

Low Alloy Steels

DATA SHEET

A-18

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CONSUMABLES FOR E911 CrMo STEEL

Alloy type

Modified 9CrMo type generically called E911, with a nominal composition of 9%Cr-1%Mo-1%W+NbVN.

Materials to be welded

EN/DIN	1.4905 X11CrMoWVNb 9 1 1 1.4906 G-X12CrMoWVNbN 10 1 1 (cast)
ASTM	A182/A336 F911 (forgings) A213 T911 (seamless tube) A234 WP911 (fittings) A335 P911 (seamless pipe) A369 FP911 (forged pipe) A387 Grade 911 (plate)

Applications

Electrodes for the new European creep-resistant steel E911, which is essentially the ASTM P91 type with 1%W added to increase creep strength for service up to at least 600°C.

These consumables are mainly intended for castings, which have a slightly higher Cr level. Castings also have up to 1%Ni to suppress retained ferrite; in wrought products nickel is limited to 0.4%. For microstructural control and to optimise toughness after PWHT, the weld metal has about 0.6%Ni added.

Applications for E911 steels include components such as **headers, main steam piping, boiler tubes, turbine casings and steam valves** in fossil fuelled **power generating plants**. It may also find future use in **oil refineries and coal liquefaction and gasification plants**.

Microstructure

In the PWHT condition consists of tempered martensite.

Welding guidelines

Preheat-interpass range for E911 is 200-300°C. Before PWHT it is preferable to cool to 100°C or lower to ensure full martensite transformation.

PWHT

PWHT requirements are essentially the same as for P91, which requires PWHT in the range 730-780°C. Castings are often PWHT at temperatures towards the bottom of this range but the time is proportionally increased to ensure sufficient tempering. As a general rule the tempering parameter (P), should be 21, or higher, to achieve adequate tempering.

$$P = °C + 273(20 + \log t) \times 10^{-3} \quad (t = \text{time in hours})$$

Suggested conditions are 12h at 730°C or 3h at 760°C.

Related alloy groups


This alloy is closely related to the P91 alloy (data sheet A-17) and P92 alloy (data sheet A-20). The 9CrWV TIG wire (A-20) can be used in conjunction with Chromet 10MW. Also see alloy 921 (data sheet A-25).

Products available

Process	Product	Specification
MMA	Chromet 10MW	--
FCW	Cormet 10MW	--

CHROMET 10MW

MMA electrode for E911 creep-resisting steel

Product description	MMA electrode with a basic low hydrogen flux system made on high purity steel core wire. Electrode is all-positional with a moisture resistant coating giving very low weld metal hydrogen levels. Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.													
Specifications	AWS A5.5 E9015-G (E9015-B9 modified)													
ASME IX Qualification	QW432 F-No --, QW442 A-No --													
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	W	Nb	V	N	Al
	min	0.08	0.50	0.15	--	--	9.0	0.40	0.85	0.85	0.04	0.18	0.03	--
	max	0.14	1.20	0.30	0.01	0.02	10.5	0.80	1.2	1.2	0.08	0.25	0.07	0.02
	typ	0.11	0.8	0.25	0.008	0.010	9.5	0.5	1	1	0.05	0.22	0.05	0.01
All-weld mechanical properties	Typical after PWHT: 730°C/12h										typical			
	Tensile strength						MPa	760						
	0.2% Proof stress						MPa	620						
	Elongation on 5d						%	19						
	Reduction of area						%	62						
	Impact energy						J	60						
	Hardness						HV	250						
Operating parameters	DC +ve or AC (OCV: 70V min) 													
	∅ mm	3.2			4.0			5.0						
	min A	80			100			140						
	max A	140			180			240						
Packaging data	∅ mm	3.2			4.0			5.0						
	length mm	380			450			450						
	kg/carton	14.4			16.5			16.8						
	pieces/carton	393			225			159						
Storage	<p>3 hermetically sealed ring-pull metal tins per carton, with unlimited shelf life. Direct use from tin will give hydrogen < 5ml/100g for longer than a working shift of 8h.</p> <p>For electrodes that have been exposed: Redry 250 – 300°C/1-2h to ensure H₂ < 10ml/100g, 300 – 350°C/1-2h to ensure H₂ < 5ml/100g. Maximum 420°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	Pb	F	OES (mg/m ³)					
		15	5	<0.2	<3	<0.1	<0.1	18	1.7					

Cormet 10MW

Metal cored wire for E911 creep-resisting steel

Product description	Metal cored wire designed to weld equivalent E911 steels. Metal powder core with an alloyed strip producing weld metal recovery of about 96%.															
Specifications	AWS A5.29 No current national standards.															
ASME IX Qualification	QW432 F-No -, QW442 A-No -															
Composition (wire wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	W	Nb	V	N	B	Al	Cu
	Min	0.08	0.50	--	--	--	9.0	0.40	0.9	0.9	0.04	0.18	0.03	--	--	--
	Max	0.13	1.20	0.40	0.015	0.02	10.0	0.85	1.2	1.2	0.08	0.25	0.07	0.0015	0.04	0.1
	Typ	0.11	0.8	0.30	0.01	0.017	9.5	0.6	1.0	1.0	0.05	0.2	0.05	0.0005	0.01	0.05
All-weld mechanical properties	PWHT 755°C / 3h											typical				
	Tensile strength											770				
	0.2% Proof stress											650				
	Elongation on 4d											11				
	Elongation on 5d											9				
	Reduction of area											20				
	Impact energy											+ 20°C 14				
Hardness											260					
Operating parameters	Shielding gas: Ar + 2.5-20%CO ₂ at 20-25l/min (operability is improved at higher CO ₂ contents but impact properties are better with lower CO ₂ contents).															
	Current: DC+ve ranges as below:															
	∅	amp-volt range										stickout				
1.2mm (0.045in)	260A, 28V										15-25mm					
Packaging data	Spools vacuum-sealed in barrier foil with cardboard carton: 15kg (33 lbs) 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.															
Fume data	Fume composition (wt %), shielding gas 80%Ar-20%CO ₂ :															
		Fe	Mn	Ni	Cr ³	Cu	Pb	OES (mg/m ³)								
		60	5	< 0.5	5	< 0.1	< 0.1	5.0								