

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 600°C, 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 martensitic 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 5 | | | | | | | | | |
| 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, 300-350°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. | | | | | | | | | |
| 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 BS EN ISO 21952-A CrMo5Si BS 2901: Pt2 A34 DIN 8575 SG CrMo5 (1.7373) | | This classification has now been withdrawn from A5.9 | | | | | | | | | |
| ASME IX Qualification | QW432 F-No 6, QW442 A-No 5 | | | | | | | | | | | |
| 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 745°C/1h | TIG 740°C/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 745°C (730-760°C) 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 | | | | | | | |
| | BS EN ISO 17634-B | | T55T1-1C/M-5CM | | | | | | | |
| ASME IX Qualification | QW432 F-No 6, QW442 A-No 5 | | | | | | | | | |
| 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: | | | | | | | | | |
| | ∅ 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 | |