Data Sheet A-12

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1¼Cr-½Mo CREEP RESISTING STEEL

Alloy type

1¼Cr-½Mo alloyed steel consumables for elevated temperature service.

Materials to be welded

ASTM

A387 Gr 11 & 12
A182 F11 & F12
A217 WC6 & WC11
A234 WP11 & WP12
A199 T11
A200 T11
A213 T11 & T12
A335 P11 & P12

BS EN & DIN

13CrMo 4-5 (1.7355)
13CrMo 4-4 (1.7335)
16CrMo 4-4 (1.7337)
11CrMo 5-5 (1.7339)
GS-25CrMo 4 (1.7128)
GS-17CrMo 5-5 (1.7357)

BS

1501 Gr 620 & 621
1502 Gr 620
1503 Gr 620 & 621
1504 Gr 621
3100 Gr B2
3604 Gr 620/440 & 621
3059 Gr 620/460

Applications

These consumables are designed for prolonged elevated temperature service up to 550°C. Main areas of application are associated with **steam generating power plant**, eg **piping, turbine castings, steam chests, valve bodies** and **boiler superheaters**. Some of the consumables will also find service in refineries where they are used for **corrosion resistance** to sulphur bearing crude oil at 250-450°C. Some of the consumables will also find applications in the chemical and petro-chemical industries where they are used for **resistance to hydrogen attack** in the fabrication of **hydrocrackers, coal liquefaction plant** and **NH_3 pressure vessels** operating at up to 450°C. In the as-welded condition the consumables also provide a useful source of 300HV hardness weld deposit for build-up or hardsurfacing to resist metal-to-metal wear and heavy impact.

Microstructure

After PWHT, the microstructure consists of tempered bainite.

Welding guidelines

Preheat and interpass temperature 200°C minimum, up to 300°C for thick sections. Maintain throughout welding cycle and some time after completion of welding.

PWHT

Apart from some special applications, PWHT will always be required. PWHT temperature is typically 690°C with time being dependent on section thickness.

Additional information

There are Technical Profiles available which cover some of the consumables on this data sheet. Additional information is available on Chromet 1X and Cormet 1.

Products available

Process	Product	Specification
MMA	**Chromet 1**	AWS E8018-B2
	Chromet 1L	AWS E7015-B2L
	Chromet 1X *	AWS E8018-B2
TIG/MIG	**1CrMo**	BS EN CrMo1Si
	ER80S-B2	AWS ER80S-B2
SAW	**SA 1CrMo**	AWS EB2
	LA436	BS EN ISO SA AB 1
FCW	**Cormet 1**	AWS E81T1-B2

* Chromet 1X is the temper embrittlement resistant (TER) version of Chromet 1.

General Data for all 1¼Cr-½Mo Electrodes

Description	Basic flux, metal powder type coatings on low carbon high purity core wire. Recovery is approximately 115% with respect to the core wire and 65% with respect to whole electrode. Moisture resistant coating gives very low metal hydrogen levels.
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 – 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.
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

Fume data

Fume composition, wt % typical:

Fe	Mn	Cr	Ni	Cu	F	OES (mg/m^3)
15	5	< 0.5	< 0.1	< 0.2	18	5

CHROMET 1

1¼Cr-½Mo MMA electrode

Product description	MMA electrode meeting AWS and BS EN national standards suitable for most power generation applications.
Specifications	**AWS A5.5** E8018-B2 H4 **BS EN ISO 3580-A** E CrMo1 B 3 2 H5 **BS EN ISO 3580-B** E 5518-1CM
ASME IX Qualification	**QW432** F-No 4, **QW442** A-No 3

Composition (weld metal wt %)

	C	Mn*	Si	S	P	Cr	Mo	Ni	Cu	Nb
min	0.05	0.50	--	--	--	1.00	0.45	--	--	--
max	0.12	0.90	0.80	0.025	0.030	1.40	0.65	0.3	0.2	0.01
typ	0.07	0.8	0.5	0.01	0.02	1.25	0.55	0.1	<0.1	0.01

* Mn may exceed AWS 0.90% max.

All-weld mechanical properties

PWHT 690°C/1h			min	typical
Tensile strength		MPa	550	640
0.2% Proof stress		MPa	460	570
Elongation on 4d		%	19	25
Elongation on 5d		%	20	24
Reduction of area		%	--	70
Impact energy	+ 20°C	J	47	160
Hardness	(AW)	HV	--	250
	(PWHT)	HV	--	210

Packaging data

ø mm	2.5	3.2	4.0	5.0
length mm	350	350	450	450
kg/carton	12.9	12.9	16.8	18.0
pieces/carton	642	372	243	159

CHROMET 1L

Low carbon 1¼Cr-½Mo MMA electrode

Product description

MMA electrode – 1¼Cr-½Mo deposit with low carbon which produces lower hardness and residual stresses for resistance to sulphide stress corrosion cracking when operating in wet 'sour' environments. Also suitable for thin section joints which are to be left in the as-welded condition.

Specifications

AWS A5.5 E7015-B2L H4
BS EN ISO 3580-A E CrMo1L B 3 2
BS EN ISO 3580-B E 5216-1CML

ASME IX Qualification

QW432 F-No 4, **QW442** A-No 3

Composition (weld metal wt %)

	C	Mn*	Si	S	P	Cr	Mo	Cu
min	0.03	0.50	--	--	--	1.00	0.45	--
max	0.05	0.90	0.80	0.025	0.025	1.40	0.65	0.15
typ	0.04	0.8	0.40	0.012	0.015	1.25	0.55	<0.10

* Mn may exceed AWS 0.90% max.

All-weld mechanical properties

PWHT 690°C/1h			min	typical
Tensile strength		MPa	520	600
0.2% Proof stress		MPa	390	500
Elongation on 4d		%	19	26
Elongation on 5d		%	20	23
Reduction of area		%	--	68
Impact energy	+ 20°C	J	--	180
	-10°C	J	--	120
Hardness	(AW)	HV	--	220
	(PWHT)	HV	--	200

Packaging data

ø mm	2.5	3.2	4.0	5.0
length mm	350	380	450	450
kg/carton	12.0	14.1	17.7	18.0
pieces/carton	612	414	252	168

CHROMET 1X

1¼Cr-½Mo alloyed MMA electrode for temper embrittlement resistance

Product description

MMA electrode – 1¼Cr-½Mo deposit which meets specific requirements for improved temper embrittlement resistance with prolonged service at 400-600°C. Relevant trace elements (P, Sn, As, Sb) are controlled to ensure low Bruscato (X) and Watanabe (J) factors.

Specifications

AWS A5.5 E8018-B2 H4
BS EN ISO 3580-A E CrMo1 B
BS EN ISO 3580-B E 5516-1CM

ASME IX Qualification

QW432 F-No 4, **QW442** A-No 3

Composition (weld metal wt %)

	C	Mn*	Si*	S	P	Cr	Mo	Cu	Sn	As	Sb
min	0.05	0.50	0.15	--	--	1.00	0.45	--	--	--	--
max	0.10	0.90	0.30	0.015	0.012	1.40	0.65	0.15	0.005	0.010	0.005
typ	0.06	0.7	0.25	0.012	0.009	1.25	0.55	<0.05	0.002	0.003	<0.002

* Mn+Si < 1.10%

Bruscato factor (X) : $\frac{10P + 5Sb + 4Sn + As \text{ (ppm)}}{100}$ = 15 max

Watanabe factor (J) : $(Mn+Si)x(P + Sn) \times 10^4$ = 180 max

CHROMET 1X (continued)

All-weld mechanical properties

PWHT 690°C/1h [1] (SC = step cooled)			min	typical	690°C/5h typical	690°C/5h + SC typical
Tensile strength		MPa	550	610	610	595
0.2% Proof stress		MPa	460	525	515	490
Elongation on 4d		%	19	25	29	29
Elongation on 5d		%	20	21	25	25
Reduction of area		%	--	70	70	70
Impact energy	+ 20°C	J	47 [2]	160	200	200
	- 30°C	J	--	100	160	140
Hardness	(AW)	HV	--	300-320	--	--
	(PWHT)	HV	--	200-210	220	190

[1] BS & AWS PWHT 690°C/1h, DIN 690°C/>30min, BS EN 720°C/1h.
[2] DIN & BS EN minimum average.

Packaging data

ø mm	2.5	3.2	4.0	5.0
length mm	350	380	450	450
kg/carton	12.6	15.0	16.8	17.4
pieces/carton	627	372	243	159

1CrMo

Solid welding wire for TIG & MIG.

Product description

Copper coated wire for TIG and MIG welding of 1¼Cr-½Mo steels, conforming to European specifications.

Specifications

AWS A5.28 ER80S-G
BS EN ISO 21952-A CrMo1Si (W = TIG, G = MIG)

ASME IX Qualification

QW432 F-No 6, **QW442** A-No 3

Composition (wire wt %)

	C	Mn	Si	S	P	Cr	Ni	Mo	Cu
min	0.08	0.80	0.50	--	--	0.90	--	0.45	--
max	0.14	1.20	0.80	0.020	0.020	1.30	--	0.65	0.4
typ	0.1	1	0.6	0.010	0.015	1.2	<0.1	0.5	0.1

All-weld mechanical properties

PWHT 690°C/4h (AWS=1h)			min	typical TIG	typical MIG
Tensile strength		MPa	550	635	590
0.2% Proof stress		MPa	470	520	480
Elongation on 4d		%	19	28	26
Elongation on 5d		%	20	23	22
Impact energy	-10°C	J	--	> 200	> 115
Hardness		HV(HB)	--	220(215)	195(190)

Typical operating parameters

	TIG	MIG
Shielding	Argon	Ar-5%CO_2
Current	DC-	DC+
Diameter	2.4mm	1.2mm
Parameters	100A, 12V	280A, 26V

Packaging data

ø mm	TIG	MIG
0.8	--	15kg reel
1.2	--	15kg reel
1.6	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	5	0.4	< 0.1	< 0.5	1.2	5

ER80S-B2

Solid welding wire for TIG & MIG.

Product description

Copper coated wire for TIG and MIG welding 1¼Cr-½Mo creep resisting steels, conforming to the AWS/ASME specification.

Specifications

AWS A5.28 ER80S-B2
BS EN ISO 21952-B 1CM

ASME IX Qualification

QW432 F-No 6, **QW442** A-No 3

Composition (wire wt %)

	C	Mn	Si	S	P	Cr	Ni	Mo	Cu
min	0.07	0.40	0.40	--	--	1.20	--	0.40	--
max	0.12	0.70	0.70	0.020	0.020	1.50	0.20	0.65	0.35
typ	0.1	0.5	0.5	0.010	0.015	1.3	<0.1	0.5	0.1

All-weld mechanical properties

PWHT 690°C/4h (AWS=620°C /1h)			min	typical TIG	typical MIG
Tensile strength		MPa	550	635	590
0.2% Proof stress		MPa	470	520	480
Elongation on 4d		%	19	27	26
Elongation on 5d		%	17	25	20
Hardness		HV(HB)	--	220(215)	195(190)
Impact energy	- 10°C	J	--	> 200	> 115

Typical operating parameters

	TIG	MIG
Shielding	Argon	Ar - 5% CO_2
Current	DC -	DC+
Diameter	2.4mm	1.2mm
Parameters	100A, 12V	280A, 26V

Packaging data

ø mm	TIG	MIG
0.8	--	15kg reel
0.9	--	15kg reel
1.0	--	15kg reel
1.2	--	15kg reel
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	5	0.4	<0.1	<0.5	1.2	5

SA1CrMo

Solid welding wire for SAW.

Product description	Solid wire for Sub Arc Welding of 1¼Cr-½Mo steels.
Specifications	**AWS A5.23** EB2 **BS EN ISO 24598-A** SCrMo1
ASME IX Qualification	**QW432** F-No 6, **QW442** A-No 3

Composition (typical)

	C	Mn	Si	S	P	Cr	Mo	Cu
SA1CrMo wire	0.10	0.8	0.15	0.010	0.012	1.3	0.55	0.01
Deposit with LA436	0.08	1.1	0.4	<0.01	<0.02	1.1	0.5	0.01

All-weld mechanical properties (LA436 flux)

PWHT 690°C/1h			min	typical
Tensile strength		MPa	550	620
0.2% Proof stress		MPa	470	535
Elongation on 4d		%	20	25
Elongation on 5d		%	20	23
Impact energy	+20°C	J	47	>47

Typical operating parameters	Current: DC or AC; DC+ve is preferred For 2.4mm: 300-500A, 28-36V, 350-700mm/min travel

Packaging data

ø mm	SAW
2.4	25kg coil
3.2	25kg coil

Fume data	SAW fume negligible

LA436

Sub-arc flux

Product description	**LA436** is agglomerated aluminate basic flux (Boniszewski BI ~1.6) with silicon pick-up of ~0.3% and manganese pick-up of ~0.4%.
Specifications	**AWS A5.23** F8 P0-EB2 B2 **BS EN ISO 14174** SA AB 1 67 AC H5
ASME IX Qualification	**QW432** F-No --, **QW442** A-No --

Composition (typical)

	C	Mn	Si	S	P	Cr	Mo
SA 1CrMo wire	0.10	0.8	0.15	0.010	0.012	1.3	0.55
Deposit with LA436	0.08	1.1	0.4	<0.01	<0.02	1.1	0.5

All-weld mechanical properties with SA 1CrMo wire

			Typical PWHT 690-720°C/1-2h
Tensile strength		MPa	620
0.2% Proof stress		MPa	535
Elongation on 4d		%	25
Impact energy	+20°C	J	>47

Typical operating parameters	Current: DC or AC; DC+ve is preferred 2.4mm: 300-500A, 28-36V, 350-700mm/min travel speed
Packaging data	Metrode **LA436** flux is supplied in sealed moisture resistant 25kg metal drums. Preferred storage conditions for opened drums: < 60%RH, > 18°C. If the flux has become damp or has been stored for a long period, it should be redried in the range 300-350°C/1-2h.

CORMET 1

All-positional flux cored wire

Product description

Cormet 1 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-B2C/M-H4	
AWS A5.36	E81T1-C1PZ-B2-H4 or E81T1-M21PZ-B2-H4	(dependent on shielding gas)
BS EN ISO 17634-B	T55T1-1C/M-1CM	

ASME IX Qualification

QW432 F-No 6, **QW442** A-No 3

Composition (weld metal wt %)

	C	Mn	Si	S	P	Cr	Mo	Cu
min	0.05	--	--	--	--	1.00	0.40	--
max	0.12	1.25	0.80	0.030	0.030	1.50	0.65	0.30
typ	0.06	1.0	0.3	0.01	0.01	1.3	0.55	0.05

All-weld mechanical properties

PWHT 690°C/1-2h			min	typical
Tensile strength		MPa	550	650
0.2% Proof stress		MPa	470	550
Elongation on 4d		%	19	24
Elongation on 5d		%	17	22
Impact energy	+ 20°C	J	--	30
Hardness		HV	--	220

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
1.6	220 – 350A, 26-32V	260A, 28V	15 – 25mm

Packaging data

Spools vacuum-sealed in barrier foil with 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.

Fume data

Fume composition (wt %)

Fe	Mn	Ni	Cr^3	Cr^6	Cu	F	OES (mg/m^3)
20	8	< 0.5	1	< 1	< 1	8	5