

High Temperature Alloys

DATA SHEET

C-40

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CONSUMABLES TO MATCH CAST & WROUGHT ALLOY 800

Alloy type

Austenitic heat resisting consumables to match alloy 800.

Materials to be welded

ASTM	A351 CT15C
BS	NA15, NA15H
BS EN & DIN	1.4850, 1.4859, 1.4876
UNS	N08800, N08810, N08811

Proprietary alloys include:

cast:	wrought:
Paralloy CR32W.	Incoloy 800, 800H, 800HT
Manaurite 900 (Manoir).	(Special Metals).
Thermalloy T52 (Lloyds)	Sanicro 31 (Sandvik).
Vicro 8 (Firth Vickers).	RA330 (Rolled Alloys).
MORE 21 (Duraloy).	Nicrofer 3220 (VDM).
Centralloy 4859 (Centracero).	

Applications

The consumables are designed to deposit weld metal with composition and properties closely matching type 800 alloys in cast and wrought forms. The weld metals are based on the composition of castings, with controlled carbon and niobium for optimum corrosion resistance and creep performance. Most wrought materials have Ti and Al instead of Nb. Weld metal Mn and Si levels are modified to give high resistance to hot cracking in highly restrained welds. For optimum resistance to ageing embrittlement, the composition will generally meet the Chiyoda parameter:

$$P \leq 9 \text{ where } P = (7C + 5Si + 8Nb - 3Mn).$$

These alloys are used for their resistance to corrosion, thermal fatigue and shock at temperatures up to about 1000°C, for the fabrication of **muffles and radiant tubes, heat treatment trays and baskets, reformer furnace outlet manifolds and ethylene plant transfer lines, in the furnace, petrochemical and nuclear engineering industries.**

These consumables are used as alternatives to various nickel base consumables up to 1000°C, with the added benefit of expansion coefficient and sulphidation resistance similar to parent material.

Microstructure

As-welded weld metal microstructure consists of austenite with cellular NbC-rich network.

Welding guidelines

No preheat, interpass <150°C preferred. Usually welds are not heat treated however in elevated temperature service the HAZ of welds in alloys 800/800H/800HT with progressively increasing levels of Ti+Al may be susceptible to stress-relaxation cracking. For pressure boundary welds designed for >538°C, ASME VIII UNF-56 requires PWHT >885°C/1h + 1h/25mm (eg. 900°C/3h), or solution annealing.

API 560 currently does not require PWHT but some specifiers may require it for particular operating conditions.

Additional information

Marshall A.W. & Farrar J.C.M. 'Matching consumables for type 800 alloys', Stainless Steel World, Sept 1999, pp 56-60.

Related alloy groups


The nickel base alloys AB (data sheet D-11), 625 (data sheet D-20) and 617 (data sheet D-40) are sometimes used as alternatives for the same base materials.

Products available

Process	Product	Specification
MMA	Thermet 800Nb	None
TIG/MIG	21.33.MnNb	None

THERMET 800Nb

MMA electrode to match alloy 800

Product description	MMA electrode – Basic moisture resistant coated electrode made on high alloy, high purity core wire. Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.																												
Specifications	There are no national specifications for this electrode.																												
ASME IX Qualification	QW432 F-No -, QW442 A-No -																												
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	Nb	Cu																		
	min	0.06	1.6	--	--	--	19.0	30.0	--	0.8	--																		
	max	0.12	4.5	0.6	0.02	0.03	23.0	35.0	0.5	1.5	0.5																		
	typ	0.1	2.5	0.3	0.007	0.015	21	32	0.4	1.3	0.15																		
All-weld mechanical properties	As welded						min *		typical																				
	Tensile strength						MPa		520		615																		
	0.2% Proof stress						MPa		210		410																		
	Elongation on 4d						%		--		> 33																		
	Elongation on 5d						%		25		> 32																		
	Reduction of area						%		--		46																		
	Impact energy						+ 20°C		J		> 55																		
	Hardness						HV		--		170-220																		
* Minimum tensile properties based on wrought alloy 800H.																													
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																					
	kg/carton	12.0		13.5		13.5		18.0																					
	pieces/carton	642		354		243		165																					
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. For electrodes that have been exposed: Redry 150 – 250°C/1-2h to restore to as-packed condition. Maximum 350° 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 border="1"> <thead> <tr> <th></th> <th>Fe</th> <th>Mn</th> <th>Cr</th> <th>Ni</th> <th>Mo</th> <th>Cu</th> <th>F</th> <th>OES (mg/m³)</th> </tr> </thead> <tbody> <tr> <td></td> <td>4</td> <td>6</td> <td>6</td> <td>2</td> <td>< 0.2</td> <td>< 0.2</td> <td>18</td> <td>0.8</td> </tr> </tbody> </table>												Fe	Mn	Cr	Ni	Mo	Cu	F	OES (mg/m ³)		4	6	6	2	< 0.2	< 0.2	18	0.8
	Fe	Mn	Cr	Ni	Mo	Cu	F	OES (mg/m ³)																					
	4	6	6	2	< 0.2	< 0.2	18	0.8																					

21.33.MnNb

Solid TIG/MIG welding wire for 800H and similar heat resisting alloys

Product description	Solid wire – This is a high Mn, 21%Cr-33%Ni-1%Nb, micro-alloyed wire for TIG/MIG welding of 800 type alloys.												
Specifications	There are no national specifications for this wire.												
ASME IX Qualification	QW432 F-No -, QW442 A-No -												
Composition (wire wt %)		C *	Mn	Si	S	P	Cr	Ni	Mo	Nb	Cu	Al	Ti
	min	0.10	3.5	--	--	--	19.0	30.0	--	0.8	--	--	--
	max	0.20	5.0	0.70	0.015	0.025	23.0	35.0	0.50	1.5	0.5	0.35	0.30
	typ	0.15	4.3	0.5	0.008	0.012	21	33	0.3	1	0.1	0.1	0.15
	* Weld deposit carbon is typically a little lower than wire analysis.												
All-weld mechanical properties	Typical values as welded						min	TIG					
	Tensile strength					MPa	520	670					
	0.2% Proof stress					MPa	210	500					
	Elongation on 4d					%	--	18					
	Elongation on 5d					%	--	18					
	Impact energy				+ 20°C	J	--	60					
* Minimum tensile properties based on wrought alloy 800H.													
Typical operating parameters		TIG					MIG						
	Shielding	Ar					Ar+2%O ₂ **						
	Current	DC –					DC+						
	Diameter	2.4mm					1.2mm						
	Parameters	100A, 12V					220A, 29V						
	* Also required as a purge for root runs.												
	** Proprietary Ar and Ar-He mixtures with <3%CO ₂ also suitable.												
Packaging data	ø mm	TIG					MIG						
	1.2	--					12.5kg spool						
	1.6	To order											
	2.0	To order											
	2.4	2.5kg tube											
	3.2	2.5kg tube											
Fume data	MIG fume composition (wt %) (TIG fume negligible)												
		Fe	Mn	Cr ³	Ni	Cu	OES (mg/m ³)						
		40	15	18	20	< 1	2.5						