

# Low Alloy Steels

## DATA SHEET

## A-23

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## CONSUMABLES FOR WB36

### Alloy type

WB36 is a NiMo base material with Cu and Nb additions with good hot strength. Although consumables of matching composition are not used compatible alternatives have been found to provide the required properties.

### Materials to be welded

The consumables listed on this data sheet can be used for a wide variety of applications (see also data sheets A-50, A-61 and A-64) but this data sheet concentrates on the welding of:

<b>DIN</b>	15NiCuMoNb5 1.6368
<b>BS EN 10216-2</b>	15NiCuMoNb5-6-4 1.6368
<b>BS 3604</b>	Grade 591
<b>ASTM</b>	Code Case 2353 A182 F36, A213 T36 & A335 P36
<b>Proprietary</b>	WB36 (V+M)

### Applications

WB36 is a high temperature construction steel for service up to 450°C; typical applications are below 400°C designed on the basis of tensile rather than creep properties. It is mainly used for **feedwater piping systems** in place of standard carbon steels (eg. A106 grade C) in conventional and nuclear power stations. WB36 also finds applications for **headers, manifolds and fittings** in power stations.

### Microstructure

In the stress relieved condition the microstructure consists of tempered ferrite/bainite.

### Welding guidelines

The actual preheat and PWHT requirements will depend on the thickness of the base material being welded. Normally preheat/interpass temperatures will be in the range 100-250°C depending on wall thickness.

### PWHT

WB36 is tempered during manufacture in the temperature range 580-680°C, depending on specifications and requirements and following welding PWHT is required for WB36. The PWHT requirements will depend on a number of factors but will normally be about 590±30°C.

### Additional information

There is a Technical Profile P36 and the related welding consumables.

For **offshore oil well-head process pipework and fittings**, after PWHT these low nickel consumables satisfy NACE MR0175 requirements (<1%Ni & <22HRC) intended to ensure resistance to sulphide-induced stress corrosion cracking in sour service, combined with good sub-zero toughness.


Also find applications for the repair of medium strength low alloy steel castings where a stress-relief only (rather than N+T) is to be applied.

### Products available

Process	Product	Specification
MMA	<b>1NiMo.B</b>	AWS E9018-G
TIG/MIG	<b>MnMo</b>	AWS ER80S-D2
SAW	<b>SA1NiMo (wire)</b>	AWS EF3
	<b>LA436 (flux)</b>	BS EN SA AB 167

# 1NiMo.B

## All-positional NiMo low alloy steel MMA electrode

<b>Product description</b>	MMA electrode with a basic flux coating on high purity mild steel core wire. Moisture resistant coating provides very low weld metal hydrogen levels. Recovery is about 120% with respect to core wire, 65% with respect to whole electrode.										
<b>Specifications</b>	<b>AWS A5.5</b>	E9018-G									
	<b>BS EN 757</b>	E 55 4 1NiMo B 32									
	<b>Approvals</b>	TÜV, DNV									
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 4, <b>QW442</b> A-No 10										
<b>Composition (weld metal wt %)</b>		C	Mn	Si	S	P	Cr	Ni	Mo	Cu	V
	min	0.04	1.0	--	--	--	--	0.8	0.20	--	--
	max	0.07	1.4	0.5	0.020	0.025	0.3	1.2	0.50	0.10	0.03
	typ	0.06	1.2	0.3	0.01	0.01	0.1	1.0	0.4	0.05	0.01
<b>All-weld mechanical properties</b>	PWHT 590-620°C/1-2h:				min	typical	High Temperature				
							250°C	350°C	450°C		
	Tensile strength				MPa	620	720	650	640	545	
	0.2% Proof stress				MPa	530	645	505	445	432	
	Elongation on 4d				%	17	26	22	28	24	
	Elongation on 5d				%	--	23	--	--	--	
	Reduction of area				%	--	65	57	69	73	
<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		350		450		450			
	kg/carton	12.9		13.5		16.8		18.0			
	pieces/carton	546		369		240		171			
<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 for longer than a working shift of 8h.</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.</p> <p><b>Storage</b> of redried electrodes at 50 – 150°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	F	OES (mg/m <sup>3</sup> )			
		14	5	0.5	<0.1	<0.2	18	5			

# MnMo

Solid MnMo low alloyed wire for TIG and MIG

<b>Product description</b>	Solid copper coated wire for TIG and MIG.									
<b>Specifications</b>	<b>AWS A5.28</b>		ER80S-D2, ER90S-D2							
	<b>BS EN 440</b>		(G4Mo)							
	<b>BS 2901: Pt1</b>		A31							
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 6, <b>QW442</b> A-No 11									
<b>Composition (wire wt %)</b>		C	Mn	Si	S	P	Ni	Mo	Cu	
	min	0.07	1.60	0.50	--	--	--	0.40	--	
	max	0.12	2.10	0.80	0.025	0.025	0.15	0.60	0.4	
	typ	0.1	1.9	0.6	0.005	0.01	0.05	0.5	0.1	
<b>All-weld mechanical properties</b>	Typical values PWHT 590-620°C/1-2h			min *	TIG	MIG		High Temperature (TIG)		
						Ar + 5%CO <sub>2</sub>	Ar + 20%CO <sub>2</sub>	250°C	350°C	450°C
	Tensile strength		MPa	550	640	725	605	650	665	585
	0.2% Proof stress		MPa	470	530	625	490	525	490	460
	Elongation on 4d		%	17	32	28	25	24	27	25
	Impact energy	- 30°C	J	27	200	>100	>100	--	--	--
	Hardness cap/mid		HV	--	235/210	235/220	220/205	--	--	--
* Minimum as-welded values are for AWS <b>ER80S-D2</b> . As shown MAG welds using more oxidising shielding gas (higher CO <sub>2</sub> + O <sub>2</sub> ) have lower strength. The AWS classification for ER80S-D2 is based on 100%CO <sub>2</sub> which is seldom used; alternatively this wire can also be classified as <b>ER90S-D2</b> using low CO <sub>2</sub> gas mixtures.										
<b>Typical operating parameters</b>		TIG			MIG					
	Shielding	Argon			Ar + 5-20%CO <sub>2</sub> *					
	Current	DC-			DC+					
	Diameter	2.4mm			1.2mm					
	Parameters	120A, 14V			280A, 26V					
* Ar + 5%CO <sub>2</sub> provides the highest strength and best impact properties, see above. Other proprietary gas mixtures also suitable.										
<b>Packaging data</b>	ø mm	TIG			MIG					
	1.2	--			15kg spool					
	1.6	5kg tube			--					
	2.0	5kg tube			--					
	2.4	5kg tube			--					
	3.2	5kg tube			--					
<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> )		
		55	10	<0.1	<0.1	<0.5	1.2	5		

# SA1NiMo

Solid NiMo alloyed wire for SAW

<b>Product description</b>	Solid copper coated wire for submerged arc welding. Nominal composition of 1%Ni-0.5%Mo capable of achieving 90ksi (620MPa) tensile strength. Supplied to NACE MR0175 1.0%Ni maximum on request.										
<b>Specifications</b>	<b>AWS A5.23</b>		EF3								
	<b>BS EN 756</b>		S3Ni1Mo								
<b>ASME IX Qualification</b>	<b>QW432</b> F-No 6, <b>QW442</b> A-No 10 (Nearest)										
<b>Composition (wire wt %)</b>		C	Mn	Si	S	P	Ni *	Mo	Cr	Cu	
	min	0.08	1.30	0.05	--	--	0.8	0.45	--	--	
	max	0.15	2.40	0.25	0.020	0.020	1.2	0.65	0.20	0.30	
	typ	0.10	1.75	0.2	0.005	0.01	0.9	0.55	0.05	0.1	
	* Ni supplied to 1.0% maximum (NACE MR0175) on request.										
<b>All-weld mechanical properties</b>	Typical values as-welded & PWHT					AW	590°C/2h				
	Tensile strength				MPa	700	680				
	0.2% Proof stress				MPa	600	560				
	Elongation on 4d				%	20	28				
	Impact energy			+20°C	J	90	140				
<b>Typical operating parameters</b>	SAW										
	Shielding		LA436 flux								
	Current		DC+								
	Diameter		2.4mm								
	Parameters		450A, 30V, 450mm/min								
<b>Packaging data</b>	ø mm		SAW								
	1.6		25kg coil								
	2.4		25kg coil								
	3.2		25kg coil To order								
	4.0		25kg coil								
<b>Fume data</b>	Fume composition (wt %) (SAW fume negligible)										
		Fe	Mn	Cr <sup>3</sup>	Ni	Mo	Cu	OES (mg/m <sup>3</sup> )			
		50	10	<0.5	<0.5	<1.5	1.2	5			