LOW ALLOY STEELS

Welding of Low Alloy Steels

Low alloy steels differ from plain carbon steels in that their characteristic properties are due to elements other than carbon and manganese, e.g. chromium, nickel, molybdenum, etc.

From the above statement, it is obvious that a wide range of steels, having different compositions and heat treatments, are available. Afrox welding consumables are available for welding three types of low alloy steels, with widely varying uses, i.e. creep resisting steels, high tensile steels and steels for use at low temperatures. The welding consumables, steels and procedures for welding these steel types are discussed separately.

Steels for Elevated Temperature Service

Creep is a property of great importance in materials used for elevated temperature applications. Creep is defined as the plastic deformation of steel occurring at an elevated temperature under constant load. Creep is a time dependent failure and occurs at stresses below the yield strength for the particular temperature to which the material is subjected.

Creep occurs in three stages:

- Primary creep (transient stage) – In this stage the creep rate is initially high and gradually decreases due to the effect of work hardening.
- Secondary creep (steady state creep) – The stage in which deformation continues at a constant rate, which results from a balance being maintained between the competing processes of work hardening and recovery.
- Tertiary creep – If the stress is sufficiently high in this stage, the creep rate accelerates until fracture occurs.

For practical purposes the resistance to creep is expressed by:

- Creep strength - The stress which, at a given temperature and after a given time, causes failure.
- Creep limit - The stress which, at a given temperature and after a given time, causes a certain amount of deformation, e.g. 1%.

Creep Resisting Steels

When materials are subject to elevated temperatures, the following properties are of major importance – the resistance of the materials to oxidation and the maintenance of an adequate level of tensile strength and creep resistance. Furthermore, the steels must be capable of operating at these elevated temperatures for an indefinite period. It is a well-known fact that chromium increases the strength and oxidation resistance of steel while molybdenum increases the red hardness of steel and its elevated temperature tensile properties. It is not surprising, therefore, that these two elements are the major alloying additions to these steel types. A wide range of creep resisting steels containing between 0,5 and 1% molybdenum and up to 12% chromium have been developed for use in the power generation and petroleum refining industries.

While the addition of chromium and molybdenum improves the elevated temperature properties of the steel, they also significantly increase the hardenability of the steel. It is therefore of the utmost importance that these steels be preheated prior to welding and maintained at the preheat temperature for the duration of welding. Immediately after welding, the fabrications should be stress relieved before cooling below the preheat temperatures. Typical preheat and stress relieving temperatures are given in the table which follows:

Table 1 Typical Preheat and Stress Relieving Temperatures

Nominal Composition	Alloy Name	Preheat (°C)	Interpass Temp (°C)	PWHT (°C)
0,5% Mo	P1	100 - 250	100 - 250	630 - 670 1 hr
1,25% Cr 0,5% Mo	P2, P11, P12	200 - 300	200 - 300	690 1-2 hr
1,25% Cr 0,5% Mo 0,25% V	CrMo V	200 - 300	200 - 300	690 1-2 hr
2,2% Cr 0,2% Mo 1,6% W Nb V N B Ni	P23	150 - 200	150 - 200	Not always required ASME 715-740 1 hr
2,5% Cr 1,0% Mo V Ti B	P24	150 - 200	150 - 200	Not always required ASME 715 - 740 1 hr
5,0% Cr 0,5% Mo	P5	200 min	200 min	AWS 732 - 760 1 hr EN DIN 725 - 745 2 hr
9,0% Cr 1,0% Mo	T9	200 min	200 min	AWS 732 - 760 1 hr BS EN 740 - 780 2 hr
9,0% Cr 1,0% Mo Nb V N	P91	150 min	200 - 300	AWS 760 2-3 hr BS EN 770 2-3 hr
9,0% Cr 1,0% Mo 1,0% W Nb V N	P911	200 - 300	200 - 300	AWS 760 2-3 hr BS EN 770 2-3 hr
12,0% Cr 1,0% Mo 0,5% W 0,3% V	X20	Up to 400 best 200 - 350	Up to 500	Slow cool to 120 and hold for 1-2 hr prior to PWHT. BS EN 750-770 3 hr
9,0% Cr 1,0% Mo 1,7% W Nb V N	P92	200 min	350 max	Slow cool to 100 prior to PWHT. BS EN 730-770 4 hr

Table 2 Typical Application for Creep Resistant Alloys

Nominal Composition	Alloy Name	Operating Temp (°C)	Applications
0,5% Mo	P1	450	Vessels and piping
1,25% Cr 0,5% Mo	P2, P11, P12	550	Steam generators, piping, turbine castings, steam chests, valve bodies, boiler superheaters, corrosion resistant to sulphur bearing crude oil at 250 - 450°C, resistance to hydrogen attack, coal liquefaction plant and NH_3 pressure vessels
1,25% Cr 0,5% Mo 0,25% V	CrMo V	580	Valve casings, steam turbines, boilers, pressure vessels
2,25% Cr 1,0% Mo	P22	600	Steam generators, piping, turbine castings, steam chests, valve bodies, boiler superheaters, corrosion resistant to sulphur bearing crude oil at 250 - 450°C, resistance to hydrogen attack, coal liquefaction plant and NH_3 pressure vessels
2,2% Cr 0,2% Mo 1,6% W Nb V N B Ni	P23	580	Water walls in ultra-super-critical boilers, power generating plants
2,5% Cr 1,0% Mo V Ti B	P24	580	Water walls in ultra-super-critical boilers, power generating plants
5,0% Cr 0,5% Mo	T5	600	Boiler superheaters, heat exchangers, piping, pressure vessels in oil refineries, corrosion resistance in superheated steam, hot hydrogen gas and high sulphur crude oils
9,0% Cr 1,0 Mo	T9	600	Reasonable corrosion resistance in superheated steam, hot hydrogen gas and high sulphur crude oils where higher performance than 5% Cr 0,5% Mo steels is required. Boiler superheater tubes, piping, pressure vessels in oil refineries and power plants
9,0% Cr 1,0% Mo Nb V N	P91	600	Headers, main steam piping, turbine casings in fossil fuel power plants. Coal liquefaction and gasification plants
9,0% Cr 1,0% Mo 1,0% W Nb V N	E911	600	Headers, main steam piping, boiler tubes, turbine casings in fossil fuel power plants. Coal liquefaction and gasification plants
12,0% Cr 1,0% Mo 0,5% W 0,3% V	X20	550	High pressure steam piping, headers, heat exchangers, turbine components
9,0% Cr 1,0% Mo 1,7% W Nb V N	P92	600	Headers, main steam piping, turbine casings in fossil fuel power plants

Basic hydrogen-controlled electrodes and wires of matching compositions are used for welding creep-resisting steels. A number of steels and matching Afrox consumables suitable for use at an elevated temperature are given in Table 3

Table 3 Afrox Electrodes and Wires Suitable for Welding High Temperature Steels According to DIN, BS and ASTM Specifications

Electrode	Base Metal Nominal	Alloy Steel Plates	Alloy Steel Tubes and Pipes	Steel Castings	Alloy Steel Forgings
Afrox KV2 MIG/TIG G2Mo FCW TM811-A1	0,5% Mo	DIN 17155 17Mn4 DIN 17155 19Mn6 DIN 17155 15Mn3 ASTM A204 A, B, C ASTM A302 A, B	DIN 17175 17Mn4 DIN 17175 19Mn5 BS 3059 243 ref CEW BS 3606 243, 245, 261 ASTM A209 TI, TIa, TIb ASTM A250 TI, TIa, TIb ASTM A335 PI ASTM A369 FPI	DIN 17245 GS-22 Mo4 BS 3100 BI BS 1504 245 ASTM A217 WCI ASTM A352 LCI	DIN 15Mo3 DIN 16Mo5 DIN 10MnMo 4 5 DIN 11MnMo 4 5 BS 10028-2 16Mo3 ASTM A204 A, B, C ASTM A336 FI
Afrox KV5 and KV5L MIG/TIG/SAW B2 FCW TM811-B2	1,25% Cr 0,5% Mo	DIN 17155 13 CrMo 44 BS 1501 620 BS 1501 621 ASTM A387 2, 12, 11 ASTM A213 T2, TII, T12	DIN 17175 13 CrMo 44 BS 3604 620-440 BS 3604 620-460 ref HFS, CFS BS 3604 621 ref HFC CFS, ERW, CEW ASTM A199 TII ASTM A356 6 ASTM A335 P2, PII, P12	DIN 17245 GS-17 CrMo 55 BS 3100 B2 ASTM A217, WC6, WCII Class 1, 2 and 3	BS 3604 620-440 BS 3059-620-540 ASTM A182 F2, FII, F12, Class 1 and 2 ASTM A336 F12, F11 FIIa, FIIb
Afrox KV3 and KV3L MIG/TIG/SAW B3 FCW TM911-B3	2,25% Cr 1,0% Mo	DIN I7155 I0 CrMo 9I0 BS I50I 622/515 ASTM A387 21, 22	DIN 17175 10 CrMo 910 BS I50I 622/51 5 BS 3059 622-490 ref SI, S2 ASTM AI99,T4,T22 ASTM A213 T22 ASTM A335 P22	DIN 17245 GS-18 CrMo 910 BS3100 B3 BS 1504 622 ASTM A217 WC9 ASTM A356 10	BS 3059 622-490 BS 1503 622-560 ASTM A182 F22 Class I and 2 ASTM A336 F22, F22a
Chromocord 5 MIG/TIG/SAW B6	5,0% Cr 0,5% Mo	ASTM A387 5	DIN 12CrMo 195 DIN X7CrMo 6 I DIN X I I CrMo 6 I BS 3604 625 HFS, CFS ASTM AI99 T5 ASTM A213 T5, T5b, ASTM A335 P5, P5b ASTM A369 FP5	ASTM A217 C5 ASTM A336 F5, F5a	BS 1503 625-520, 590 ASTM AI82 F5, F5a ASTM A336 F5, F5a

Table 3 (continued)

Electrode	Base Metal Nominal	Alloy Steel Plates	Alloy Steel Tubes and Pipes	Steel Castings	Alloy Steel Forgings
TBA	9,0% Cr 1,0% Mo	ASTM A387 9	ASTM A335, 9 ASTM A234, WP9 ASTM A199, T9 ASTM 213, T9 BS 3604, CFS & HFS 629-470, CFS 7 HSF 629-590 DIN XI2CrMo 9 I DIN X7CrMo 9 I	DIN GS-12CrMo 10 I ASTM A217 CI2 BS 1504 G629 BS 3100 G B6	ASTM AI82 F9 ASTM A336 F9
TBA	9,0% Cr 1,0% Mo Nb V N	ASTM A387, 91 DIN/BS EN XI OCrMoVNb 9 I BS 1503, 91 AFNOR NF A-492 I 3/A-492 I 8 TU Z 10 CDVNb 09-0 I	ASTM A213, T91 ASTM A335, P91	ASTM A217, CI2A ASTM A234, WP91 ASTM A369, FP91	ASTM AI82I, A336, F91

Steels with High Tensile Strength

High tensile alloy steels can be divided into two distinct groups, i.e. the low carbon quenched and tempered or low carbon martensitic types and the high carbon content alloy steels, which transform to high carbon martensite during quenching. In this section, only the first group will be discussed.

Low Carbon Martensitic Steel Types

The low carbon martensitic steel types exhibit an excellent combination of high strength (yield strength in the vicinity of 700 MPa), toughness, abrasion resistance, excellent HAZ structure resistant to hydrogen-induced cracking coupled with good weldability. These properties have led to steels of this type being used extensively in industries such as earth moving, mining, pressure vessel construction and for military applications.

These steels are low in carbon, e.g. 0,10% to 0,23% and are alloyed with elements such as nickel, chromium, vanadium, molybdenum, boron and in some cases titanium. The elements are balanced carefully to obtain the optimum hardenability and excellent mechanical properties with relatively low cost. In many cases, these steels are sold on the basis of their mechanical properties under a wide variety of proprietary brand names such as ROQ-tuf, T1, etc.

Hydrogen Cracking

Hydrogen-induced cold cracking, which occurs during the welding of high tensile steels, can be divided into two distinct areas:

- Cracking in the weld metal
- Cracking in the heat affected zone.

Generally, when the tensile strength of the deposited weld metal exceeds that of the parent material, cold cracking is most likely to occur in the weld metal. These cracks can either be longitudinal centre bead cracks or transverse cracks running perpendicularly through the weld bead into the base material. The direction of the cracks are perpendicular to the stresses imposed upon the joint by restraint and shrinkage of the weld metal during solidification.

Manufacturers of high tensile steels invariably provide adequate data on the preheat and maximum heat input necessary to avoid heat affected zone cracking of the base material. These requirements will be discussed briefly below. In many instances, however, the minimum preheat and interpass temperatures may be insufficient to avoid weld metal cracking.

The American Welding Society Structural Welding code D1.1 indicates that preheat and interpass temperatures should be high enough to prevent crack formation in highly restrained joints and provides the following temperatures which should be employed:

Table 4 Preheat and Interpass Temperatures

Steel Types	Thicknesses (mm)	Minimum Preheat Temp (°C)	Maximum Preheat Temperature (°C)
ASTM	Up to 19	10	205
A514	19 - 38	50	205
A517	38 - 64	80	230
A709	Over 64	107	230

In order to limit heat input, it is important that weld beads be deposited using the stringer technique and that weaving be limited to less than 2,5 times the electrode diameter (i.e. where the stringer bead technique is not possible). A general guide for maximum heat input values is as follows:

Table 5 Allowing Heat Input

Preheat Temperature (°C)	Maximum Heat Input (kJ/mm)			
	6 mm	12 mm	15 mm	32 mm
20	1,25	1,9	4	5
65	Unnecessary	1,65	2,4	4,3
95	Unnecessary	1,4	2,2	3
150	Unnecessary	1,3	2,1	2,6
200	Unnecessary	1,2	2	2,5

Notes on Welding High Carbon High Tensile Steels

Steels of this type can form very hard structures in the heat affected zone when welded. To avoid possible cracking problems, preheat temperatures up to approximately 300°C may be required, followed in some instances by post weld heat treatment. With regard to these steels, precautions similar to those for carbon- manganese steels should be followed. Steels in this category with a carbon equivalent above 0,5 may be welded with Afrox 309LMo, 312, 98 and 118.

Where high carbon, high tensile steels are to be welded with one of the austenitic type consumables recommended above, a lower preheat temperature would be required.

Table 6 Afrox Consumables for Welding Low Alloy Steels

Product	Materials to be Welded	Application
MIG/TIG Ni-I FCW TM811-Ni	ASTM A333 Gr 6 ASTM A334 Gr 6 ASTM A350 Gr LF2 & LF5 ASTM 352 Gr LCB & LCC (cast) API 5L, X65 BS 4360 Gr 43E, 50E, 55C, 55EE, 55F	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. Ni also increases the atmospheric weathering resistance and improves the electrochemical balance between weld metal and base metal, thus minimising preferential weld area corrosion in marine environments. For offshore oilfield sour service, a minimum of 1% Ni is commonly required.
Tenacito 70B TIG 80Ni2	ASTM A203 Gr A & B Plate ASTM A333 Gr 6 pipe ASTM A350 Gr LF I & LF2 forgings ASTM A352 Gr LC2 casting BS 1501-224 Gr 490B plate Hyplus 29 Corten	Fabrication of storage tanks, process plant and associated pipework where good fracture toughness from as-welded joints is demanded down to temperatures in the region of -60°C. The addition of about 2,5% Ni improves microstructural refinement and tolerance to procedural variations compared to plain CMn weld metal. It also promotes the formation of a stable patina as required for matching the characteristics of weathering steels, and is an alternative to using matching consumables.
Afrox 75	BS 150 I Gr 503, plate ASTM A203 Gr D, E & F plate ASTM A333 Gr 3 pipe BSI503 Gr 503 forging ASTM A350 Gr LF3 forging BS 1504 Gr 503 LT60 casting ASTM A352 Gr LC3 casting	Construction of cryogenic plant and associated pipework e.g. petrochemical industry, demanding resistance to weld brittle fracture when operating at temperatures down to -80°C in the manufacture, storage and distribution of volatile liquids and liquefied gas. It can be used for welding CMn and low alloy steel for critical applications demanding a combination of strength and reliable toughness down to temperatures in the region of -600°C.
Afrox 98	ASTM A553-BO Gr A C1.1 ASTM A67B-75 Gr C ASTM A656-79 type 1-7 ASTM A537-BO C1.2 DIN StE500, WstE 460, WstE 500, TstE 420, TstE 460, TstE 500 DIN 17100 5t 50-2 Mittal ROQ-tuf	High yield strength quenched and tempered steels, alloy steel plate, structural steels for bridges, high tensile quenched and tempered steels, pressure vessel plates, alloy steel MnMo and MnMoNi quenched and tempered steels, quenched and tempered CMn steel plates for structural applications, hot rolled structural steel plates and pressure vessel plates CMnSi type, fine grained structural steel, high temperature fine grained steel, low temperature fine grained steel and steels for general structural purposes, high strength roller quenched and tempered structural steel plates.
MIG/TIG D2	AISI 4130, 4140, 8630 BS 970 Gr 709M40 (EN 19) DIN 42CrMo4, 34CrMo4 ASTM A487 Gr 4B, 4D, 6A cast	Fabrication of higher strength steels for use in the stress relieved condition. For offshore oil well head process pipework and fittings, these low nickel consumables satisfy NACE MRO 175 requirements intended to ensure resistance to sulphide-induced stress corrosion cracking in sour service, combined with good sub-zero toughness.

Table 6 (continued)

Product	Materials to be Welded	Application
Afrox 118 Hoballoy 11018M MIG 6048	ASTM A514-77 ASTM A709-80 Gr 100, 100W ASTM A533-80 Gr Cl.2 DIN WstE460, WstE500, TstE 420, TstE 460, TstE 500 DIN 17100St60-2 Mittal ROQ-tuf	High yield strength quenched and tempered steels, alloy steel plate, structural steels for bridges, high tensile quenched and tempered steels, pressure vessel plates, alloy steel MnMo and MnMoNi quenched and tempered steels, quenched and tempered CMn steel plates for structural applications, hot rolled structural steel plates and pressure vessel plates CMnSi type, fine grained structural steel, high temperature fine grained steel, low temperature fine grained steel and steels for general structural purposes, high strength roller quenched and tempered structural steel plates.
OE-N127 MIG/TIG 120 FCW BI21 T5 K4	HY 80, Q I(N) Possibly HY I00 & Q2(N)	For welding a range of high strength low alloy steels, in particular for military applications by the MoD and US Navy for the construction and repair of naval craft and submarines. The consumable also has applications in general structural steel fabrications in HSLA steels, which may be used for cranes, earth-moving equipment, and other highly stressed structural components.

Steels for Low Temperature Service

As the temperature decreases the resistance to impact of steels decreases. This may be gradual in some cases or can occur in a narrow transition band. The ductile to brittle transition of steel, subject to impact loading, is influenced by a number of factors, which include:

- The carbon content – which should be as low as possible
- The degree of deoxidation – the steel should be fully killed
- The grain size – should be fine grained
- The alloy content – particularly the nickel level.

A number of these factors can be combined in steels to give the low temperature notch toughness required. In some cases carbon manganese steels, such as BS 4360 grades 40E and 43E, have specified minimum impact values at -50°C and below. Nickel bearing steels, however, are normally required to have impact properties at temperatures below -60°C. Acceptance criteria for low temperature steels with regard to impact properties are as follows:

Table 7 Acceptance Criteria for Low Temperature Steels with Regard to Impact Properties

Minimum average impact value at these temperatures are 27 J										
Specification	Grade	Charpy V-Notch Impact Test at Temperature (°C)								
		-20	-30	-40	-50	-60	-80	-100	-110	-196
Structural Steel Plate										
BS 4360-79	40E				X					
	43E				X					
	50D			X						
	50E				X					
	50F					X				
	50E				X					
	50F					X				
ASTM A633-79	Grade D				X					
DIN 17102	TStE 255-500				X					
Steel Plate for Boiler and Pressure Vessels										
BS 1501 Part I	164 Grade 360 LT 20	X								
	164 Grade 400 LT 20	X								
	223 Grade 460 LT 30		X							
	225 Grade 490 LT 50				X					
ASTM A662-79	Grade A			X						
	Grade B				X					
	503 3,5 % Ni						X			
BS 15012 Part 2-70	509 9,0 % Ni									X

Generally, these steels are supplied in the normalised, controlled rolled, normalised and tempered or quenched and tempered conditions.

Notes on Welding Steels for Low Temperature Service

When low temperature steels are to be welded, a number of factors should be kept in mind to ensure the metallurgical integrity of the joint:

- Preheating is not generally required
- Consumables must be selected which will ensure adequate strength and impact properties at the lowest recommended temperature. In all cases, the consumables should be of the basic coated hydrogen-controlled type
- Excessive heat inputs should be avoided as these may lead to coarse grained weld metal deposits and heat affected zones. High heat input positions such as vertical-up should be avoided where possible.

Table 8 Afrox Consumables for Welding SSAB Domex Cold Forming Steels

Steel Type	Description	Afrox Consumable
Domex 80W	Hot rolled weather resistant steel	MIG/TIG 80 Ni I Fluxofill 20
Domex 100 XF Domex 240 YP Domex 315 MC Domex 355 MC Domex 420 MC	Hot rolled extra high strength cold forming steel	Afrox 7018-1 MIG 9000 Glodflow TM 791 Coremax 71 Plus Afrox TIG 70S-6 Sub 70-2 SWX110160
Domex 460 MC Domex 500 MC	Hot rolled extra high strength cold forming steel	Afrox 98 Tenacito 70 B MIG/TIG 80 Ni I Fluxofill 20 Subarc S2Mo/SWX
Domex 550 MC Domex 600 MC Domex 650 MC Domex 700 MC	Hot rolled extra high strength cold forming steel	Afrox 118 MIG 6048 TIG 100 Fabcor 1100
Domex Wear	Wear plate	Afrox 7018-1 MIG 9000 Glodflow TIG 70S-6 TM 791 Coremax 71 Plus

Table 9 Afrox Consumables for Welding Mittal Low Alloy Steels

Steel Type	Description	Afrox Consumable
Wearplate 200 (Bennox) SAE/AISI 1055 (Cr, 30) MCR 24	Hot rolled high carbon steel plate for hardening and wear resistance	On account of the high carbon content, which increases the hardenability, high carbon steels are not readily weldable. Rapid cooling in the heat affected zone results in the formation of hard, brittle phases, which are susceptible to cracking. High carbon steels should only be welded using special procedures. An Afrox welding engineer should be consulted for advice on welding procedures
RB 390 RB 500	Armour plate	Afrox 307, 309L, 312 MIG/TIG 307Si, 309LSi, 312, 309MoL Coremax 309L, 309MoL Subarc 307Si, 309L/MK-SS
ROQ-last TH400 ROQ-last 500	Hot rolled quenched abrasion resistant steel	Afrox 7018-1 - depending on joint design Afrox 118 Hoballoy 11018M Metalloy 110 MIG 6048 TIG 100
ROQ-tuf AM700	Hot rolled roller quenched and tempered structural and pressure vessel steel	Afrox 118 Hoballoy 11018M Metalloy 110 MIG 6048

Table 10 Consumables for Welding SSAB Wear Resistant and Structural Steel Plates

Steel Type	Description	Afrox Consumable	
Hardox 400	Abrasion resistant plate	Afrox 7018-1 Afrolux MIG 6000 TIG 70S-6 TM 791 Coremax 71 Plus Sub 70-2/HPF-N90	
Hardox 450 Hardox 500	Abrasion resistant plate	Tenacito 70 B MIG/TIG 80 Ni1 TM811-N1 Sub 70-2/HPF-A72 Subarc S2Mo/HPF-NIIX	
Weldox 355	High strength structural plate	Afrox 7018-1 MIG 6000 TIG 70S-6 TM 791 Coremax 71 Plus Sub 70-2/HPF-N90	
Weldox 420 Weldox 460	Extra high strength structural plate	**For butt welds** Tenacito 70 B MIG/TIG 80 Nil TM811-N1 Subarc S2Mo/HPF-NIIX	**For other joints** Afrox 7018-1 MIG 6000 TIG 70S-6 TM 791 Coremax 71 Plus Sub 70-2/HPF-N90
Weldox 500	Extra high strength structural plate	**For butt welds** Afrox 98	**For other joints** Afrox 7018-1 MIG 6000 TIG 705-6 TM 791 Coremax 71 Plus Sub 70-2/HPF-N90
Weldox 700	Extra high strength structural plate	**For butt welds** Afrox 118 Hoballoy 11018M MIG 6048 TIG 100	**For other joints** Rockweld CI MIG/TIG 80 Ni1 TM811-N1 Subarc S2Mo/HPF-NIIX
Weldox 900 Weldox 960 Weldox 1100	Extra high strength structural plate	**For butt welds** OE-N127 MIG/TIG 120 BI21 T5 K4	**For other joints** Afrox 118 Hoballoy 11018M MIG 6048 TIG 100

Classification for Low Alloy Consumables

Welding consumables are commonly classified under either the American (AWS) or European (EN) systems. The following is a summarised outline of the classifications for low alloy electrodes.

Under AWS, the following classifications apply:

AWS A5.5 Low Alloy Steel Electrodes for Shielding Metal Arc Welding

AWS A5.28 Low Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding

AWS A5.29 Low Alloy Steel Electrodes for Flux Cored Arc Welding

AWS A5.23 Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding

Under the Euronorm classifications, low alloys can fall under three types of classification: Creep Resistant Steels, High Strength Low Alloy Steels, and Non-Alloyed Fine Grained Steels:

EN ISO 3580 Covered Electrodes for Manual Metal Arc Welding of Creep Resistant Steels

EN ISO 21952 Wire Electrodes, Wires, Rods and Deposits for Gas Shielded Arc Welding of Creep Resistant Steels

EN ISO 17634 Tubular Cored Electrodes for Gas Shielded Metal Arc Welding of Creep Resistant Steels

EN ISO 24598 Solid Wire Electrodes, Tubular Cored Electrodes and Electrode Flux Combinations for Submerged Arc Welding of Creep Resistant Steels

EN ISO 757 Covered Electrodes for Manual Metal Arc Welding of High Strength Steels

EN ISO 16834 Wire Electrodes, Wires, Rods and Deposits for Gas Shielded Arc Welding of High Strength Steels

EN ISO 2560 Covered Electrodes for Manual Metal Arc Welding of Non-Alloy and Fine Grained Steels

EN ISO 14341 Wire Electrodes, Wires, Rods and Deposits for Gas Shielded Arc Welding of Non-Alloy and Fine Grained Steels

EN ISO 636 Rods, Wires and Deposits for Tungsten Inert Gas Welding of Non-Alloy and Fine Grained Steels

EN ISO 17632 Tubular Cored Electrodes Gas Shielded Metal Arc Welding of Non-Alloy and Fine Grained Steels

EN ISO 756 Solid Wires, Solid Wire-Flux and Tubular Wire Flux Combinations for Welding of Non-Alloy and Fine Grained Steels

For detailed information about the classification of consumables to the above specifications, please contact the product manager at Afrox MPG marketing on +27 (0) 11 490 0400.

AWS A5.01 Filler Material Procurement Guidelines

The specification covers the testing and classification of welding consumables from a procurement point of view and outlines how customers should specify what product testing and quality control they require. The first section covers the classification of 'lots' or batch sizes and testing. The second section covers product testing. In all instances when a customer orders a product, they should state on the order the lot classification and testing schedule they require.

Lot Classification

This covers electrodes, solid wires and tubular wires with the suffix 'C' for covered electrodes, 'S' for solid wires, 'F' for submerged arc welding, brazing and braze welding and 'T' for tubular wires. See Table 11 below for details.

Table 11 Lot Classifications

Lot Classification	Requirements
Covered Electrodes	
C1	Manufacturer's standard lot as defined in its quality system
C2	A lot of one size not exceeding 45 350 kg of any size produced in 24 hrs of consecutively scheduled production
C3	A lot of one size not exceeding 45 350 kg produced in 24 hrs of consecutively scheduled production. The flux to be identified by wet mix or controlled chemical composition and core wire identified by heat number or controlled chemical composition
C4	A lot of any one size produced from one wet mix and one heat of core wire
C5	A lot of one size produced from one dry blend of flux and one heat of core wire
Solid Wire	
S1	A lot as defined in the manufacturer's quality assurance programme
S2	A lot not exceeding 45 350 kg of one size, form and temper produced in 24 hrs of consecutively scheduled production from one heat or from material identified by controlled chemical composition
S3	A lot of one size produced from one heat in one production cycle
S4	A lot not exceeding 45 350 kg of one size, form and temper produced under one production schedule from one heat or from material identified by controlled chemical composition
Tubular Electrodes	
T1	A lot as defined in the manufacturer's quality assurance programme

Table 11 (continued)

Lot Classification	Requirements
T2	A lot not exceeding 45 350 kg of one size produced in 24 hrs of consecutively scheduled production. The strip to be identified by one heat or from material identified by controlled chemical composition. The core ingredients to be identified by dry blend
T3	A lot of one size produced from one heat and one dry batch or dry blend of core ingredients
T4	A lot not exceeding 45 350 kg of one size produced under one production schedule from tube or strip identified by heat number or controlled chemical composition the core ingredients to be identified by dry blend or controlled chemical composition
Submerged Arc Fluxes	
F1	A lot as defined in the manufacturer's quality assurance programme
F2	A lot produced from the same combination of raw materials in one production cycle

Testing Schedule

AWS A5.01 specifies the level of testing as follows:

Table 12 Testing Schedule for Low Alloy Electrodes

Schedule	Requirements
F	The manufacturer's standard testing level
G	Test of the material from any production run of the product within the 12 months preceding the data of the purchase
H	Chemical analysis only for each lot shipped
I	See Table 13
J	All tests called for in the AWS filler metal specification, for each lot shipped. See Table 15
K	All tests specified by the purchaser, for each lot shipped

Table 13 Schedule I Tests for Low Alloy Electrodes

AWS Classification	Chemical Analysis	Tensile Test	Impact Test	Soundness X-Ray	Moisture Test
A5.5 MMA	Y	Y	Y	Y	Y
A5.28 MMA/TIG	Y	Y	N	Y	N
A5.23 SAW	Y	Y	Y	Y	N
A5.29 FCW	Y	Y	Y	Y	N

Table 14 Schedule J Tests for Low Alloy Electrodes

AWS Classification	Chemical Analysis	Tensile Test	Impact Test	Soundness X-Ray	Fillet Weld Test
A5.5 MMA	Y	Y >3,2 mm	Y >3,2 mm for flux type 18	N	Y >3,2 mm
A5.28 MIG/TIG	Y	Y	N - CrMo Y - Others	Y	N
A5.23 SAW	Y - Solid wire and flux wire combination N-composite, test weld metal	Y - Wire flux combination only	Y - Wire flux combination only	Y - Wire flux combination only	N
A5.29 FCW	Y	Y - Except G	N - CrMo Y - Others Except K5	Y - Except G	Y for EXIT N - Others

Low Alloy & Creep Resistant Electrodes for Manual Metal Arc Welding

Afrox KV2

Afrox KV2 is a basic coated hydrogen controlled electrode for all position welding of high tensile low alloy steels and creep resisting steels containing 0,5 molybdenum for service up to 450°C. The ease of operation and stability of the arc make this electrode eminently suitable for use in difficult to weld positions. The electrode deposits weld metal of high metallurgical and radiographic qualities in all positions.

Approvals
TÜV, EN 13479, CE (C880-CPD-0035)

Classifications		
AWS	A5.5	E7018-A1 H4
EN ISO	3580-A	E Mo B 22 H5

Typical Chemical Analysis			
% Carbon	0,05 - 0,09	**% Sulphur**	0,025 max
% Manganese	0,75 - 0,9	**% Phosphorous**	0,025 max
% Silicon	0,45 max	**% Molybdenum**	0,4 - 0,6

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	390 MPa min
Tensile Strength	480 MPa min
% Elongation on 50 mm	25 min
Charpy V-Notch at +20°C	120 J min

Packing Data (DC+ only)				
Diameter (mm)	**Current (A)**	**Electrode Length (mm)**	**Pack Mass (kg)**	**Item Number**
2,5	65 - 95	300	3 x 4,0	W075512
3,15	85 - 130	350	3 x 4,0	W075513
4,0	120 - 180	350	3 x 4,0	W075514
2,5 (DriPac)	65 - 95	300	3 x 4,0	W075516
3,15 (DriPac)	85 - 130	350	3 x 4,0	W075517
4,0 (DriPac)	120 - 180	350	3 x 4,0	W075518

Classifications Afrox KV2 (DriPac)		
AWS	A5.5	E7018-A1
EN ISO	3580-A	E Mo B 22 H5

Afrox KV5
Afrox KV5L

Afrox KV5 and KV5L are basic coated DC type, hydrogen controlled all position electrodes depositing weld metal containing 1,25% chromium and 0,5% molybdenum. The deposits from these electrodes are characterised by excellent radiographic and metallurgical qualities which, together with exceptional weldability, make these ideally suited for positional welding. The product was developed to weld a wide variety of 1,25 Cr, 0,5 Mo creep resisting steels.

Approvals
TÜV, EN 13479, CE (C880-CPD-0035)

Classifications Afrox KV5		
AWS	A5.5	E8018-B2 H4
EN ISO	3580-A	E Cr Mo1 B H5

Classifications Afrox KV5L		
AWS	A5.5	E7018-B2L H4
EN ISO	3580-A	E Cr Mo1 B H5

Typical Chemical Analysis

	Afrox KV5	Afrox KV5L		Afrox KV5	Afrox KV5L
% Carbon	0,05 - 0,1	0,05 max	**% Phosphorous**	0,025 max	0,025 max
% Manganese	0,5 - 0,9	0,5 - 0,9	**% Chromium**	1,0 - 1.3	1,0 - 1,3
% Silicon	0,45 max	0,45 max	**% Molybdenum**	0,04 - 0,6	0,04 - 0,6
% Sulphur	0,025 max	0,025 max			

Typical Mechanical Properties (All weld metal in the stress relieved condition to AWS A5.5)

	Afrox KV5	Afrox KV5L
Stress Relieving Temp.	690°C for 1 hr	690°C for 1 hr
0,2% Proof Stress	460 MPa min	390 MPa min
Tensile Strength	550 - 650 MPa	520 MPa min
% Elongation on 50 mm	22 min	19 min
Charpy V-Notch at +20°C	90 J min	-
Charpy V-Notch at 0°C	70 J min	-
Vickers Hardness	190 - 200 HV	-

Packing Data (DC+ only)

Diameter (mm)	Current (A)	Electrode Length (mm)	Pack Mass (kg)	Item Number Afrox KV5	Item Number Afrox KV5L
2,5	65 - 95	300	3 x 3,0	W075542	W075572
3,15	80 - 130	350	3 x 4,0	W075543	W075573
4,0	120 - 180	350	3 x 4,0	W075544	W075574
5,0	185 - 250	450	3 x 6,0	W075545	-
2,5 (DriPac)	65 - 95	300	3 x 3,0	W075546	W075576
3,15 (DriPac)	80 - 130	350	3 x 4,0	W075547	W075577
4,0 (DriPac)	120 - 180	350	3 x 4,0	W075548	-
5,0 (DriPac)	185 - 250	450	3 x 6,0	W075549	W075579

Classifications Afrox KV5 (DriPac)		
EN ISO	3580-A	E Cr Mo1 B H5

Classifications Afrox KV5L (DriPac)		
EN ISO	3580-A	E Cr Mo1 B H5

Afrox KV3

Afrox KV3 is a basic coated DC type hydrogen controlled all position electrode depositing weld metal containing 2,25% chromium and 1% molybdenum. The deposits from these electrodes are characterised by excellent radiographic and metallurgical qualities which, together with exceptional weldability, make these electrodes ideally suited for positional welding. Afrox KV3 is recommended for welding a wide variety of 2,25 Cr, 1 Mo creep resisting steels.

Approvals
TÜV, EN 13479, CE (C880-CPD-0035)

Classifications		
AWS	A5.5	E9018-B3 H4
EN ISO	3580-A	E Cr Mo2 B 22 H5

Typical Chemical Analysis			
% Carbon	0,05 - 0,1	**% Phosphorous**	0,025 max
% Manganese	0,5 - 0,9	**% Chromium**	2,0 - 2,5
% Silicon	0,45 max	**% Molybdenum**	0,9 - 1,2
% Sulphur	0,025 max		

Typical Mechanical Properties (All weld metal in the stress relieved condition to AWS A5.5)	
Stress Relieving Temp.	690°C for 1 hr
0,2% Proof Stress	530 MPa min
Tensile Strength	630 - 720 MPa
% Elongation on 50 mm	20 min
Charpy V-Notch at +20°C	120 J min

Packing Data (DC+ only)				
Diameter (mm)	**Current (A)**	**Electrode Length (mm)**	**Pack Mass (kg)**	**Item Number**
2,5	60 - 95	300	3 x 3,0	W075522
3,15	85 - 130	350	3 x 4,0	W075523
4,0	120 - 180	350	3 x 4,0	W075524
2,5 (DriPac)	60 - 95	300	3 x 3,0	W075526
3,15 (DriPac)	85 - 130	350	3 x 4,0	W075527
4,0 (DriPac)	120 - 180	350	3 x 4,0	W075528
5,0 (DriPac)	185 - 250	450	3 x 6,0	W075529

Classifications Afrox KV3 (DriPac)		
EN ISO	3580-A	E Cr Mo2 B 22 H5

Oerlikon Tenacito 70B

Oerlikon Tenacito 70B is a basic all position electrode containing 2,5% nickel for welding notch tough steels. It has good slag removal and a regular bead appearance. It is recommended for use in applications requiring low temperature toughness down to -60°C and is also suited for welding weathering steels.

Re-drying

Only dry electrodes should be used. Re-drying should be carried out at 300 - 350°C for 2 hours.

Classifications		
AWS	A5.5	E8018-C1
EN ISO	2560-A	E 42 6 2Ni B H5

Typical Chemical Analysis			
% Carbon	0,06	**% Nickel**	2,4
% Manganese	1,0	**% Copper**	<0,09
% Silicon	0,4		

Typical Mechanical Properties (All weld metal in the as welded condition)		
	As Welded	**PWHT 580°C/15 hr**
Yield Strength	440 MPa	420 MPa
Tensile Strength	520 - 620 MPa	500 - 600 MPa
% Elongation on 5d	>24	>26
Charpy V-Notch at +20°C	>160	>160
Charpy V-Notch at -40°C	>90	>80
Charpy V-Notch at -60°C	>70	>50
Charpy V-Notch at -80°C	>40	>30
Charpy V-Notch at -100°C	-	-

Packing Data (DC+)				
Diameter (mm)	**Current (A)**	**Electrode Length (mm)**	**Pack Mass (kg)**	**Item Number**
3,15	90 - 135	350	5,0	W112023
4,0	140 - 185	450	5,0	W112024
5,0	185 - 240	450	5,0	W112025

Afrox 88 (88D3)

Afrox 88 (88D3) is a basic coated manganese molybdenum electrode recommended for use in all positions with the exception of vertical down. The electrode features a smooth and stable arc and gives excellent penetration. The slag release in all positions is excellent and the electrode operates with minimum spatter levels on both AC and DC. The product is used for the construction of boilers, pressure vessels and reactors commonly used in the petrochemical industry.

Classifications		
AWS	A5.5	E8018-D3 H4
EN ISO	2560-B	E5516-3M3 H5

Typical Chemical Analysis			
% Carbon	0,12 max	**% Sulphur**	0,03 max
% Manganese	1,0 - 1,8	**% Phosphorous**	0,03 max
% Silicon	0,8 max	**% Molybdenum**	0,4 - 0,65

Typical Mechanical Properties (All weld wetal in the as welded condition)	
0,2% Proof Stress	460 MPa min
Tensile Strength	550 MPa min
% Elongation on 50 mm	19 min
Charpy V-Notch at -51°C	27 J min

Packing Data (DC+ AC 70 OCV min)

Diameter (mm)	Current (A)	Electrode Length (mm)	Pack Mass (kg)	Item Number
3,15	90 - 135	350	3 x 4,0	W075453
3,15	135 - 200	380	3 x 6,0	W075454
4,0	180 - 260	450	3 x 6,0	W075455

Afrox 98

Afrox 98 is a basic coated hydrogen controlled electrode for all position welding of high tensile low alloy steels. The electrode deposits a weld metal containing approximately 1,5% nickel and 0,3% molybdenum which apart from having good tensile properties, is extremely tough and ductile. Afrox 98 produces weld metal of the highest radiographic and metallurgical qualities in all positions. The product is recommended for welding a range of fine grained structural steels, low temperature steels and quenched and tempered steels, having an ultimate tensile strength of up to approximately 750 MPa.

Classifications		
AWS	A5.5	E9018-G H4
EN ISO	2560 - A	E 50 5 1NiMo B H5

Typical Chemical Analysis			
% Carbon	0,04 - 0,08	**% Phosphorous**	0,025 max
% Manganese	0,7 - 1,2	**% Molybdenum**	0,2 - 0,35
% Silicon	0,5 max	**% Nickel**	1,4 - 1,8
% Sulphur	0,025 max		

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Stress	540 - 620 MPa
Tensile Strength	620 MPa min
% Elongation on 50 mm	24 min
Charpy V-Notch at -51°C	45 J min

Packing Data				
Diameter (mm)	**Current (A)**	**Electrode Length (mm)**	**Pack Mass (kg)**	**Item Number**
3,15	90 - 135	350	3 x 4,0	W075423
4,0	120 - 175	350	3 x 4,0	W075424
5,0	170 - 245	450	3 x 5,0	W075425

Afrox 118

Afrox 118 is a basic hydrogen controlled electrode for all position welding of high tensile low alloy steels. The electrode deposits a weld metal containing approximately 2% nickel and 0,4% molybdenum which, apart from having good tensile properties, is extremely tough and ductile. Afrox 118 produces weld metal of the highest radiographic and metallurgical qualities in all positions. Afrox 118 is recommended for welding a range of fine grained structural steels.

Classifications		
AWS	A5.5	E11018-G H4
EN ISO	2560-A	E505 2 Ni B (nearest) H5

Typical Chemical Analysis			
% Carbon	0,06 - 0,1	**% Phosphorous**	0,025 max
% Manganese	1,3 - 1,8	**% Molybdenum**	0,25 - 0,5
% Silicon	0,5 max	**% Nickel**	1,70 - 2,5
% Sulphur	0,025 max		

Typical Mechanical Properties (All weld metal in the as welded condition)	
0,2% Proof Strength	670 MPa min
Tensile Strength	760 MPa min
% Elongation on 50 mm	20 min
Charpy V-Notch at -51°C	45 J min

Packing Data				
Diameter (mm)	Electrode Length (mm)	Current (A)	Pack Mass (kg)	Item Number
3,15	350	90 - 145	3 x 4,0	W075443
4,0	380	135 - 200	3 x 4,0	W075444
5,0	450	180 - 260	3 x 5,0	W075445

Low Alloy & Creep Resistant Wires for Gas Metal Arc Welding & Gas Tungsten Arc Welding

MIG/TIG D2

MIG/TIG D2 is a low alloy solid wire, with Mn and Mo additions, designed for welding low alloy steels with high tensile strength. For use in the stress relieved condition. Often used in oil process pipework and fittings where resistance to sulphide-induced stress corrosion cracking is important.

Classifications		
AWS	A5.28	ER 90S-D2/ER 80S-D2 (depending on gas used)
MIG		
EN ISO	14341-A	G 50 5 M G4Mo
EN ISO	14341-B	G57 P 5 M G4 M31 (nearest)
TIG		
EN ISO	636-A	W 50 2 WO
EN ISO	636-B	W 57 P 2 W4M3 (nearest)

Typical Mechanical Properties (All weld metal in the as welded condition)	MIG	TIG
Tensile Strength	650 MPa	630 MPa
Yield Strength	560 MPa	520 MPa
% Elongation on 5d	22	26
Charpy V-Notch at +20°C	150 J	200 J
Charpy V-Notch at 0°C	120 J	-
Charpy V-Notch at -20°C	90 J	-

Typical Chemical Analysis			
% Carbon	0,08	**% Sulphur**	0,01
% Manganese	1,8	**% Molybdenum**	0,5
% Silicon	0,7	**% Copper**	0,12
% Phosphorous	0,01		

Packing Data
MIG (DC+)

Diameter (mm)	Current		Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)		
1,0	230	25	15,0	W078210
1,2	280	26	15,0	W078212

TIG (DC-)

Diameter (mm)	Current		Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)		
2,0	100	12	5,0	W078204
2,4	100	12	5,0	W078206

Suggested gas for welding: Argoshield® 5 (MIG), Argon (TIG)

MIG/TIG 80 Ni1

MIG/TIG 80 Ni1 is designed for welding low alloy steels with 1% Ni and fine grain steels as well as for low temperature applications that require good sub-zero toughness.

Classifications		
AWS	A5.28	ER 80S-Ni1
MIG		
EN ISO	14341-A	G 46 4 M G3 Ni 1
EN ISO	14341-B	G49 A 4 GN 2 (nearest)
TIG		
EN ISO	636-A	W 50 4 W 3Ni 1
EN ISO	636-B	W 57 A 4 WN2 (nearest)

Typical Chemical Analysis			
% Carbon	0,1	**% Sulphur**	0,01
% Manganese	1,1	**% Nickel**	1,0
% Silicon	0,6	**% Molybdenum**	0,1
% Phosphorous	0,01	**% Copper**	0,12

Typical Mechanical Properties (All weld metal in the as welded condition)		
	MIG	**TIG**
Tensile Strength	600 MPa	600 MPa
Yield Strength	530 MPa	500 MPa
% Elongation on 5d	26	26
Charpy V-Notch at -20°C	130 J	130 J
Charpy V-Notch at -40°C	80 J	80 J

Packing Data MIG (DC+)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,0	230	25	15,0	W078224

TIG (DC-)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
2,0	120	14	5,0	W078230
2,4	120	14	5,0	W078232

Suggested shielding gas: Argoshield® 5 (MIG), Argon (TIG)

TIG 80Ni2 / MIG 80Ni2

TIG/MIG 80Ni2 is designed for welding low alloy steels with 2% Ni and fine grain steels as well as for low temperature applications that require good sub-zero toughness.

Classifications		
AWS	A5.28	ER 80S-Ni2
EN ISO	636-A	W 50 6 W2Ni2
EN ISO	636-B	W 57 A 6 WN5 (nearest)
EN ISO	14341-A	G 46 M G2 Ni2

Typical Chemical Analysis			
% Carbon	0,1	**% Sulphur**	0,01
% Manganese	1,0	**% Nickel**	2,3
% Silicon	0,55	**% Copper**	0,12
% Phosphorous	0,01		

Typical Mechanical Properties (All weld metal in the as welded condition)	
Tensile Strength	620 MPa
Yield Strength	530 MPa
% Elongation on 5d	26
Charpy V-Notch at -20°C	130 J
Charpy V-Notch at -40°C	80 J
Charpy V-Notch at -60°C	50 J

Packing Data TIG		
Diameter (mm)	**Pack Mass (kg)**	**Item Number**
2,4	5,0	W078238

Suggested gas for welding: Argon

Packing Data MIG		
Diameter (mm)	**Pack Mass (kg)**	**Item Number**
1,2	15,0	W078233
1,6	15,0	W078272

MIG 120

MIG 120 is a solid wire suitable for welding of low alloyed steels and high yield strength Cr-Ni-Mo steels. Excellent mechanical properties, with tensile strength of 840 MPa. Not recomended for applications that require PWHT.

Classifications		
AWS	A5.28	ER 120S-I
EN ISO	12534	G 79 4 M Mn4Ni 2 Mo

Typical Chemical Analysis			
% Carbon	0,07	**% Chromium**	0,10
% Manganese	1,7	**% Nickel**	2,3
% Silicon	0,5	**% Molybdenum**	0,5
% Phosphorous	0,007	**% Copper**	0,08
% Sulphur	0,007		

Typical Mechanical Properties (All weld metal in the as welded condition)	
Tensile Strength	840 MPa
Yield Strength	790 MPa
% Elongation on 5d	16
Charpy V-Notch at -20°C	140 J
Charpy V-Notch at -30°C	100 J
Charpy V-Notch at -40°C	90 J

Packing Data (DC-)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,20	280	26	15,0	W078196

Suggested gas for welding: Argoshield® 5

Afrox MIG 6048

Afrox 6048 is a low alloy steel welding wire containing nickel, molybdenum and vanadium. The wire, which is copper coated, is suitable for use in all positions. Afrox 6048 is recommended for welding a range of fine grained structural steels and low alloy quenched and tempered steels having an ultimate tensile strength of up to 930 MPa. The wire may be used with Argoshield® 5, Argoshield® Light, Argoshield® Heavy and Argoshield® Universal as well as CO_2 at flow rates of 14-16 ℓ/min. Argon-based shielding gases are recommended.

Classifications		
AWS	A5.28	ER 110S-G and ER 100S-G
EN ISO	16834-A	W 69 4M Mn3Ni1 CrMo
EN ISO	16834-B	W 76 A 4M N4M2 (nearest)

Typical Chemical Analysis			
% Carbon	0,08 - 0,1	**% Chromium**	0,3 - 0,4
% Manganese	1,6 - 1,8	**% Nickel**	1,4 - 1,6
% Silicon	0,5 - 0,7	**% Molybdenum**	0,25 - 0,3
% Phosphorous	0,15 max	**% Copper**	0,35 max
% Sulphur	0,018 max	**% Vanadium**	0,09 - 0,11

Typical Mechanical Properties (All weld metal in the as welded condition)	
Tensile Strength	>690 MPa
0,2% Proof Stress	>770 MPa
% Elongation on 5d	>17
Charpy V-Notch at -40°C	>47 J

Packing Data (DC-)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,0	230	25	15,0	W078192
1,2	280	26	15,0	W033188
1,2	280	26	350,0	W033189

Suggested shielding gas: Argoshield® 5, Argoshield® Light, Argoshield® Heavy, Argoshield® Universal, 100% CO_2

MIG/TIG G2Mo

MIG/TIG G2Mo is a low alloy solid wire, with 0,5% Mo, designed for welding low alloy steels such as type ASTM A335 grade P1 and similar. Suitable for pipelines and pressure vessels with operating temperatures of approximately 500°C.

Classifications		
AWS	A5.28	ER 70S-A1
EN ISO	21952-A	G/W MoSi
EN ISO	21952-B	G/W 52 M IM3 (nearest)
EN ISO	636-A	W 2Mo

Typical Chemical Analysis			
% Carbon	0,09	**% Sulphur**	0,01
% Manganese	1,2	**% Molybdenum**	0,5
% Silicon	0,6	**% Copper**	0,15
% Phosphorous	0,01		

Typical Mechanical Properties (In PWHT condition)		
	MIG	**TIG**
Tensile Strength	620 MPa	630 MPa
Yield Strength	500 MPa	520 MPa
% Elongation on 5d	25	26
Charpy V-Notch at +20°C	150 J	200 J
Charpy V-Notch at 0°C	130 J	-
Charpy V-Notch at -20°C	90 J	80 J

Packing Data MIG (DC-)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,0	230	25	15,0	W033187
1,2	280	26	15,0	W033186

TIG (DC-)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,6	100	12	5,0	W030533
2,0	100	12	5,0	W030534
2,4	100	12	5,0	W030535

Suggested gas for welding: Argoshield® 5 (MIG), Argon (TIG)

MIG/TIG B2

MIG/TIG B2 is a low alloy solid wire, with 1,25% Cr and 0,5% Mo, designed for welding low alloy steels with high tensile strength and creep resistant steels. For welding ASTM A387 grade 11 and 12 and similar types employed for pipelines and pressure vessels with operating temperatures of approximately 500°C.

Classifications		
AWS	A5.28	ER 80S-B2
EN ISO	21952-A	G/W CrMo1Si (nearest)
EN ISO	21952-B	G/W 55 M ICM3

Typical Chemical Analysis			
% Carbon	0,08	**% Sulphur**	0,01
% Manganese	0,6	**% Chromium**	1,3
% Silicon	0,6	**% Molybdenum**	0,5
% Phosphorous	0,01	**% Copper**	0,12

Typical Mechanical Properties (In PWHT condition)		
	***MIG**	***TIG**
Tensile Strength	570 MPa	590 MPa
Yield Strength	460 MPa	490 MPa
% Elongation on 5d	23	25
Charpy V-Notch at +20°C	150 J	250 J

* After PWHT of 1 hour at 690°C

Packing Data MIG (DC+)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
0,8	140	22	15,0	W078280
1,0	230	25	15,0	W078282
1,2	280	26	15,0	W078284
1,6	300	26	15,0	W078286

TIG (DC-)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,6	100	12	5,0	W078274
2,0	100	12	5,0	W078276
2,4	100	12	5,0	W078278

Suggested shielding gas: Argoshield® 5 (MIG), Argon (TIG)

TIG B2L

TIG B2L contains 1,25% Cr and 0,5% Mo, and is designed for welding low alloy steels with high tensile strength and creep resistant steels. For welding ASTM A387 grade 11 and 12 and similar types for pipelines and pressure vessels with operating temperatures of about 500°C. This low carbon version of the B2 type is preferred where as welded repairs are done or where PWHT is not viable.

Classifications		
AWS	A 5.28	ER 70S-B2L
EN ISO	21952-B	W 52 M CML 1

Typical Chemical Analysis			
% Carbon	0,03	**% Sulphur**	0,01
% Manganese	0,6	**% Chromium**	1,3
% Silicon	0,6	**% Molybdenum**	0,5
% Phosphorous	0,01	**% Copper**	0,15

Typical Mechanical Properties (All weld metal in the as welded condition)	
Tensile Strength	550 MPa
Yield Strength	470 MPa
% Elongation on 5d	23
Charpy V-Notch at +20°C	250 J

Packing Data		
Diameter (mm)	**Pack Mass (kg)**	**Item Number**
1,6	5,0	W078275
2,4	5,0	W078279

MIG/TIG B3

MIG/TIG B3 is a low alloy solid wire, with 2,5% Cr and 1% Mo, designed for welding low alloy steels with high tensile strength and creep resistant steels. For welding ASTM A387 grade 21 and 22 and similar types employed for pipelines and pressure vessels with operating temperatures of approximately 550°C.

Classifications		
AWS	A5.28	ER 90S-B3
EN ISO	21952-A	G/W CrMo2Si (nearest)
EN ISO	21952-B	G/W 62 M 2CIM2

Typical Chemical Analysis			
% Carbon	0,08	**% Sulphur**	0,01
% Manganese	0,6	**% Chromium**	2,5
% Silicon	0,6	**% Molybdenum**	1,0
% Phosphorous	0,01	**% Copper**	0,15*
* For MIG 0,12%			

Typical Mechanical Properties (In PWHT condition)		
	***MIG**	***TIG**
Tensile Strength	670 MPa	650 MPa
Yield Strength	570 MPa	570 MPa
% Elongation on 5d	20	22
Charpy V-Notch at +20°C	170 J	230 J
* After PWHT of 1 hour at 690°C		

Packing Data MIG (DC+)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,2	280	26	15,0	W078312

TIG (DC-)				
Diameter (mm)	**Current**		**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**		
1,6	100	12	5,0	W078304
2,0	100	12	5,0	W078306
2,4	100	12	5,0	W078308

Suggested shielding gas: Argoshield® 5 (MIG), Argon (TIG)

MIG/TIG B6

MIG/TIG B6 is a low alloy solid wire, with 5% Cr and 0,5% Mo, designed for welding creep resistant steels, for service temperatures up to 600°C. For welding ASTM A335 grade P5 and similar types that are employed in the chemical industry and in the ammonia synthesis process.

Classifications		
AWS	A5.28	ER 80S-B6
EN ISO	21952-A	G/W CrMo5Si
EN ISO	21952-B	G/W 55 M 5CM (nearest)

Typical Chemical Analysis			
% Carbon	0,07	**% Sulphur**	0,008
% Manganese	0,5	**% Chromium**	5,8
% Silicon	0,4	**% Molybdenum**	0,55
% Phosphorous	0,008	**% Copper**	0,10*

* For MIG 0,12%

Typical Mechanical Properties (In PWHT condition)		
	***MIG**	***TIG**
Tensile Strength	620 MPa	620 MPa
Yield Strength	500 MPa	500 MPa
% Elongation on 5d	25	25
Charpy V-Notch at +20°C	70 J	200 J

* After PWHT of 1 hour at 745°C

Packing Data
MIG (DC+)

Diameter (mm)	Current		Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)		
1,2	280	26	15,0	W078324

TIG (DC-)

Diameter (mm)	Current		Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)		
1,6	100	12	5,0	W078326
2,4	100	12	5,0	W078330

Suggested gas for welding: Argoshield® 5 or Stainshield® Plus (MIG), Argon (TIG)

MIG/TIG B8

MIG/TIG B8 is a low alloy copper coated solid wire, with 9% Cr and 1% Mo, designed for welding creep resistant steels, for service temperatures up to 600°C. For welding ASTM A387 grade 9 and similar types that are employed in the chemical industry and in the ammonia synthesis process.

Classifications		
AWS	A5.28	ER 80S-B8
EN ISO	21952-A	G/W CrMo9
EN ISO	21952-B	G/W 55 M 9CIM (nearest)

Typical Chemical Analysis			
% Carbon	0,07	**% Sulphur**	0,008
% Manganese	0,5	**% Chromium**	9,0
% Silicon	0,004#	**% Molybdenum**	1,0
% Phosphorous	0,008	**% Copper**	0,1*
# For MIG 0,008%		* For MIG 0,12%	

Typical Mechanical Properties (In PWHT condition)		
	***MIG**	***TIG**
Tensile Strength	670 MPa	670 MPa
Yield Strength	530 MPa	530 MPa
% Elongation on 5d	24	24
Charpy V-Notch at +20°C	60 J	250 J
* After PWHT of 1 hour at 745°C		

Packing Data
MIG (DC+)

Diameter (mm)	Current		Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)		
1,2	280	26	15,0	W078348

TIG (DC-)

Diameter (mm)	Current		Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)		
1,6	100	12	5,0	W078340
2,4	100	12	5,0	W078342

Suggested gas for welding: Argoshield® 5 or Stainshield® Plus (MIG), Argon (TIG)

Submerged Arc Wires

Subarc S2Mo

Subarc S2Mo is a copper coated solid wire for submerged arc welding with 1% Mn and 0,5% Mo content to be used for the welding of creep resistant low alloy Mo steel keeping high yield values even after heat treatment. Generally used on boilers and pressure vessels.

Classifications		
AWS	A5.23	E A2
EN ISO	24598-A	SMo
EN ISO	24598-B	SU I M3 (nearest)

Typical Chemical Analysis			
% Carbon	0,1	**% Sulphur**	0,01
% Manganese	1,1	**% Molybdenum**	0,55
% Silicon	0,1	**% Copper**	0,15
% Phosphorous	0,01		

Packing Data (DC+/AC)				
Diameter (mm)	Current		Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)		
2,4	350	28	27,0	W078122

Suggested flux: Afrox Flux HPF-N11X

Submerged Arc Fluxes

Hobart SWX 120

Hobart SWX 120 is an agglomerated aluminate-basic type flux for general fabrication. It is slightly Mn alloying and has excellent slag detachability. It can be used for single and multi-wire applications on mild and medium tensile steels and produces weld metal with good impact toughness down to -50°C.

Applications

Applications include general construction, pressure vessel fabrication, heavy beams, double jointing of pipes, heavy equipment, tank building structural bridge fabrication, ship building, and sewage and water pipes.

Classifications

EN ISO	14174	SA AB 1 57 AC H5

Flux Characteristics

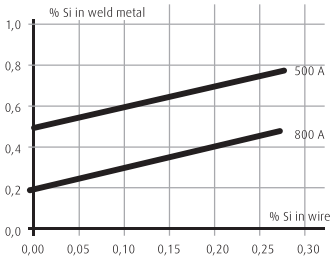
Flux Type	Aluminate-Basic
Basicity Index	1.9 (Boniszewski)
Alloy Transfer	Slightly Mn alloying
Density	1,2 Lg/Lt
Grain Size	0,2-2,0 mm 10-70 mesh
HDM	<5 ml/100 g weld metal
Current	DC+/AC
Re-drying Unopened Bag	Not required
Re-drying Opened Bag	300-350°C for 2 hours
Storage of Dried Flux	150 ± 250°C in a heated hopper

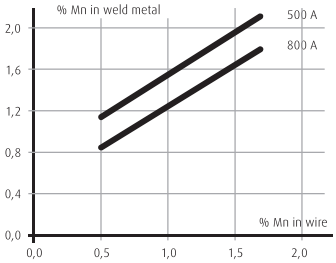
Flux Main Components

Al_2O_3+MnO	CaO+MgO	SiO_2+TiO_2	CaF_2
~35%	~25%	~20%	~20%

Metallurgical Behaviour

The diagrams show the typical weld metal analysis in relation to wire analysis for Si & Mn.





Single wire, Ø4,0 mm, DC+, 30 V, 60 cm/min

Flux Wire-Combination Classifications

With Wire		EN ISO 14171-A	AWS A5.17 & A5.23	Re/Rp 0,2 MPa	Rm MPa	A %	CVN J				
							0°C	-20°C	-30°C	-40°C	-46°C
EM 13K	AW	S 38 4 AB S2	F7A4-EM13K	420	500	26	130	110		65	
S2	AW	S 38 a AB S2Si	F7A5-EM12K	420	500	26	130	110		60	
S3Si EH12K*	AW	S 42 4 AB S3Si	F7A6-EH12K	450	560	28		110			50
	SR[1]		F7P6-EH12K	440	550	28		110			40
S2Mo-EA2	AW	S 46 2 AB S2Mo	F7A4-EA2-A4	510	590	24	90	70		50	
	SR[1]						70	40			
	TR	S 4T 2 AB S2Mo	F7P4-EA2-A4	470	560	24		50			
S4-EH14*	AW	S 46 4 AB S4	F7A4-EH14	520	620	21		80		60	
	SR[2]		F7P4-EH14	480	580	27		90		65	
S3NiMo0.2-ENi5	AW	S 50 4 AB S3NiMo0.2	F8A6-ENi5-Ni5	570	640	24		90	75	65	40
S2NiCu	AW	S 46 3 AB S2NiCu		485	570	26		70	55		

Packing Data

Pack Mass (kg bags)	Item Number
25,0	W078121

Hobart HA-495

Hobart HA-495 is an agglomerated aluminate-rutile type active flux. It allows for high speed welding even over millscale and light rust. It provides excellent bead wetting action and very good slag removal helping to reduce clean-up time and improve productivity. The flux performs well up to 1 000 A using both DC or variable balance square-wave AC (VBAC) currents this allows flexibility in selecting productive procedures and torch configurations (single, twin, tandem, etc.).

Applications

Applications include joining carbon steels up to 25 mm thickness, single and two pass groove welds, high speed fillet welds, welding over millscale or light rust, thin wall pressure vessels and tanks, thin structural steels and railcars.

Classifications		
EN ISO	14174	SA AR 1 88 AC

Flux Main Components			
SiO_2	$Al_2O_2+TiO_2$	MnO+FeO	$CaO+Mg+CaF_2$
~5%	~60%	~15%	~20%

Flux Characteristics	
Flux Type	Aluminate-Rutile
Basicity Index	~0,8 (Boniszewski)
Alloy Transfer	Si & Mn alloying
Density	1,2 Lg/Lt
Grain Size	0,2-1,6 mm 10-65 mesh
HDM	<8 ml/100 g weld metal
Current	DC+/DC-/AC
Re-drying Unopened Bag	Not required
Re-drying Opened Bag	300-350°C for 2 hours
Storage of Dried Flux	150 ± 250°C in a heated hopper

Flux Wire-Combination Classifications

With Wire		EN ISO 14171-A	AWS A5.17	Re/Rp 0,2 MPa	Rm MPa	A %	CVN J				
							0°C	-20°C	-30°C	-40°C	-46°C
S1-EL12	AW		F7A0-EL12	524	600	26		34			
S2Si-EM12K	AW		F7A2-EM12K	579	648	22		41	34		

Metric and imperial values are typical of AWS testing. AW: as welded, all weld metal. SR: stress relieved, all weld metal. TR: two-run.

Packing Data	
Pack Mass (kg bags)	**Item Number**
25,0 Aluminium/PE bag	W071403

Hobart SWX HF-N

Hobart SWX HF-N is an agglomerated fluoride-basic type flux. The slag is self-pealing at high currents and temperatures and works well when the weld metal contains difficult elements such as niobium and vanadium. Hobart SWX HF-N is suitable for twin arc, single and multi-layer applications and for stringer or oscillating welding. It is designed to perform with a wide range of cored or solid wires.

Applications

Applications include continuous caster rollers, crusher rollers for the mining and forestry industry, sugar mills, etc.

Chemical Composition All Weld Metal - Typical Values

Product	Chemical Composition (%)											
	C	Si	Mn	Cr	Ni	Mo	Cu	V	Nb	N	W	Co
TA 242-S Mod	0,14	0,8	2,0	3,0		0,75						
TA 810-S	0,28	0,7	1,0	5,5		3,5						
TA 8620-S	0,06	0,8	1,4	0,5	0,4	0,2						
TA 865-S Mod	0,18	0,4	1,1	13,5	2,3	1,0	0,15		0,15			
TA 875-S	0,13	0,4	1,2	12,5	2,4	1,4		0,2		0,1		2,0
TA 952-S	0,27	0,6	1,2	12,8	0,6	1,8		0,19	0,18		1,4	
TA A250-S	0,19	0,6	0,8	13,5	2,0	1,0						
TA A2JL-S	0,04	0,8	1,8	0,7								

Flux Characteristics

Flux Type	Fluoride-Basic
Basicity Index	2,6 (Boniszewski)
Alloy Transfer	None
Density	1,2 Lg/Lt
Grain Size	0,2-2,0 mm 10-70 mesh
Current	DC+
Re-drying Unopened Bag	Not required
Re-drying Opened Bag	300-350°C for 2 hours
Storage of Dried Flux	150 ± 250°C in a heated hopper

Flux Main Components

AlO_2+MnO	CaO+MgO	SiO_2+TiO_2	CaF_2
~19%	~34%	~18%	~29%

Packing Data

Pack Mass (kg bags)	Item Number
25,0	W071406

Hardness – Typical Values HRc

With Wire	As Deposited			After Tempering			
	Layer 1	Layer 2	Layer 3	Time	510°C	565°C	620°C
TA 242-S Mod	29	38	39				
TA 810-S	45	48	52	8	58	58	48
TA 8620-S	12	19	21	6	19	16	15
TA 865-S Mod	45	46	48	6 10 20	47 43 42	43 37 36	35 32 31
TA 875-S	45	45	45				
TA 952-S	40	45	49	8	52	50	43
TA A250-S	44	46	48	6	33 32 32	28 28 23	24 23 22
TA A2JL-S	40	40	35	6 10 20	29 25 22	23 22 22	21 19 19

OP 121TT

OP 121TT is a fully basic agglomerated submerged-arc welding flux that is widely used for the welding of structural and fine grained low alloy steels requiring high integrity welds with low temperature impact and CTOD fracture toughness properties. OP 121TT flux, in combination with a range of Oerlikon submerged-arc wires, in particular with OE-SD3, is established for the welding of offshore structures such as oil platform jackets, piles, decks and modules giving a high level of consistency and mechanical property performance. The flux is widely used for the welding of thick section components in the offshore, nuclear and pressure vessel industries. The flux exhibits a low hydrogen content in the as manufactured condition and gives a high resistance to moisture pick up during exposure under workshop conditions. The flux promotes a very stable arc characteristic during use with excellent slag detachment. The weld is of a uniform, even profile with regular fine ripple formation and smooth toe blending. OP 121TT flux is suitable for use with DC+ or AC and is ideal for single wire, tandem arc (DC+/AC) and other multi-arc systems using up to 1 000 A with single wire welding. Grain size according to EN760: 2 - 20.

Re-drying

Re-dry at 300-350°C for 2-4 hours.

Classifications			
AWS	A5.23	F11A8-EG-EG	
OE	SD3	2NiCrMo	

Chemical Analysis			
% Carbon	0,07	**% Chromium**	0,6
% Manganese	1,4	**% Nickel**	2,2
% Silicon	0,4	**% Molybdenum**	0,5

Typical Mechanical Properties (As welded)	
Tensile Strength MPa	760 - 900
Yield Strength MPa	≥720
% Elongation on 5a	≥18

Packing Data	
Pack Mass (kg)	**Item Number**
25,0	W124503

Hobart SWX 150

Hobart SWX 150 is a non-alloying agglomerated fluoride-basic type flux for low-alloy high strength materials. It has excellent slag detachability and can be used for single and multi-wire applications. It produces weld metal of high purity with good impact toughness down to -60°C. When used with creep resistant alloys, the high purity weld metal will meet X Factor requirements.

Applications

Applications include pressure vessel fabrication, nuclear applications, off shore constructions and high strength applications.

Classifications

EN ISO	14174	SA FB 1 55 AC H5

Flux Characteristics

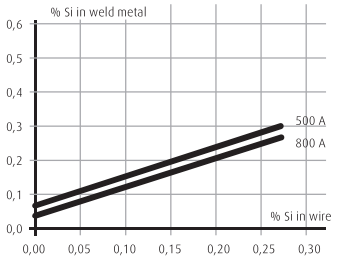
Flux Type	Fluoride-Basic
Basicity Index	2,7 (Boniszewski)
Alloy Transfer	None
Density	1,1 Lg/Lt
Grain Size	0,2-2,0 mm 10-70 mesh
HDM	<5 ml/100 g weld metal
Current	DC+/AC
Re-drying Unopened Bag	Not required
Re-drying Opened Bag	300-350°C for 2 hours
Storage of Dried Flux	150 ± 250°C in a heated hopper

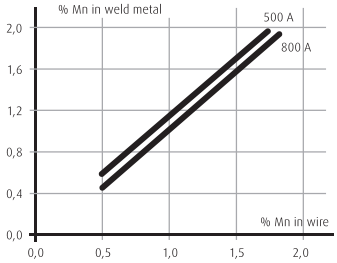
Flux Main Components

Al_2O_3+MnO	CaO+MgO	SiO_2+TiO_2	CaF_2
~20%	~35%	~15%	~25%

Metallurgical Behaviour

The diagrams show the typical weld metal analysis in relation to wire analysis for Si & Mn.





Single wire, Ø4,0 mm, DC+, 30 V, 60 cm/min

Flux Wire-Combination Classifications

With Wire		EN ISO 14171-A	AWS A5.17 & A5.23	Re/Rp 0,2 MPa	Rm MPa	A %	CVN J				
							0°C	-20°C	-30°C	-40°C	-50°C	-60°C
EH 10K	AW	S 42 5 FB S3	F7A6-EH10K	450	540	24				100	70	
	SR[1]	S 42 5 FB S3										
S3Si	SR[1]	S 38 6 FB S3Si	F7P8-EH12K	410	500	28				110		70
EB2R	SR[2]	S S CrMo1 FB	F8P2-EB2R-B2R	480	590	22		110	90			
	SR[1]			480	580	22		110	90			
EB3R*)	SR[2]	S S CrMo2 FB	F8P2-EB3R-B3R	530	630	22		110	90			
	SR[3]			500	590	22		110	90			
P91	SR[4]	S S CrMo91 FB		560	670	20	50					
S3Ni2.5CrMo	AW	S 79 6 FB S3Ni2.5CrMo		820	880	18				90		40

AW: as welded, all weld metal. SR: stress relieved, all weld metal. SR1: PWHT 620°C (1150°F)/1h. SR2: PWHT 690°C (1275°F)/1h. SR3: 665°C (1 230°F)/20h.
SR4: PWHT 760°C (1 400°F)/3h.
*) Step cooling data available.

Packing Data (DC+/AC)

Pack Mass (kg bags)	Item Number
25,0	W071405

Low Alloy & Creep Resistant Wires for Flux Cored Welding

FabCO 811A1

FabCO 811-A1 deposits a weld metal containing 0,5% Mo, and is designed for welding creep resistant steels for service up to 500°C. FabCO 811-A1 offers good weldability in all positions, with a fast freezing slag that removes easily. The wire is recommended for single and multi-pass welding in all positions using either 100% CO_2 or Fluxshield® shielding gases.

Classifications		
AWS	A5.29	E81T1-A1 H8

Typical Chemical Analysis 100% CO_2			
% Carbon	0,06	**% Sulphur**	0,011
% Manganese	0,96	**% Phosphorous**	0,012
% Silicon	0,32	**% Molybdenum**	0,47

Typical Mechanical Properties 100% CO_2 DC+				
	As welded	**PWHT 1hr @ 595°C**	**PWHT 1hr @ 630°C**	**PWHT 4hr @ 650°C**
Yield Strength	565 MPa	570 MPa	565 MPa	563 MPa
Tensile Strength	654 MPa	642 MPa	641 MPa	637 MPa
% Elongation	25	25	25	26
Charpy V-Notch CO°C	40 J	38 J	N/A J	30 J

Packing Data					
Diameter (mm)	**Current**		**Deposition Rate (kg/hr)**	**Pack Mass (kg)**	**Item Number**
	Amps (A)	**Volts (V)**			
1,2 All Position	21	115	1,2	15 (spool)	W081018
	26	**200**	2,8		
	28	250	4,0		

Bold indicates optimum parameters for welder appeal.
Suggested shielding gas: 100% CO_2 or Afrox Fluxshield®

Hobart FabCO 115

FabCO 115 is a high strength, flux cored wire that is comparable to a low alloy E11018M electrode but with higher deposition rates. It is used primarily for welding A514, A517, HY100 and similar quenched and tempered high strength, low alloy steels, producing a low hydrogen deposit with basic slag which helps to minimise cracking. FabCO 115 has high impact values at low temperatures and provides a modified globular metal transfer. For use with 100% CO_2 shielding gas only.

Classifications		
AWS	A5.29	E110T5-K4

Chemical Analysis			
% Carbon	0,04	**% Sulphur**	0,014
% Manganese	1,5	**% Chromium**	0,42
% Silicon	0,41	**% Nickel**	2,37
% Phosphorous	0,012	**% Molybdenum**	0,42

Typical Mechanical Properties (All weld metal PWHT 48 hr @ 104°C)	
Tensile Strength	>690 MPa
0,2% Proof Stress	>770 MPa
% Elongation on 5d	>17
Charpy V-Notch at -40°C	>47 J

Packing Data (DC-)

Diameter (mm)	Current		Stick Out (mm)	Pack Mass (kg)	Item Number
	Amps (A)	Volts (V)			
2,4	290 - 525	25 - 32	25,0	27,2	W078188

Suggested gas for FCW welding: 100% CO_2

Fabcor 1100

Fabcor 1100 is a gas shielded metal cored wire designed for use in semi-automatic applications requiring high strength weld deposits, particularly those in which high resistance to cracking and good toughness is a requirement. It is recommended for single and multi-pass welding in the flat and horizontal positions using Fluxshield® as a shielding gas at flow rates of 14-24 ℓ/min.

Fabcor 1100 is recommended for welding quenched and tempered steels such as ROQ-tuf and T1.

Classifications		
AWS	A5.29	E110C-K4

Chemical Analysis 75% Ar 25% CO_2			
% Carbon	0,07	% Nickel	1,92
% Manganese	1,52	% Molybdenum	0,47
% Silicon	0,52	% Chromium	0,18
% Phosphrus	0,004	% Sulphur	0,007

Typical Mechanical Properties (All weld metal PWHT 48 hr @ 104°C)	
Yield Stress	725 MPa
Tensile Strength	810 MPa
% Elongation on 50 mm	19
Charpy V-Notch at -50°C	58 J

Packing Data (DC+)							
Diameter (mm)	Position	Current		Optimum Settings		Deposition Rates (kg/hr)	Electrode Stick Out (mm)
		Amps (A)	Volts (V)	Amps (A)	Volts (V)		
1,6	Flat/Horizontal	275 - 450	26 - 30	350	28	3,2 - 9,1	19 - 25

Packing Data		
Diameter (mm)	Pack Mass (kg)	Item Number
1,6	15,0 (spool)	W081027