

High Temperature Alloys

DATA SHEET

C-30

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310 STAINLESS STEEL

Alloy type

25%Cr-20%Ni (310) stainless steel.

Materials to be welded

	wrought	cast
ASTM/UNS	310 / S31000 310S / S31008	CK20
DIN	1.4841, 1.4842, 1.4845	1.4840
BS	310S24, 310S31	310C45
Proprietary	Immaculate 5 (Firth Vickers) Sirius 3 (CLI) 15RE10 (Sandvik)	

Applications

These consumables are used primarily for welding similar wrought or cast 25%Cr-20%Ni (310) parent alloys with up to 0.25% carbon. Parent metal and weld metal are fully austenitic, unlike the other common 300 series stainless steels. For maximum resistance to solidification cracking and microfissuring, the MMA weld metal manganese range is raised to 2-5% in accordance with European practice.

The high alloy content of type 310 gives useful oxidation resistance up to peak temperatures of about 1200°C for **heat shields**, **furnace parts** and **ducting**.

These consumables can also be used for **mixed welding** and **dissimilar joints** including those where PWHT is applied, but it should be noted that the relatively high thermal expansion coefficient may promote thermal fatigue in transition joints which are subject to thermal cycling. In such cases, nickel base consumables are usually preferred (eg. D-10, D-11).

Other uses include **buffer layers** and for **surfacing**. The fully austenitic weld metal can be useful for specialised applications requiring **low magnetic permeability** (typically <1.01). 310 weld metals are also inherently tough down to -196°C and therefore suitable for **cryogenic installations** involving any of the standard 300 series austenitic stainless steels.

Microstructure

Fully austenitic. Typical magnetic permeability <1.01.

Welding guidelines

No preheat required. Preferably keep interpass temperature below 150°C and heat input below 1.5kJ/mm; this is particularly important for high heat input processes eg. SAW.

Related alloy groups


These standard 310 alloy should not be confused with 0.4% carbon 310H cast alloys of the HK40 type (see data sheet C-31), or the very low carbon 310L alloys which are used in severely corrosive conditions (see data sheet B-45).

Products available

Process	Product	Specification
MMA	25.20 Super R	(E310-16)
	Ultramet B310Mn	(E310-15)
TIG/MIG/ SAW	310S94	AWS ER310


25.20 SUPER R

Rutile MMA electrode for welding 310 stainless steel

Product description	MMA electrode with low silica rutile flux on high purity 310 core wire. Low silicon and high manganese levels are desirable to ensure freedom from microfissuring. Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.										
Specifications	AWS A5.4	(E310-16)	AWS specification has Mn range of 1.0-2.5%.								
	BS EN 1600	E 25 20 R 32									
	BS 2926	25.20.R									
	DIN 8556	E 25 20 R 26									
ASME IX Qualification	QW432 F-No 5, QW442 A-No 9										
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	
	min	0.08	2.0	--	--	--	25.0	20.0	--	--	
	max	0.15	5.0	0.70	0.025	0.030	27.0	22.0	0.50	0.50	
	typ	0.12	3.5	0.4	0.008	0.02	26	21	0.2	0.1	
All-weld mechanical properties	As welded					min	typical				
	Tensile strength					MPa	560	575			
	0.2% Proof stress					MPa	350	400			
	Elongation on 4d					%	30	37			
	Elongation on 5d					%	25	35			
	Reduction of area					%	--	50			
	Impact energy	+ 20°C				J	--	80			
	Impact energy	- 196°C				J	--	45			
	Hardness					HV	--	200			
Operating parameters	DC +ve or AC (OCV: 70V 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		350		450			
	kg/carton	12.0		13.5		14.7		20.1			
	pieces/carton	675		405		282		198			
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. For electrodes that have been exposed: Redry 150 – 200°C/1-2h to restore to as-packed condition. Maximum 250° 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	Fume composition, wt % typical:										
		Fe	Mn	Ni	Cr	Cu	F	OES (mg/m ³)			
		9	10	2	7.5	<0.2	18	0.6			

ULTRAMET B310Mn

All-positional basic MMA electrode for welding 310 stainless steel

Product description	<p>MMA electrode with basic carbonate-fluoride flux on high purity 310 core wire. Low silicon and high manganese levels are desirable to ensure freedom from microfissuring. The electrode is particularly suited to positional welding, including fixed pipework in the ASME 5G/6G positions.</p> <p>Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.</p>																							
Specifications	AWS A5.4 BS EN 1600 BS 2926 DIN 8556	(E310-15) E 25 20 B 42 25.20.B E 25 20 B 20+	AWS specification has Mn range of 1.0-2.5%.																					
ASME IX Qualification	QW432 F-No 5, QW442 A-No 9																							
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu														
	min	0.08	2.0	--	--	--	25.0	20.0	--	--														
	max	0.15	5.0	0.70	0.025	0.030	27.0	22.0	0.50	0.50														
	typ	0.1	3.8	0.4	0.008	0.018	26	21	0.2	0.1														
All-weld mechanical properties	As welded					min		typical																
	Tensile strength					MPa	560	615																
	0.2% Proof stress					MPa	350	435																
	Elongation on 4d					%	30	36																
	Elongation on 5d					%	25	34																
	Reduction of area					%	--	50																
	Impact energy					+ 20°C	J	--	105															
	Impact energy					- 196°C	J	--	75															
	Hardness					HV	--	220																
Operating parameters	DC +ve 																							
	ø mm	2.5		3.2		4.0																		
	min A	60		75		100																		
	max A	90		120		155																		
Packaging data	ø mm	2.5		3.2		4.0																		
	length mm	300		350		350																		
	kg/carton	12.0		13.5		13.5																		
	pieces/carton	669		384		255																		
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>10</td> <td>2</td> <td>7.5</td> <td><0.2</td> <td>28</td> <td>0.6</td> </tr> </tbody> </table>										Fe	Mn	Ni	Cr	Cu	F	OES (mg/m ³)	9	10	2	7.5	<0.2	28	0.6
Fe	Mn	Ni	Cr	Cu	F	OES (mg/m ³)																		
9	10	2	7.5	<0.2	28	0.6																		

310S94

Solid wire for TIG, MIG and SAW of 310 stainless steel

Product description	Solid wire for TIG, MIG and SAW.									
Specifications	AWS A5.9		ER310							
	BS EN ISO 14343-A		25 20							
	BS EN ISO 14343-B		SS310							
	BS 2901: Pt2		310S94							
	DIN 8556		(SG X12CrNi 25 20)							
	UNS		S31080							
ASME IX Qualification	QW432 F-No 6, QW442 A-No 9									
Composition (wire wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Cu
	min	0.08	1.0	0.30	--	--	25.0	20.0	--	--
	max	0.15	2.5	0.65	0.02	0.030	27.0	22.0	0.3	0.3
	typ	0.11	1.8	0.4	0.005	0.02	26	21	0.1	0.1
All-weld mechanical properties	Typical values as welded					MIG Ar+2%O ₂				
	Tensile strength					MPa	540			
	0.2% Proof stress					MPa	355			
	Elongation on 4d					%	27			
	Impact energy					J	70			
	Hardness cap/mid					HV	185			
Typical operating parameters		TIG			MIG		SAW ***			
	Shielding	Argon *			Ar+2%O ₂ **		SS300 or SSB flux			
	Current	DC-			DC+		DC+			
	Diameter	2.4mm			1.2mm		2.4mm			
	Parameters	100A, 12V			220A, 29V		325A, 30V			
	* Also required as a purge for root runs.									
	** Proprietary Ar and Ar-He mixtures with <3%CO ₂ also suitable.									
	*** Heat input should be restricted with SAW to minimise the risk of solidification cracking.									
Packaging data	ø mm	TIG			MIG		SAW			
	0.8	--			15kg spool		--			
	1.2	--			15kg spool		--			
	1.6	2.5kg tube			--		25kg coil			
	2.4	2.5kg tube			--		25kg coil			
	3.2	2.5kg tube			--		--			
Fume data	MIG fume composition (wt %) (TIG & SAW fume negligible)									
		Fe	Mn	Cr ³	Ni	Mo	Cu	OES (mg/m ³)		
		30	13	22	16	<0.5	<0.5	2.3		