

Low Alloy Steels

DATA SHEET

A-40

METRODE PRODUCTS LTD
HANWORTH LANE, CHERTSEY
SURREY, KT16 9LL

Tel: +44(0)1932 566721
Fax: +44(0)1932 565168 Sales
Fax: +44(0)1932 569449 Technical
Fax: +44(0)1932 566199 Export
Email: info@metrode.com
Internet: http://www.metrode.com

1%Ni FOR IMPROVED TOUGHNESS

Alloy type

Low alloy steel alloyed with nominally 1%Ni for improved toughness. Actual Ni content is kept below 1% to ensure conformance with NACE MR0175.

Materials to be welded

CMn steels with yield stress of 450MPa or where good toughness is required down to -50°C , such as:

- ASTM** A333 & A334 Grade 6.
A350 Grades LF2 & LF5.
A352 Grades LCB & LCC (cast).
- API** 5L X65.
- BS** 4360 Grades 43E, 50E, 55C, 55EE, 55F.

Applications

For welding higher strength steel structures where PWHT is impracticable so that welds must possess an appropriate degree of toughness and crack resistance.

The addition of about 1%Ni promotes microstructural refinement, with improved tolerance to procedural variations compared to plain CMn weld metal. Nickel also increases atmospheric weathering resistance and improves electrochemical balance between weld and base metal, thus minimising preferential weld area corrosion in marine environments. For offshore oilfield sour service, a maximum of 1.0%Ni is commonly required (NACE MR0175).

Also recommended where design requirements specify toughness testing of higher strength low alloy steel welds down to -50°C eg. **offshore construction, pipelines and pressure vessels.**

Microstructure

In the as-welded condition the microstructure is ferritic with a component of acicular ferrite for optimum toughness.

Welding guidelines

Preheat will dependent on the grade and thickness of the base material.

Related alloy groups

The 2%Ni (data sheet A-41) and 3%Ni (data sheet A-42) are also designed for applications requiring low temperature toughness.

Products available

Process	Product	Specification
MMA	Tufmet 1Ni.B	AWS E8018-C3
TIG/MIG	1Ni	AWS ER80S-Ni1
FCW	Metcore DWA55E	AWS E71T-5

TUFMET 1Ni.B

1%Ni MMA electrode for good low temperature toughness

Product description	MMA electrode with a basic, metal powder, type flux on high purity low carbon core wire. 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	E8018-C3										
	BS EN ISO 2560-A	E 46 6 1Ni B 42										
	BS EN ISO 2560-B	E5518-N2 A U										
	BS 2493	(1Ni.BH)										
	DIN 8529	EY 4675 1NiB										
	Conforms with	NACE MR0175										
ASME IX Qualification	QW432 F-No 4, QW442 A-No 10											
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	V	Nb	Cu
	min	--	0.80	0.20	--	--	--	0.80	--	--	--	--
	max	0.10	1.20	0.50	0.030	0.030	0.15	1.00*	0.2	0.05	0.05	0.3
	typ	0.05	1	0.3	0.015	0.015	0.05	0.9	0.1	0.01	<0.05	0.05
	* BS and AWS 1.10%Ni max.											
All-weld mechanical properties	As welded				min		typical					
	Tensile strength				MPa	550-680	610					
	0.2% Proof stress				MPa	470-550	520					
	Elongation on 4d				%	24	27					
	Elongation on 5d				%	20	25					
	Reduction of area				%	--	70					
	Impact energy						150					
					- 20°C	J	--					
					- 40°C	J	120					
					- 50°C	J	80					
					- 60°C	J	47					
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	380	450	450							
	kg/carton	12.0	13.5	16.8	16.2							
	pieces/carton	627	390	243	162							
Storage	<p>3 hermetically sealed ring-pull metal tins per carton, with unlimited shelf life. Direct use from tin will give hydrogen <5ml/100g weld metal during 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)			
		14	5	< 0.5	< 0.1	0.2	< 0.1	18	5			

1Ni

1%Ni wire for improved toughness

Product description	Solid copper coated wire for TIG and MIG.											
Specifications	AWS A5.28					ER80S-Ni1						
	BS EN 440 & BS EN ISO 636-A					(G3Ni1 – MIG; W3Ni1 – TIG)						
ASME IX Qualification	QW432 F-No 6, QW442 A-No 10											
Composition (wire wt %)		C	Mn	Si	S	P	Cr	Ni	Mo *	Cu	V	
	min	0.06	0.80	0.40	--	--	--	0.80	--	--	--	
	max	0.12	1.25	0.80	0.015	0.020	0.15	1.00	0.35	0.35	0.05	
	typ	0.10	1	0.5	0.010	0.010	0.05	0.9	0.02	0.2	0.01	
	* Most wire has a typical Mo of 0.02% but some batches will have typically 0.3% Mo.											
All-weld mechanical properties	Typical values as welded					min *	TIG	MAG Ar + 5%CO ₂				
	Tensile strength					MPa	550	550-650	571			
	0.2% Proof stress					MPa	470	460-510	475			
	Yield strength					MPa	--	472	498			
	Elongation on 4d					%	24	32	35			
	Impact energy					J	27	> 120	> 130			
						J	--	> 110	> 50			
Hardness cap/mid					HV	--	195/240	190/205				
	* Minimum as-welded properties according to AWS. All-weld tests show actual proof stress values close to minimum or slightly lower, depending on process, shielding gas and Mo content (higher Mo wires produce the higher typical strengths reported). However, note that yield point is typically 10-20MPa above the 0.2% proof stress, and in either case, exceeds 450MPa (65ksi).											
Typical operating parameters		TIG			MIG							
	Shielding	Argon			Ar + 5-20%CO ₂ *							
	Current	DC-			DC+							
	Diameter	2.4mm			1.2mm							
	Voltage	120A, 14V			280A, 26V							
	* Ar + 1-5%O ₂ and proprietary mixtures also suitable.											
Packaging data	ø mm	TIG			MIG							
	1.0	--			15kg spool							
	1.2	--			15kg spool							
	1.6	5kg tube			--							
	2.0	to order			--							
	2.4	5kg tube			--							
	3.0 (not 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	6	< 0.1	0.5	< 0.1	1.2	5				

METCORE DWA 55E

Ni alloyed all-positional flux cored wire

Product description	<p>Flux cored wire with a rutile flux system for spray transfer at low currents and easy operation in all welding positions. The wire is alloyed with about 0.4%Ni and provides good as-welded ed toughness down to -40°C. Low moisture potential giving weld metal hydrogen content of typically < 5ml/100g.</p> <p>Metal recovery 90% with respect to wire.</p>																							
Specifications	<p>AWS A5.20 E71T-5 (MJ)* BS EN ISO 17632-A T42 4 P M 1 H5 BS EN ISO 17632-B T494T12-1MAP-H5 BS 7084 T541 GPH</p> <p>* Meets suffix M (Ar+20%CO₂) and J (27J at -40°C) requirements. Note that the new classification E71T-9MJ introduced in AWS A5.20-95 is strictly more appropriate.</p>																							
ASME IX Qualification	QW432 F-No 6, QW442 A-No 1																							
Composition (weld metal wt %)		C	Mn	Si	S	P	Cr	Ni	Mo	V														
	min	--	--	--	--	--	--	0.30	--	--														
	max	0.08	1.75	0.90	0.03	0.03	0.20	0.50	0.30	0.08														
	typ	0.05	1.1	0.5	0.01	0.02	< 0.1	0.35	< 0.1	0.02														
All-weld mechanical properties	As welded (PWHT with caution)				min *	typical as-welded		600 °C/4h **																
	Tensile strength		MPa		480	580		575																
	0.2% Proof stress		MPa		400	500		485																
	Elongation on 4d		%		22	32		29																
	Impact energy		- 40°C		J	115		>27																
	Hardness		HV		--	190		180																
	<p>* As specified by AWS A5.20 E71T-5MJ as-welded. ** PWHT has a detrimental effect on impact energy but all batches are impact tested after PWHT of 600°C/4h.</p>																							
Operating parameters	<p>Shielding gas: 80%Ar-20%CO₂ at 20-25l/min. Proprietary gases may be used but argon should not exceed 80%.</p> <p>Current: DC+ve ranges as below:</p> <table border="1"> <thead> <tr> <th>ø mm</th> <th>amp-volt range</th> <th>typical</th> <th>stickout</th> </tr> </thead> <tbody> <tr> <td>1.2</td> <td>130-300A, 16-32V</td> <td>232A, 26V</td> <td>15-25mm</td> </tr> </tbody> </table>										ø mm	amp-volt range	typical	stickout	1.2	130-300A, 16-32V	232A, 26V	15-25mm						
ø mm	amp-volt range	typical	stickout																					
1.2	130-300A, 16-32V	232A, 26V	15-25mm																					
Packaging data	<p>Spools supplied in cardboard carton: 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.</p>																							
Fume data	<p>Fume composition (wt %)</p> <table border="1"> <thead> <tr> <th>Fe</th> <th>Mn</th> <th>Cr</th> <th>Ni</th> <th>Cu</th> <th>F</th> <th>OES (mg/m³)</th> </tr> </thead> <tbody> <tr> <td>33</td> <td>12</td> <td>< 0.5</td> <td>< 0.1</td> <td>< 0.5</td> <td>2</td> <td>5</td> </tr> </tbody> </table>										Fe	Mn	Cr	Ni	Cu	F	OES (mg/m ³)	33	12	< 0.5	< 0.1	< 0.5	2	5
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33	12	< 0.5	< 0.1	< 0.5	2	5																		