-10), 16.8.2 (data sheet C-12) and 316H (data sheet C-13) consumables are also relevant for many of the same materials and applications.

### Products available


Process	Product	Specification
MMA	<b>Ultramet 347H</b>	AWS E347-16
	<b>Ultramet B347H</b>	AWS E347-15
TIG/SAW	<b>ER347H</b>	AWS ER347
FCW	<b>Supercore 347HP</b>	AWS E347T1-1/4

## General Data for all 347H 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>Ni</th> <th>Cr</th> <th>Cu</th> <th>F *</th> <th>OES (mg/m<sup>3</sup>)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">8</td> <td style="text-align: center;">5</td> <td style="text-align: center;">0.8</td> <td style="text-align: center;">5</td> <td style="text-align: center;">&lt;0.2</td> <td style="text-align: center;">16</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> <p>* F=28% for basic coated Ultramet B347 but this does not affect the OES.</p>	Fe	Mn	Ni	Cr	Cu	F *	OES (mg/m <sup>3</sup> )	8	5	0.8	5	<0.2	16	1
Fe	Mn	Ni	Cr	Cu	F *	OES (mg/m <sup>3</sup> )									
8	5	0.8	5	<0.2	16	1									


## ULTRAMET 347H

All-positional rutile MMA electrode for 321H/347H

<b>Product description</b>	<p>MMA rutile flux coated 347 electrode on high purity 304L core wire. Ultramet 347H has all the benefits of an advanced rutile flux design, including all-positional fixed pipework welding with the 2.5/3.2mm diameter electrodes.</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> E347-16 <b>BS EN 1600</b> E 19 9 Nb R32 <b>BS 2926</b> 19.9.Nb.R <b>DIN 8556</b> E 19 9 Nb R 23											
<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	Nb *	Cu	FN
	min	0.04	0.5	--	--	--	18.0	9.0	--	8xC	--	2
	max	0.08	2.0	0.9	0.025	0.030	21.0	11.0	0.50	1.00	0.50	8
	typ	0.05	0.7	0.7	0.01	0.02	19	9.5	0.05	0.5	0.07	4
	* BS requires 10xC minimum.											
<b>All-weld mechanical properties</b>	As welded						Room Temperature		High Temperature			
							min	typical	650°C	732°C	815°C	
	Tensile strength				MPa		560	650	354	308	233	
	0.2% Proof stress				MPa		350	500	283	269	206	
	Elongation on 4d				%		30	40	--	--	--	
	Elongation on 5d				%		25	37	19	20	7	
	Reduction of area				%		--	52	47	38	23	
<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	12.0		12.0		12.9		16.5				
	pieces/carton	693		354		243		168				

# ULTRAMET B347H

Basic pipe-welding electrode for 321H/347H which is made to order

<b>Product description</b>	<p>MMA electrode with basic carbonate-fluoride flux on high purity 304L core wire. Designed to give good moisture resistance and hence freedom from weld porosity. The electrode is particularly suited to positional welding of fixed pipework qualified in the ASME 5G/6G position and is tolerant to adverse wind and draughts under site conditions. Compared with rutile types, the basic flux gives a more convex fillet bead profile and although the slag does not self-lift, it is easily removed and gives welds of exceptional appearance and quality.</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>		E347-15									
	<b>BS EN 1600</b>		E 19 9 Nb B 42									
	<b>BS 2926</b>		19.9.Nb.B									
	<b>DIN 8556</b>		E 19 9 Nb 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	Nb *	Cu	FN
	min	0.04	0.5	--	--	--	18.0	9.0	--	8xC	--	2
	max	0.08	2.0	0.9	0.025	0.030	21.0	11.0	0.50	1.00	0.50	8
	typ	0.05	1.5	0.3	0.01	0.02	19	9.5	0.05	0.6	0.07	5
	* BS requires 10xC minimum.											
<b>All-weld mechanical properties</b>	As welded					Room Temperature		High Temperature				
						min	typical	650°C	732°C	815°C		
	Tensile strength				MPa	560	650	354	311	248		
	0.2% Proof stress				MPa	350	500	263	265	223		
	Elongation on 4d				%	30	40	--	--	--		
	Elongation on 5d				%	25	37	18	14	5		
	Reduction of area				%	--	52	43	30	19		
<b>Operating parameters</b>	DC +ve 											
	ø 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>	ø mm		2.5		3.2		4.0		5.0			
	length mm		300		350		350		450			
	kg/carton		11.4		13.5		13.5		16.8			
	pieces/carton		627		396		258		159			

# ER347H

Solid welding wire for 321H/347H

<b>Product description</b>	Solid wire for TIG and SAW.											
<b>Specifications</b>	<b>AWS A5.9</b>		ER347									
	<b>BS EN ISO 14343-A</b>		19 9 Nb									
	<b>BS EN ISO 14343-B</b>		SS347									
	<b>BS 2901: Pt2</b>		347S96									
<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	Nb	Cu	FN
	min	0.04	1.0	0.30	--	--	19.0	9.0	--	10xC	--	3
	max	0.08	2.5	0.65	0.020	0.030	20.0	11.0	0.3	1.0	0.3	9
	typ	0.055	1.7	0.4	0.005	0.02	19.5	9.2	0.1	0.6	0.1	8
<b>All-weld mechanical properties</b>	As welded					Typical TIG		High Temperature				
						650°C		732°C		815°C		
	Tensile strength				MPa		660		398		235	
	0.2% Proof stress				MPa		450		318		184	
	Elongation on 4d				%		42		23		22	
	Elongation on 5d				%		40		21		21	
	Reduction of area				%		67		55		52	
Impact Energy				+20°C J		125		--		--		
Hardness cap/mid				HV		190/230		--		--		
<b>Typical operating parameters</b>						TIG			SAW			
	Shielding					Argon *			SS300 or SSB flux			
	Current					DC-			DC+			
	Diameter					2.4mm			2.4mm			
	Parameters					100A, 12V			350A, 28V			
* Also required as a purge for root runs.												
<b>Packaging data</b>	ø mm					TIG			SAW			
	2.4					2.5kg tube			25kg coil			
<b>Fume data</b>	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 347HP

All-positional rutile flux cored wire for 321H/347H

<b>Product description</b>	Flux cored wire made with an austenitic stainless steel sheath and rutile flux system. Supercore 347HP is designed for all-positional welding from 1G/2G up to 5G/6G fixed pipework. Metal recovery is about 90% with respect to the wire.												
<b>Specifications</b>	<b>AWS A5.22</b>		E347T1-1/4										
	<b>BS EN ISO 17633-A</b>		T 19 9 Nb P C/M 2										
	<b>BS EN ISO 17633-B</b>		TS347-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	Nb	Cu	FN	
	min	0.04	0.5	--	--	--	18.0	9.0	--	8xC	--	4	
	max	0.08	2.0	1.0	0.025	0.030	21.0	11.0	0.3	1.0	0.3	9	
	typ	0.05	1.4	0.6	0.01	0.02	19.5	10.2	0.1	0.5	0.1	5	
<b>All-weld mechanical properties</b>	As welded					Room Temperature			High Temperature				
						min	typical		732°C				
	Tensile strength					MPa	550	630		310			
	0.2% Proof stress					MPa	350	470		265			
	Elongation on 4d					%	30	43		24			
	Elongation on 5d					%	25	40		22			
Reduction of area					%	--	46		43				
Impact energy					+ 20°C	J	--	70		--			
<b>Operating parameters</b>	<b>Shielding gas:</b> 80%Ar-20%CO <sub>2</sub> at 20-25l/min. Proprietary gases may be used but argon should not exceed 85% argon.												
	<b>Current:</b> DC+ve ranges as below:												
	ø mm	amp-volt range			typical				stickout				
1.2	120-280A, 22-34V			180A, 29V (downhand) 160A, 25V (positional)				15-20mm 15-20mm					
<b>Packaging data</b>	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.												
<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	11	2	4	5	<1	5	1				