

# Low Alloy Steels

DATA SHEET

A-16

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## 9CrMo FOR ELEVATED TEMPERATURE

### Alloy type

9%Cr-1%Mo martensitic alloy for elevated temperature service.

### Materials to be welded

#### plates:

**ASTM** A387 grade 9

#### pipe/tube:

**ASTM** A335 grade 9  
 A234 grade WP9 (fittings)  
 A199 grade T9  
 A213 grades T9  
**BS** 3604 grades CFS & HFS 629-470, CFS & HFS 629-590  
**DIN** X12CrMo 9 1 (1.7386)  
 X7CrMo 9 1 (1.7388)

#### forgings:

**ASTM** A182 grade F9  
 A336 grade F9

#### cast:

**ASTM** A217 grade C12  
**BS** 1504 grade 629  
 3100 grade B6  
**DIN** GS-12CrMo 10 1 (1.7389)

### Applications

For elevated temperature service up to 600°C, with reasonable degree of corrosion resistance in superheated steam, hot hydrogen gas and high sulphur crude oils, where higher performance than 5%Cr-0.5%Mo steels is required.

Used primarily for **boiler superheater tubing, heat exchangers, piping and pressure vessels in oil refineries and power plants.**

### Microstructure

In the PWHT condition the microstructure consists of tempered martensitic bainite.

### Welding guidelines

Owing to the as-deposited hardness (up to 450HV) and the relatively poor fracture resistance of the martensitic 9CrMo microstructure, a preheat and minimum interpass temperature of 200°C shall be applied to ensure freedom from hydrogen induced cracking. Properly controlled and handled electrodes will provide weld metal with hydrogen <5ml/100g. For TIG root runs or all-TIG welds, a lower preheat of 150°C may be acceptable.

During welding, full transformation may not be complete within a working range of 200-350°C, so partial cooling to around 150°C is advised before direct transfer to PWHT, followed by NDE. If PWHT will be applied after complete cool out and NDE, the preheat temperature should be maintained for some time, according to thickness, to promote hydrogen dispersal. The latter precaution is less significant for the TIG and solid wire MAG processes.

### PWHT


PWHT to temper the weldment would normally be in the range 705-780°C (eg. BS2633 710-750°C, PD5500 740-780°C, ASME B31.3 705-760°C). Minimum holding time recommended is two hours. For castings the minimum suggested PWHT temperature is lower, with temperatures as low as 670°C being specified.

### Products available

Process	Product	Specification
MMA	<b>Chromet 9</b>	AWS E8015-B8
TIG/MIG	<b>9CrMo</b>	AWS ER80S-B8
FCW	<b>Cormet 9</b>	AWS E81T1-B8

# CHROMET 9

9%Cr-1%Mo MMA electrode

<b>Product description</b>	<p>Basic metal powder type made on high purity low carbon core wire. Moisture resistant coating giving very low weld metal hydrogen levels.</p> <p>Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.</p>												
<b>Specifications</b>	<p><b>AWS A5.5</b> E8015-B8  <b>AWS A5.4</b> E505-15  <b>BS EN ISO 3580-A</b> E CrMo9 B 3 2 H5  <b>BS EN ISO 3580-B</b> E 6216-9C1M  <b>BS 2493</b> 9CrMoBH  <b>DIN 8575</b> ECrMo9 B26</p>	<p>This classification has now been withdrawn from A5.4</p>											
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 4, <b>QW442</b> A-No 5												
<b>Composition (weld metal wt %)</b>		C *	Mn	Si	S	P	Cr	Ni	Mo	Cu			
	min	0.05	0.50	--	--	--	8.0	--	0.90	--			
	max	0.10	1.00	0.60	0.025	0.025	10.0	0.40	1.20	0.3			
	typ	0.06	0.75	0.35	0.012	0.015	9	0.2	1	<0.05			
	* Carbon 0.05-0.10% for E8015-B8 (<0.05% for E8015-B8L, made to order).												
<b>All-weld mechanical properties</b>	Typical PWHT				min *	740°C/2h typical	746°/3h typical						
	Tensile strength				MPa	590	710	680					
	0.2% Proof stress				MPa	460	600	550					
	Elongation on 4d				%	19	22	26					
	Elongation on 5d				%	18	20	25					
	Reduction of area				%	--	70	70					
	Impact energy				+ 20°C	J	34	90	130				
					0°C	J	--	50	--				
					-10°C	J	--	25	90				
	Hardness				HV	--	235	220					
	AWS PWHT is 732-760°C /1 hour. BS EN PWHT is 740-780°C/2 hours. See front page under PWHT for normal fabrication practice.												
	* ASTM base material minimum varies in the range 414-586MPa depending on grade.												
<b>Operating parameters</b>	DC +ve or AC (OCV: 70V min)												
	ø mm	2.5	3.2	4.0	5.0								
	min A	70	80	100	140								
	max A	110	140	180	240								
<b>Packaging data</b>	ø mm	2.5	3.2	4.0	5.0								
	length mm	350	380	450	450								
	kg/carton	11.7	15.0	17.4	16.5								
	pieces/carton	612	399	249	150								
<b>Storage</b>	<p><b>3 hermetically sealed ring-pull metal tins</b> per carton, with unlimited shelf life. Direct use from tin will give hydrogen &lt; 5ml/100g weld metal during 8h working shift.</p> <p>For electrodes that have been exposed:  <b>Redry</b> 250 – 300°C/1-2h to ensure H<sub>2</sub> &lt; 10ml/100g, 300-350°C/1-2h to ensure H<sub>2</sub> &lt; 5ml/100g. Maximum 420°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>	Fume composition, wt % typical:												
	Fe	Mn	Ni	Cr	Cu	Pb	F	OES (mg/m <sup>3</sup> )					
	15	5	<0.1	2.5	<0.2	<0.1	18	2					

# 9CrMo

TIG and MIG copper coated wire for 9%Cr-1%Mo

<b>Product description</b>	Solid copper coated wire for TIG and MIG.										
<b>Specifications</b>	<b>AWS A5.28</b> ER80S-B8 <b>AWS A5.9</b> ER505 <b>BS EN ISO 21952-A</b> CrMo9 <b>BS 2901: Pt1</b> A35 <b>DIN 8575</b> SG CrMo9 (1.7388)		This classification has now been withdrawn from A5.9								
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 6, <b>QW442</b> A-No 5										
<b>Composition (wire wt %)</b>		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	
	min	0.06	0.40	0.30	--	--	8.5	--	0.80	--	
	max	0.10	0.60	0.50	0.020	0.020	10.0	0.5	1.20	0.35	
	typ	0.07	0.5	0.4	0.01	0.015	9	0.1	0.9	0.1	
<b>All-weld mechanical properties</b>	Typical values after 745°C/1h:						min	TIG			
	Tensile strength				MPa		590	730			
	0.2% Proof stress				MPa		470	612			
	Elongation on 4d				%		17	25			
	Impact energy				+ 20°C J		--	80			
	Hardness cap/mid				HV		--	225/230			
<b>Typical operating parameters</b>		TIG					MIG				
	Shielding	Argon *					Ar + 1-3%O <sub>2</sub> or 5-20% CO <sub>2</sub>				
	Current	DC-					DC+				
	Diameter	2.4mm					1.2mm				
	Parameters	140A, 14V					260A, 26V				
	* Also required as a purge for root runs.										
<b>Packaging data</b>	ø mm	TIG					MIG				
	1.2	--					To order				
	1.6	5kg tube					--				
	2.4	5kg tube					--				
	3.2	To order					--				
<b>Fume data</b>	MIG fume composition (wt %) (TIG fume negligible):										
		Fe	Mn	Cr <sup>3</sup>	Ni	Mo	Cu	OES (mg/m <sup>3</sup> )			
		50	4	6	<0.1	<0.5	1.2	5			

## CORMET 9

All-positional flux cored wire

<b>Product description</b>	Cormet 9 is an all-positional flux cored wire suitable for welding fixed pipework. Made using a high purity steel sheath with a metal recovery of about 90% with respect to the wire.										
<b>Specifications</b>	<b>AWS A5.29</b>		E81T1-B8C/M								
	<b>BS EN ISO 17634-B</b>		T55T1-1C/M-9C1M								
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 6, <b>QW442</b> A-No 5										
<b>Composition (weld metal wt %)</b>		C	Mn	Si	S	P	Cr	Mo	Cu	Ni	
	min	0.05	--	--	--	--	8.0	0.85	--	--	
	max	0.12	1.25	1.00	0.030	0.030	10.5	1.20	0.5	0.4	
	typ	0.06	0.8	0.3	0.01	0.01	9	1.0	0.05	0.3	
<b>All-weld mechanical properties</b>	PWHT 745°C/2h *						min	typical			
	Tensile strength					MPa	550	640			
	0.2% Proof stress					MPa	470	500			
	Elongation on 4d					%	19	24			
	Elongation on 5d					%	17	21			
	Reduction of area					%	--	65			
* BS EN ISO-B requires 1 hour PWHT. AWS Requires 2 hour PWHT.											
<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 80%. The wire is also suitable for use with 100%CO <sub>2</sub> . (Note: for 100%CO <sub>2</sub> shielding gas, voltage should be 1-2V higher.)										
	<b>Current:</b> DC+ve ranges as below:										
	∅ mm	amp-volt range					typical	stickout			
1.2	160 – 260A, 24-30V					190A, 25V	15 – 25mm				
<b>Packaging data</b>	Spools vacuum-sealed in barrier foil with cardboard carton: 1.2mm diameter 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> )			
	20	8	< 0.5	3	3	< 1	8	1.7			