Low Alloy Steels

DATA SHEET **A-15**

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5CrMo FOR ELEVATED TEMPERATURE

Alloy type

5%Cr-½%Mo steel for elevated temperature service up to 600°C.

Materials to be welded

plates:

ASTM	A387 grade 5

pipe/tube:

ASTM	A335 grades P5, P5b A234 grade WP5 (fittings) A199 grade T5 A213 grades T5, T5b
BS	3604 grades HFS 625, CFS 625
DIN	12CrMo 19 5 (1.7362) X7CrMo 6 1 (1.7373) X11CrMo 6 1 (1.7374)

forgings:

ASTM	A182 grade F5, F5a A336 grade F5
BS	1503 grade 625 1501 grade 625 (section & bar)

cast:

ASTM	A217 grade C5
BS	1504 grade 625 3100 grade B5
DIN	GS-12CrMo 19 5 (1.7353, 1.7363)

Applications

For elevated temperature service up to 600ºC, with corrosion resistance in superheated steam, hot hydrogen gas and high sulphur crude oils.

Used primarily for **boiler superheaters, heat exchangers, piping** and **pressure vessels** in **oil refineries.**

This weld metal has also been used successfully for subsequent **nitriding**, for example in the repair of 3Cr-1Mo-V and 2Cr-Mo-1A1 (BS En40C, En41) steels used for **moulds** for injection-moulding of plastics.

Microstructure

In the PWHT condition the microstructure consists of tempered bainite.

Welding guidelines

Owing to the as-deposited hardness (up to 400HV) and the relatively poor fracture resistance of the 5CrMo bainitic microstructure, a preheat and minimum interpass temperature of 200°C should be applied to ensure freedom from hydrogen induced cold 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, though it should be recognised that faster cooling rates may lead to partially martensitc and harder deposits.

Full transformation of 5CrMo during welding will be completed within a 200-350°C working range, so direct transfer (at >150°C) to PWHT is permissible, followed by NDE. If PWHT will be applied after complete cool out and NDE, the preheat temperature should be maintained for some time after welding, 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 705-760°C (eg. BS2633 & PD5500 710-750°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	**Chromet 5**	AWS E8015-B6
TIG/MIG	**5CrMo**	AWS ER80S-B6
FCW	**Cormet 5**	AWS E81T1-B6

CHROMET 5

5%Cr-0.5%Mo MMA electrode

Product description

Basic metal powder type made on high purity low carbon core wire. Moisture resistant coating gives 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	E8015-B6	
AWS A5.4	E502-15	This classification has now been withdrawn from A5.4
BS EN ISO 3580-A	E CrMo5 B 3 2 H5	
BS EN ISO 3580-B	E 6216-5CM	
BS 2493	(5CrMoBH)	
DIN 8575	ECrMo5 B26	

ASME IX Qualification

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

Composition (weld metal wt %)

	C *	Mn	Si	S	P	Cr	Ni	Mo	Cu
min	0.05	0.50	--	--	--	4.0	--	0.45	--
max	0.10	1.00	0.80	0.025	0.025	6.0	0.40	0.65	0.3
typ	0.06	0.8	0.40	0.01	0.015	5	0.2	0.55	0.05

* Carbon 0.05-0.10% for E8015-B6 (<0.05% for E8015-B6L made to order).

All-weld mechanical properties

Typical properties after PWHT *			745°C/1h **		740°C/2h	745°C/3h
			min.	typical	typical	typical
Tensile strength		MPa	550 ***	610	610	540
0.2% Proof stress		MPa	460	500	480	360
Elongation on 4d		%	19	25	23	28
Elongation on 5d		%	18	22	20	25
Reduction of area		%	--	69	71	74
Impact energy	+ 20°C	J	--	150	130	140
	- 10°C	J	--	80	50	50
Hardness cap/mid		HV	--	210/205	210/200	205/160

* AWS A5.4 requires a PWHT of 840-870°C/2h, (this PWHT is never applied in practice so is not shown).
** This is the AWS A5.5 PWHT (732-760°C/1h). BS is 725-745°C/2h, BS EN & DIN is 730-760°C/1h.
*** BS EN and DIN minimum is 590MPa. There are no base material grades requiring such a high tensile strength ASTM is 414-552MPa dependent on grade.

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	14.4	17.1	16.8
pieces/carton	636	366	246	156

Storage

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 8h working shift.
For electrodes that have been exposed:
Redry 250 – 300°C/1-2h to ensure H_2 < 10ml/100g, 300-350ºC/1-2h to ensure H_2 < 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.

Fume data

Fume composition, wt % typical:

Fe	Mn	Ni	Cr	Cu	Pb	F	OES (mg/m^3)
15	5	<0.1	1.5	<0.2	<0.1	18	3

5CrMo

Solid TIG and MIG wire for 5%Cr-0.5%Mo creep resisting steels

Product description

Solid copper coated wire for TIG and MIG, alloyed with 5%Cr-0.5%Mo.

Specifications

AWS A5.28	ER80S-B6	
AWS A5.9	ER502	This classification has now been withdrawn from A5.9
BS EN ISO 21952-A	CrMo5Si	
BS 2901: Pt2	A34	
DIN 8575	SG CrMo5 (1.7373)	

ASME IX Qualification

QW432 F-No 6, **QW442** A-No 4

Composition (wire wt %)

	C	Mn	Si	S	P	Cr	Ni	Mo	Cu	V
min	0.03	0.40	0.30	--	--	5.5	--	0.50	---	--
max	0.10	0.70	0.50	0.020	0.020	6.0	0.3	0.65	0.3	0.03
typ	0.07	0.5	0.4	0.01	0.01	5.7	0.1	0.55	0.2	0.02

All-weld mechanical properties

Typical values after PWHT:			min. *	TIG 745ºC/1h	TIG 740ºC/2h
Tensile strength		MPa	590	640	570
0.2% Proof stress		MPa	470	530	440
Elongation on 4d		%	17	28	25
Elongation on 5d		%	17	25	20
Reduction of area		%	--	72	78
Impact energy	+ 20°C	J	--	240	--
Hardness cap/mid		HV10	--	195/215	--

* Minimum values after PWHT 745ºC (730-760ºC) for 1h according to AWS A5.28 for ER80S-B6 and BS EN 12070.

Typical operating parameters

	TIG	MIG
Shielding	Argon *	Ar + 1-3%O_2 or 5-20% CO_2
Current	DC-	DC+
Diameter	2.4mm	1.2mm
Parameters	140A, 14V	260A, 26V

* Also required as a purge for root runs.

Packaging data

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

Fume data

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

Fe	Mn	Cr^3	Ni	Mo	Cu	OES (mg/m^3)
50	5	3	<0.1	<0.5	1.2	5

CORMET 5

All-positional flux cored wire

Product description

Cormet 5 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.

Specifications

AWS A5.29	E81T1-B6C/M	Concurrent specifications – E502T1-4 will be withdrawn at the next revision of AWS A5.22
AWS A5.22	E502T1-1/4	
BS EN ISO 17634-B	T55T1-1C/M-5CM	

ASME IX Qualification

QW432 F-No 6, **QW442** A-No 4

Composition (weld metal wt %)

	C	Mn	Si	S	P	Cr	Mo	Cu	Ni
min	0.05	--	--	--	--	4.00	0.45	--	--
max	0.10	1.20	0.50	0.030	0.030	6.00	0.65	0.3	0.40
typ	0.06	0.8	0.3	0.01	0.01	5	0.5	0.05	0.01

All-weld mechanical properties

PWHT 745°C/2h *		min	typical
Tensile strength	MPa	550	690
0.2% Proof stress	MPa	470	600
Elongation on 4d	%	19	22
Elongation on 5d	%	17	19
Reduction of area	%	--	67

* BS EN ISO requires 1 hour PWHT. AWS requires 2 hour PWHT.

Operating parameters

Shielding gas: 80%Ar-20%CO_2 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_2. (Note: for 100%CO_2 shielding gas, voltage should be 1-2V higher.)

Current: DC+ve ranges as below:

ø mm	amp-volt range	typical	stickout
1.2	160 – 260A, 24-30V	190A, 25V	15 – 25mm

Packaging data

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.

Fume data

Fume composition (wt %)

Fe	Mn	Ni	Cr^3	Cr^6	Cu	F	OES (mg/m^3)
20	8	< 0.5	1.5	1.5	< 1	8	3.3