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:

DIN	15NiCuMoNb5 1.6368
BS EN 10216-2	15NiCuMoNb5-6-4 1.6368
BS 3604	Grade 591
ASTM	Code Case 2353 A182 F36, A213 T36 & A335 P36
Proprietary	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	**1NiMo.B**	AWS E9018-G
TIG/MIG	**MnMo**	AWS ER80S-D2
SAW	**SA1NiMo (wire)**	AWS EF3
	LA436 (flux)	BS EN SA AB 167

1NiMo.B

All-positional NiMo low alloy steel MMA electrode

Product description

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.

Specifications

AWS A5.5	E9018-G
BS EN 757	E 55 4 1NiMo B 32
Approvals	TÜV, DNV

ASME IX Qualification

QW432 F-No 4, **QW442** A-No 10

Composition (weld metal wt %)

	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

All-weld mechanical properties

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

Operating parameters

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

Packaging data

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

Storage

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.
For electrodes that have been exposed:
Redry 250 – 300°C/1-2h to ensure H_2 < 10ml/100g, 300 – 350°C/1-2h to ensure H_2 < 5ml/100g. Maximum 420°C, 3 cycles, 10h total.
Storage 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): < 60% RH, > 18°C.

Fume data

Fume composition, wt % typical:

Fe	Mn	Ni	Cr	Cu	F	OES (mg/m^3)
14	5	0.5	<0.1	<0.2	18	5

MnMo

Solid MnMo low alloyed wire for TIG and MIG

Product description

Solid copper coated wire for TIG and MIG.

Specifications

AWS A5.28 ER80S-D2, ER90S-D2
BS EN 440 (G4Mo)
BS 2901: Pt1 A31

ASME IX Qualification

QW432 F-No 6, **QW442** A-No 11

Composition (wire wt %)

	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

All-weld mechanical properties

Typical values PWHT 590-620°C/1-2h			min *	TIG	MIG		High Temperature (TIG)		
					Ar + 5%CO_2	Ar + 20%CO_2	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 **ER80S-D2**. As shown MAG welds using more oxidising shielding gas (higher CO_2 + O_2) have lower strength. The AWS classification for ER80S-D2 is based on 100%CO_2 which is seldom used; alternatively this wire can also be classified as **ER90S-D2** using low CO_2 gas mixtures.

Typical operating parameters

	TIG	MIG
Shielding	Argon	Ar + 5-20%CO_2 *
Current	DC-	DC+
Diameter	2.4mm	1.2mm
Parameters	120A, 14V	280A, 26V

* Ar + 5%CO_2 provides the highest strength and best impact properties, see above. Other proprietary gas mixtures also suitable.

Packaging data

ø mm	TIG	MIG
1.2	--	15kg spool
1.6	5kg tube	--
2.0	5kg tube	--
2.4	5kg tube	--
3.2	5kg tube	--

Fume data

MIG fume composition (wt %) (TIG fume negligible)

Fe	Mn	Cr^3	Ni	Mo	Cu	OES (mg/m^3)
55	10	<0.1	<0.1	<0.5	1.2	5

SA1NiMo

Solid NiMo alloyed wire for SAW

Product description

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.

Specifications

AWS A5.23 EF3
BS EN 756 S3Ni1Mo

ASME IX Qualification

QW432 F-No 6, **QW442** A-No 10 (Nearest)

Composition (wire wt %)

	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.

All-weld mechanical properties

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

Typical operating parameters

	SAW
Shielding	LA436 flux
Current	DC+
Diameter	2.4mm
Parameters	450A, 30V, 450mm/min

Packaging data

ø mm	SAW	
1.6	25kg coil	
2.4	25kg coil	
3.2	25kg coil	To order
4.0	25kg coil	

Fume data

Fume composition (wt %) (SAW fume negligible)

Fe	Mn	Cr^3	Ni	Mo	Cu	OES (mg/m^3)
50	10	<0.5	<0.5	<1.5	1.2	5