Mild Steel

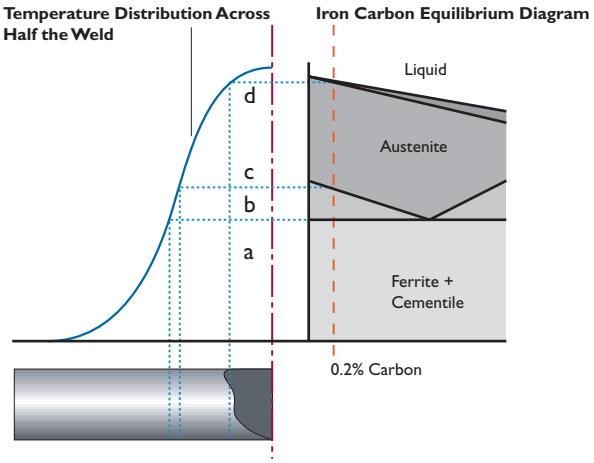
Weldability of Steel

Overview

Weldability is a term used to describe the relative ease or difficulty with which a metal or alloy can be welded. The better the weldability, the easier it is to weld. However, weldability is a complicated property, as it encompasses the metallurgical compatibility of the metal or alloy with a specific welding process, its ability to be welded with mechanical soundness, and the capacity of the resulting weld to perform satisfactorily under the intended service conditions.

Before attempting to weld any material, it is essential to know how easy it is to weld and to be aware of any problems that might arise. One of the main problems likely to be encountered when welding carbon and alloy steels is hydrogen cracking. For hydrogen cracking to occur, it is necessary to have a supply of hydrogen to the weld and a heat affected zone (HAZ), a susceptible hardened microstructure, and tensile stress. If any one of these three components is eliminated, then hydrogen cracking will not happen. Solidification cracking and lamellar tearing are other potential problems associated with welding steel.

The main problem when welding steel is hardenability. As long as the steel contains sufficient carbon when it is cooled rapidly from high temperature, a phase transformation takes place. The phase transformation from austenite to martensite causes the material to harden and become brittle. It is then liable to crack on cooling, due to restraint, or later under the action of hydrogen.



Variation in temperature from the centre of the weld to the base material.

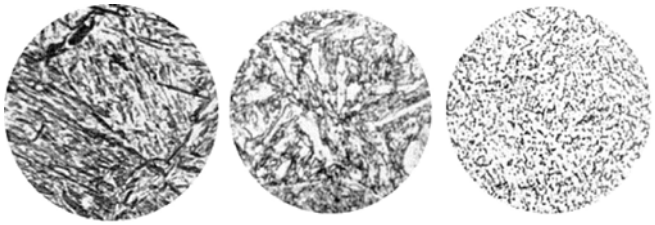
The weldability of steel depends primarily on its hardenability and this, in turn, depends largely on its composition (most importantly its carbon content). Steels with carbon content under 0.3% are reasonably easy to weld, while steels with over 0.5% are difficult. Other alloying elements that have an effect on the hardenability of steel, but to a much lesser extent than carbon, are manganese, molybdenum, chromium, vanadium, nickel and silicon. These, together with carbon, are all generally expressed as a single value (the carbon equivalent). The higher the carbon equivalent, the higher the hardenability, the more difficult the steel is to weld, and the more susceptible the microstructure is likely to be to hydrogen cracking.

This effect can be overcome by preheat combined with the use of a low hydrogen process or low hydrogen welding consumables. Calculation of preheat is usually based on carbon equivalent (derived from steel composition), combined thickness of the components, and heat input from the welding process. It also takes account of the amount of hydrogen likely to be introduced into the weld metal by the welding process. If welding under high restraint, extra preheat may need to be applied. Some high carbon steels and low alloy steels may also need a post weld stress relief or tempering.

Hardenability and Hardness

To become harder, steel must undergo a phase change. The starting point is austenite, so the steel must first be heated into the austenitic temperature range (see iron-carbon Equilibrium Diagram on previous page).

- Austenite, quenched rapidly, will be transformed into martensite, a hard but brittle phase
- A slower cooling rate will promote formation of bainite and/or other softer phases
- Cooled even more slowly, a soft structure of ferrite plus cementite, called pearlite, results



Martensite, Tempered Martensite and Heavily Tempered Martensite

Hardenability

Hardenability is the potential for any particular steel to harden on cooling and, as the carbon content of the steel increases towards 0.8%, so the potential of the steel to harden increases. Increasing the alloy content of the steel also increases the hardenability.

While hardness and strength may be desirable in a welded steel structure, martensite can be brittle and susceptible to cracking, and it should be noted that the potential brittleness of the material also increases as hardenability increases.

Hardenability describes the potential of steel to form hard microstructures. What hardness is actually achieved in steel with known hardenability depends on the maximum temperature to which it is heated and the cooling rate from that temperature. During welding, the parent material close to the weld will be heated to temperatures near melting point, while further away it will remain at ambient temperature. The cooling rate depends on the mass of material, its temperature, and the welding heat input. Therefore, when welding any given hardenable steel, the hardness in the HAZ depends on the cooling rate – the faster the cooling rate, the harder the microstructure produced and the more susceptible it is to cracking.

After welding, the hardness in the HAZ may range from less than 300 Hv to more than 550 Hv, depending on the parent steel composition and the other factors described above. As the hardness of the HAZ increases, so does its susceptibility to hydrogen cracking. However, as a rule of thumb, if the maximum hardness in the HAZ is maintained below 350 Hv, then hydrogen cracking will be avoided.

Carbon Equivalent

Carbon has the greatest effect on the hardenability of steel, but other alloying elements may be added to increase its hardenability. The addition effectively reduces the critical cooling rate and the temperature at which the austenite to martensite transformation takes place, making it easier for martensite to form at slower cooling rates.

Alloying elements that have the greatest influence on the hardenability of steel are manganese, molybdenum, chromium, vanadium, nickel, copper and silicon, but they have a much smaller effect than carbon.

The effect of these elements on the tendency to form HAZ martensite, and hence the likelihood of hydrogen cracking, is expressed conveniently as a carbon equivalent (CE). This basically describes the influence of each element on hardenability in terms of the effect that carbon has. There have been many different formulae derived to express carbon equivalent, but the one quoted here is the International Institute of Welding (IIW) equation that is applicable to carbon steel and is widely used:

Carbon equivalent (CE) =

$$\%C + \frac{\%Mn}{6} + \frac{(\%Ni + \%Cu)}{15} + \frac{(\%Cr + \%Mo + \%V)}{5}$$

The equation is only valid for certain maximum percentages of each element and these percentages can be found in the technical literature.

The carbon equivalent is used mainly for estimating preheat. Preheat is necessary to slow down the cooling rate sufficiently to reduce hardening in the HAZ of welds in susceptible carbon and low alloy steels. This, in turn, helps to prevent subsequent HAZ hydrogen cracking. The overall effect is to improve the weldability of the steel being welded, or at least to overcome the weldability problems presented by it.

CE is calculated from the composition of the steel in question and is used – together with welding heat input, potential hydrogen from the consumable, and combined thickness, or by reference to published data – to determine the preheat. It is recommended that the actual composition of the steel is used to ensure accuracy of calculation of CE, but nominal or maximum specified compositional data may be used when this is unavailable. The use of nominal composition obviously carries some risk that CE will be underestimated and too low preheat will be used, with potential cracking problems.

Weldability

Weldability describes the relative ease or difficulty with which a metal or alloy can be welded.

The relative weldability of carbon and low alloy steels are summarised here.

As has already been stated, weldability varies with the chemistry of the steel, particularly with reference to its carbon content.

The majority of carbon steels are weldable, but some grades have better weldability and, therefore, are more easily welded than others. As the carbon content increases, weldability tends to decrease as the hardenability increases and the steel becomes more prone to cracking.

Low carbon steels containing <0.15% carbon and <0.6% manganese generally have good weldability, as the composition is too lean to give any significant hardening effect during welding. However, steels with <0.12% carbon and low levels of manganese can be prone to porosity, although they are not susceptible to hydrogen cracking.

Steels with carbon contents between 0.15 and 0.3% carbon and up to 0.9% manganese, have good weldability, particularly those with carbon content below 0.22% These are mild steels and rarely present problems, as long as impurity levels are kept low. They are all weldable without preheat, using any of the common welding processes. Those at the top end of the composition range, above about 0.25% carbon, may be prone to cracking under certain circumstances. They may be welded using any of the common welding processes, but are best welded with a low hydrogen process such as MIG or low hydrogen consumables. Thick sections may require preheating to reduce the cooling rate.

Medium carbon steels containing between 0.25 and 0.5% carbon, with generally <1% manganese, are hardenable by heat treatment and so are prone to cracking when welded. They can be welded, but require suitable welding procedures, specifying preheat and interpass temperature control to account for the carbon content or carbon equivalent and the combined thickness of the joint being produced. These steels should always be welded using a low hydrogen welding process or controlled hydrogen consumables.

Steels with even higher carbon levels, between 0.5 and 1.0%, with <1% manganese, are used where their higher hardness and strength can be exploited. However, their high hardenability means that they have poor weldability and are difficult to weld without cracking. They are generally welded in the hardened condition and so require preheating, interpass temperature control and post weld stress relief to give any chance or avoiding cracking. Low hydrogen processes, such as MIG and TIG welding or low hydrogen consumables, such as low hydrogen MMA electrodes will always be required when welding these steels.

Carbon-manganese steels have carbon typically between 0.15 and 0.5%, and manganese levels between 1.0 and 1.7% For structural purposes, carbon is normally held below 0.3%, manganese not above 1.2% and sulphur and phosphorous are required to be below 0.05% Generally, they are weldable, although some will require controls on preheat and heat input. Those at the higher end of the carbon range also benefit from the use of low hydrogen welding processes or controlled hydrogen consumables.

Structural steels often have limits imposed on maximum carbon equivalent to ensure good weldability and ease of welding for the fabricator.

Weldable high strength low alloy (HSLA) steels have weldability similar to the low carbon steels, and so do not usually present problems.

Most quenched and tempered steels can be welded, but they rely on relatively high cooling rates for the strong martensitic structures to form. Careful control of preheat, heat input and interpass temperature is required to achieve the correct structure without cracking. Welding must be carried out using a low hydrogen process, or hydrogen controlled consumables, and welding procedures need to be tested and approved.

Alloy Steels

Many low alloy steels are weldable, but some grades are easier to weld than are others. Weldability again varies with the chemistry of the steel, particularly with reference to its carbon content, but also with reference to alloying additions, particularly manganese, chromium, molybdenum, vanadium and nickel content. The weldability of alloy steels therefore depends on its carbon equivalent.

Nickel steels with between 1 and 3% nickel may be welded with suitable welding procedures, specifying preheat and interpass temperature, current levels and heat inputs. As carbon and nickel content increases, so the weldability of these steels becomes worse. This is due to an increase in hardenability and is reflected by an increase in the carbon equivalent. Nickel steels should always be welded using a low hydrogen process, such as MIG or TIG, or with controlled hydrogen consumables.

Steels containing 5% or 9% nickel have poor weldability. As they fall outside the maximum nickel content for which the carbon equivalent formula is valid, preheat must be estimated by other means.

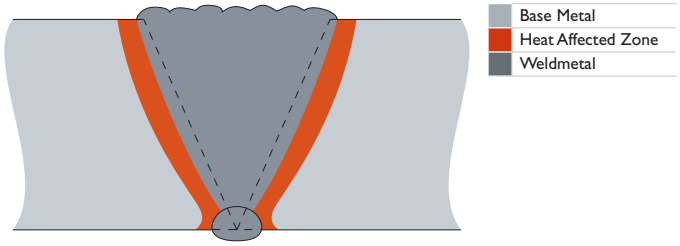
All molybdenum, chromium-molybdenum, and chromium-molybdenum-vanadium steels are hardenable and their weldability is not good. They will crack when welded unless attention is paid to preheat, interpass temperature, cooling rate and post-weld stress relief heat treatment. Normally, low hydrogen processes or hydrogen-controlled consumables are used to reduce the likelihood of cracking.

The weldability of direct hardening steels is not good since, because of their medium carbon and alloy content, they are very hardenable. Any welding must be carried out with due attention to preheat and maintenance of heat during welding, or they will crack. Consumable selection is important and low hydrogen or austenitic types may be used.

Case hardening steels are basically low carbon alloy steels with reasonable weldability as long as precautions are taken. Usually this means using a moderate preheat and standard, low hydrogen carbon-manganese consumables. However, welding will destroy the case hardened layer.

Weld and HAZ Cracking

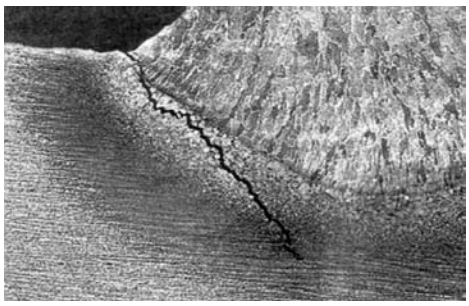
With steel, poor weldability often manifests in a reduction of the resistance of the steel to cracking after welding.



The main causes of cracking in steel are:

- High levels of carbon and other alloy elements, resulting in brittle zones around the weld
- High cooling rates after welding increasing the hardness, which increases the susceptibility to cold cracking
- Joint restraint preventing contraction after welding, leading to cracking
- Hydrogen in the weld bead or HAZ, leading to hydrogen induced cold cracking
- Contaminants like sulphur and phosphorus, resulting in solidification cracking
- Lamellar tearing due to inclusions layering during rolling, resulting in deterioration of the through-thickness properties

The most common cause of cracking in steel is the presence of hydrogen. Hydrogen (or cold) cracking is usually considered the most serious potential problem with modern steels. Hydrogen cracking is most frequently a HAZ phenomenon, but it can also occur in weld metal, particularly in high alloy steels. Hydrogen, like carbon, is more soluble in austenite than ferrite and can easily be picked up by the weld metal. When ferrite is formed as the material cools, hydrogen solubility decreases and hydrogen diffuses to the HAZ, where it becomes trapped and can cause crack propagation.



Heat Affected Zone (Cold cracking)

There are published guidelines and standards that contain welding procedures to avoid hydrogen cracking. For hydrogen cracking to occur, it is necessary to have a supply of hydrogen to the weld and HAZ, a susceptible hardened microstructure, and tensile stress. If any one of these three components is eliminated, then hydrogen cracking will not happen.

To avoid cold cracking, the following point should be noted:

- The lower the carbon equivalent, the lower the potential for cracking
- Limit the hydrogen content of weld metal and HAZ by using a low hydrogen process or low hydrogen consumables
- Keep joint restraint to a minimum by careful joint design
- Reduce the cooling rate of the weld area by preheat and suitable welding heat input
- Eliminating hydrogen after the weld is completed by keeping the weld hot (hydrogen release treatment)
- Ensure impurities are kept at a low levels

The above guide is of a very general nature. If in doubt, seek expert technical advice.

Factors Influencing Weldability

In terms of avoiding weldability problems, particularly hydrogen cracking, when welding carbon or low alloy steels there are several factors that demand consideration. These include the amount of hydrogen generated by the welding process or consumable, the heat input into the weld, the combined thickness (heat sink) of the joint, and the level of preheat applied to the components prior to welding. Joint configuration and restraint are also important factors when considering weldability.

Process Hydrogen

One of the three key components necessary for hydrogen cracking is a source of hydrogen. During welding, the most likely sources of hydrogen are the welding consumables or contaminants on the parent material. Here we consider hydrogen from the welding process and consumables only.

The amount of hydrogen put into the weld will vary from one welding process to another and may also vary within a process from one consumable type to another. The risk of hydrogen cracking increases as the amount of hydrogen from the process or consumable gets larger.

Solid wire processes, such as MIG and TIG, are capable of giving hydrogen levels below 5ml/100g of weld metal. These are generally thought to be low hydrogen processes, provided the MIG wire is clean.

The manual metal arc process can give a wide range of hydrogen levels, from well over 15ml/100g of weld metal (with cellulosic and rutile coated electrodes) to less than 5ml/100g of weld metal (with basic coated electrodes) given the appropriate baking or re-drying treatment.

The potential hydrogen levels can vary with product type for cored wire welding processes too. Basic type flux-cored wires may be capable of getting below 5ml/100g of weld metal, but rutile-cored and metal-cored wire types may give 10 or 15ml/100g of weld metal. Some recent developments have enabled metal-cored and rutile-cored wire to achieve hydrogen levels below 10ml/100g, with some even below 5ml/100g.

Submerged arc wires, like MIG wires, should be able to give low levels of hydrogen but, when used in combination with different fluxes, the hydrogen level may vary between <5 to 15ml/100g of weld metal.

Welding Heat Input

The heat input from the welding process plays a major role in the heating and cooling cycles experienced by the weld and parent plate during welding. For a given plate thickness, a high heat input is likely to result in a slower cooling rate than a low heat input, and will therefore produce a softer microstructure in the HAZ that is less prone to hydrogen cracking. However, that does not mean that welding should always be carried out with a high heat input, because this brings with it other problems, such as loss of mechanical properties and an increased risk of solidification cracking. So it is necessary to select a heat input to give a sound weld with the desired mechanical properties and to use preheat to exert control of the cooling rate.

Heat input 'Q' may be calculated as:

$$Q = \frac{k \times V \times I \times 60}{S \times 1000} \quad kJ/mm$$

where 'V' is arc Voltage (V), 'I' is welding current, and 'S' is welding speed in mm/min.

The value derived from this formula may be multiplied by a factor 'k', the thermal efficiency factor for the welding process, to give an energy input that takes the efficiency of the welding process into account. Typical thermal efficiency factors are:

- 'k' = 1.0 for submerged arc welding
- 'k' = 0.8 for MIG/MAG, MMA, flux-cored and metal-cored arc welding
- 'k' = 0.6 for TIG and plasma welding

For example, when MIG welding, the welding heat input formula becomes:

$$Q = \frac{0.8 \times V \times I \times 60}{S \times 1000} \quad kJ/mm$$

Welding heat input will vary with process and consumable type and size. With small diameter electrodes, low current and fast welding speeds, heat inputs below 1.0kJ/mm are readily attained. With large diameter electrodes, high currents and slower welding speeds, heat inputs in excess of 6.0kJ/mm can be reached.

Note that a weld made using a stringer bead technique will have a lower heat input than a weld made with the same size electrode at the same current but using a weave bead technique.

For more extensive calculation on heat input and preheat requirements of steel, refer to the WTIA Technical Note 1 and AS/NZS 1554.1.

Combined Thickness

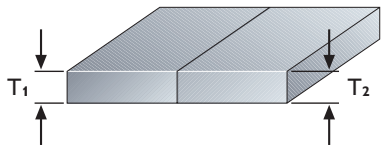
The cooling rate of plate in the region of a weld depends on the thickness of the plates in the joint, the number of plates meeting at the joint, the amount of heat put into the weld area, and the initial temperature of these plates. Cooling occurs by conduction and so the greater the heat sink, the faster the cooling rate. Therefore, other factors being constant, the thicker the plate, the greater the potential for rapid cooling, and so the greater the likelihood of hardening in the HAZ of susceptible steels.

Estimates of preheat will normally take into account the thickness of each of the components in the joint to allow for the cooling effect. The thickness of each component is added together to give what is normally referred to as 'combined thickness' (CT).

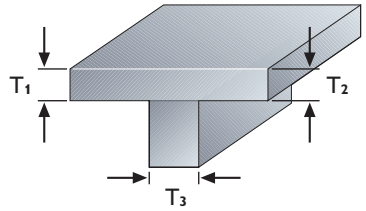
How the combined thickness is derived depends on the joint configuration and is illustrated below:

$$CT = T_1 + T_2 + T_3 \ldots$$

Example of combined thickness calculation for butt joint



Example of combined thickness calculation for fillet joint



For butt welds, the CT equals the sum of the thicknesses of the two plates being welded; for fillet welds, the CT equals twice the thickness of the base plate plus the thickness of the up-stand. Therefore, for a given plate thickness, a fillet joint has a faster cooling rate than a butt joint.

Welding Consumables Selection Chart

Carbon and Low Alloy Steel Castings

Material Specification			Welding Process			
AS 2074	ASTM	BS	MMAW	GMAW	FCAW	SAW
C1		**BS3100 AW1**	BOC Smootharc 16 BOC Smootharc 18	BOC Mild Steel	BOC SmoothCor 711 BOC SmoothCor 70C6 BOC SmoothCor 715	Lincoln L60 + 780 Lincoln L61 + 860 Lincoln L70 + 860 Lincoln L-S3 + 8500
C2	**–**	**BS3100 AM1, AM2**	BOC Smootharc 13 BOC Smootharc 16 BOC Smootharc 18			
C3	**A27 N-1**	**BS3100 A1**				
C4-1	**A27 65-35**	**–**	BOC Smootharc 16 BOC Smootharc 18			
C4-2	**A27 70-36**	**BS3100 A2**				
C5	**–**	**BS3100 A3**				
C6	**–**	**BS3100 AW2**				
C7A-1 **C7A-2** **C7A-3**	**A214 WCA** **A214 WCB** **A214 WCB**	**BS1504 430** **BS1504 480** **BS1504 540**				
L1A **L1B**	**–**	**BS3100 A4** **BS3100 A5, A6**	BOC Smootharc 16 BOC Smootharc 18			
L2A **L2B**	**–**	**BS3100 BW2, BW3** **BS3100 BW4**	Alloycraft 80-B2 Lincoln SL19G	Autocraft CrMo1	W55X.B2H (NA)	Lincoln LAC-B2 + 880
L3A	**A352 LC2**	**BS3100 BL2**	E5518-C2 (NA) [Alloycraft 80-C1] [Jet-LH 8018-C1 MR]	W559AH-Ni3 (NA) [Autocraft Mn-Mo]	W559.Ni3H (NA) [BOC SmoothCor 811K2]	W559.Ni3H (NA) [Lincoln LAC-Ni2 + 880]
L4A	**–**	**–**	Alloycraft 80-C1 Jet-LH 8018-C1 MR	Autocraft Mn-Mo	BOC SmoothCor 811K2	Lincoln LAC-Ni2 + 880
L5A-1 **L5A-2**	**A217 WC1** **A356 - 2**	**BS3100 B1**	E4818-A1 (NA) [BOC Smootharc 16] [BOC Smootharc 18]	W501AH-A1 [Autocraft Mn-Mo]	W501.A1H	Lincoln LA-90 + 880
L5B	**A217 WC6, W11**	**BS3100 B2**	Alloycraft 80-B2 Lincoln SL19G	Autocraft CrMo1	W551.B2H (NA)	Lincoln LAC-B2 + 880
L5C	**A217 WC9** **A356 - 10**	**BS3100 B3**	Alloycraft 90-B3 Lincoln SL20G	W629AH-B3 (NA)	W621.B3H (NA)	Lincoln LA-93 + 880M
L5D		**BS3100 B4**				
L5E	**–**	**BS3100 B5**	E6218-5Cr (NA)	W621AH-5Cr (NA)	W621.5CrH (NA)	W621.5CrH (NA)
L5F	**–**	**BS3100 B6**	Alloycraft 90-B3 Lincoln SL20G	W629AH-B3 (NA)	W62X.B3H (NA)	Lincoln LA-93 + 880M
L5G	**–**	**–**	Alloycraft 80-B2 Lincoln SL19G	Autocraft CrMo1	W55X.B2H (NA)	Lincoln LAC-B2 + 880
L5H	**–**	**BS3100 B7**				
L6	**A148 90-60**	**–**	Alloycraft 90 Lincoln 9018G	W62XAH-G (NA) Autocraft NiCrMo	BOC SmoothCor 115	Lincoln LA-100 + 880
L6A-1 **L6A-2**	**A148 105-85**	**BS3100 BT1**	Alloycraft 110 Jetweld LH-110M MR	Autocraft NiCrMo	BOC SmoothCor 115	Lincoln LAC-M2 + 880
L6B-1 **L6B-2** **L6C**	**A148 115-95** **A148 150-135**	**BS3100 BT2** **BS3100 BT3**	E8318-M (NA) {Alloycraft 110} {Jetweld LH-110M MR}	W831AH-G (NA) {Autocraft NiCrMo}	W831.GH (NA) {BOC SmoothCor 115}	W831.GH (NA) {Lincoln LAC-M2 + 880}

NOTES
(1) NA indicates product not available in Australia / NZ.
(2) Products in [ ] brackets have similar specified minimum tensile strength.
(3) Products in { } brackets have lower than matching specified minimum tensile strength.
(4) Products in [ ] and { } brackets are not pre-qualified to AS 1988–1989. (5) Welding procedure qualification should be carried out prior to welding for structural and matching strength applications.
(6) Consult you BOC welding process specialist or visit BOC's Inform website (subscription required) for more detailed information.

Ferritic Steels

Steel Type	Grade		Welding Process				
Carbon Steels	AS, AISI or SAE	ASTM or BS970	MMAW Electrode	GMAW Wire	FCAW Gas Shielded	FCAW Gasless	SAW Wire and Flux
Mild Steel	**200** **250** **300** **1006** **1010** **1015** **1016** **1020** **1022** **7-430** **7-460**	**A36** **A106** **EN3A** **EN201**	BOC Smootharc 13	BOC Mild Steel	BOC SmoothCor 711 BOC SmoothCor 70C6	Innershield NR-211-MP NR-232 NS-3M NR-311	Lincoln L60 + 780 or 860
350–500 MPa Yield Strength Steels	**350** **400** **450** **XF500** **7-490** **1030** **X1033** **1035** **1040** **1045** **X1320** **8620**	**A105** **A106** **EN5** **EN5B** **EN8A** **EN8** **EN14A**	BOC Smootharc 16 BOC Smootharc 18	BOC Mild Steel	BOC SmoothCor 711 BOC SmoothCor 70C6 BOC SmoothCor 715	Innershield NR-211-MP NR-232 NS-3M NR-311	Lincoln L61 + 860
Medium Tensile Steels	**1050** **1055** **X1340**	**EN43A** **EN33** **EN9** **EN15A**	Alloycraft 80-C1 Jet-LH 8018-C1 MR	Autocraft Mn-Mo	BOC SmoothCor 811K2	Innershield NR-208-H	Lincoln LA-90 + 880
High Tensile Steels	**U1058** **1070** **4140** **4340** **K5140** **P20** **6F7**	**EN42** **EN19** **EN24** **EN18D** **EN25** **EN30B**	Alloycraft 90 Lincoln 9018G	Autocraft NiCrMo	BOC SmoothCor 115	Innershield NR-208-H	Lincoln LA-100 + 880
High Tensile Steels	**U1058** **1070** **4140** **4340** **K5140** **P20** **6F7**	**EN42** **EN19** **EN24** **EN18D** **EN25** **EN30B**	Alloycraft 110 Jetweld LH-110M MR	Autocraft NiCrMo	BOC SmoothCor 115	NA	Lincoln LAC-M2 + 880
Spring Steels	**XK5155S** **XK5160S** **XK9258S** **9255** **XK9261S**	**EN48** **EN45A**	Alloycraft 110 Jetweld LH-110M MR	Autocraft NiCrMo	BOC SmoothCor 115	NR	NR
Free Cutting Steels	**1137** **X1112** **1141** **1144** **1146** **X1147** **1214**	**EN1A**	BOC Smootharc 18	NR	NR	NR	NR
Galvanised Steels	**–**	**–**	BOC Smootharc 13	BOC Mild Steel	NR	NR-211-MP	NR

NOTES
(1) Steels listed on one line are not necessarily equivalent.
(2) Consumables listed against a steel may not achieve matching mechanical properties, depending on the condition (heat treatment history) of the steel.
(3) Welding procedure qualification should be carried out prior to welding for structural and matching strength applications.
(4) Consult you BOC welding process specialist or visit BOC's Inform website (subscription required) for more detailed information.

NR = Not Recommended, NA = Not Available

Quenched and Tempered High Strength Steels and Wear Plate

Material Specification		MMAW	GMAW (Solid)	FCAW	SAW
AS/NZS 3597 Grade 500 (e.g. Bisplate60, Welten60, Weldox 420)	**MS**	Alloycraft 90 Lincoln 9018G	Autocraft Mn-Mo	BOC SmoothCor 115	Lincoln LA-100 + 880
	LS	Alloycraft 80-C1 Jet-LH 8018-C1 MR BOC Smootharc 16 BOC Smootharc 18	BOC Mild Steel	BOC SmoothCor 711 BOC SmoothCor 715 BOC SmoothCor 70C6	Lincoln LA-90 + 880 Lincoln L61 + 860 or 880
AS/NZS 3597 Grade 600 (e.g. Bisplate 70, Welten 70, Weldox 500)	**MS**	Alloycraft 110 Jetweld LH-110M MR	Autocraft NiCrMo	BOC SmoothCor 115	Lincoln LAC-M2 + 880
	LS	Alloycraft 90 Lincoln 9018G BOC Smootharc 16 BOC Smootharc 18	Autocraft Mn-Mo BOC Mild Steel	BOC SmoothCor 811K2 BOC SmoothCor 711 BOC SmoothCor 715 BOC SmoothCor 70C6	Lincoln LA-100 + 800 Lincoln LA-90 + 880 Lincoln L61 + 860 or 880
AS/NZS 3597 Grade 700 (e.g. Bisplate 80, 80PV, Welten 80, Weldox 700)	**MS**	Alloycraft 110 Jetweld LH-110M MR	Autocraft NiCrMo	BOC SmoothCor 115	Lincoln LAC-M2 + 880
	LS	Alloycraft 90 Lincoln 9018G BOC Smootharc 16 BOC Smootharc 18	Autocraft Mn-Mo BOC Mild Steel	BOC SmoothCor 811K2 BOC SmoothCor 711 BOC SmoothCor 715 BOC SmoothCor 70C6	Lincoln LA-100 + 800 Lincoln LA-90 + 880 Lincoln L61 + 860 or 880
Wear Plates (e.g Bisplate320, 360, 400, 500, Welten RE, Hardox 400, 500)	**MS**	NA	NA	BOC SmoothCor 115	NR
	LS	Alloycraft 110 Jetweld LH-110M MR Alloycraft 90 Lincoln 9018G BOC Smootharc 16 BOC Smootharc 18	Autocraft NiCrMo Autocraft Mn-Mo BOC Mild Steel	BOC SmoothCor 811K2 BOC SmoothCor 711 BOC SmoothCor 715 BOC SmoothCor 70C6	Lincoln LAC-M2 + 880 Lincoln LA-100 + 800 Lincoln LA-90 + 880 Lincoln L61 + 860 or 880

Notes

MS = Matching Strength
LS = Lower Strength
NR = Not Recommended
NA = Not Available

Smootharc™ 12

Description

Smootharc™ 12 is a multi-purpose, rutile-cellulosic electrode suitable for a wide range of applications in mild steel. The electrode is fully positional, including very good appeal in the vertical-down position. The electrode welds with a crisp steady arc to produce a smooth weld bead surface to enhance good slag detachability. Performance can be insensitive to rust, dirt and surface coatings, and has good ability to bridge gaps or poor fit-up.

Application

For the welding of all mild steels, sheet metal, tank work and general fabrication. Combined with the excellent strike/re-strike and a high tolerance to large gaps or poor fit-up, this electrode is easy to use and recommended for all round fabrication work.

Technique

Either the contact or free arc technique can be used. For vertical-down welding, the contact weld technique must be used with a high rate of travel.

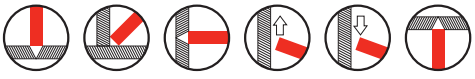
Storage

Electrodes, once the seal is broken, should be stored in heated cabinets at 40–50°C.

Re-Drying/Conditioning

BOC Smootharc™ 12 electrodes are sealed from moisture during manufacture, but all fluxes are hydroscopic and, when left in the opened state for a period of time, will absorb moisture. Moisture is indicated by a noisy or 'digging arc', high spatter, tight slag, undercut or excessive 'cup' on the end of an electrode. Re-dry damp electrodes for 2 hours at 80–90°C.

Welding Positions



Specifications

Coating Type	Rutile-Cellulosic	
Classification	AWS/ASME-SFA A5.1	E6013
	AS/NZS 1553.1	E4112-0
Approvals	Lloyds Register of Shipping	Grade 2
	Det Norske Veritas	Grade 2
	American Bureau of Shipping	Grade 2
Welding Current*	AC, OCV >50V or DC+-	
Metal Recovery	90%	

* DC– is recommended for root passes.

Chemical Composition, wt% – All Weld Metal			
	C	Si	Mn
Typical	0.07	0.4	0.5

Mechanical Properties – All Weld Metal	
	Typical (as welded)
Yield strength	470 MPa
Tensile strength	540 MPa
Elongation	24%
Impact energy, CVN	50J @ 0°C

Packaging Data					
Dia. (mm)	2.5	3.2	2.5	3.2	4.0
Part No.	184133	184134	184135	184136	184137
Weight packet (kg)	1.0	1.0	5.0	5.0	5.0
Weight carton (kg)	10.0	10.0	15.0	15.0	15.0
Electrodes pkt (approx)	55	33	278	168	109

Welding Parameters			
Dia. (mm)	2.5	3.2	4.0
Length (mm)	350	350	350
Current (A)	70–100	90–145	120–195
Voltage (V)	25	25	25

Deposition Data			
Dia. (mm)	2.5	3.2	4.0
Kg weld metal/kg electrodes	0.7	0.7	0.7
No. of electrodes/kg weld metal	98	48	33
Kg weld metal/hour arc time	0.8	1.2	1.7
Burn off time/electrode (sec)	48	49	58

Data for Welding Horizontal Fillet Joints			
Dia. (mm)	2.5	3.2	4.0
Throat thickness	2.0	3.5	5.0
Leg length	2.8	5.0	7.0
Amps	65	125	165
Arc time (sec)	50	52	59
Bead length/electrode (mm)	201	195	208
Weld speed (m/hr)	15.0	12.4	11.2

Note: operator technique will influence the values shown

Smootharc™ 13

Description

Smootharc™ 13 is a thicker coated all positional rutile electrode that performs very well in the down hand position, exceptionally well in the vertical-up and overhead positions, and can also be used in the vertical-down position. The electrode welds with a very smooth, low spatter arc to produce a finely rippled bead surface with excellent slag detachability.

Application

For welding mild steels, sheet metal, tank work and general fabrication. Combined with the excellent strike/restrike and a high tolerance to large gaps or poor fit-up, this electrode is easy to use and recommended for all round fabrication work. Especially good for the less experienced welder.

Technique

Either the contact or free arc technique can be used. For vertical-down welding, the contact weld technique must be used with a high rate of travel.

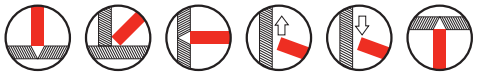
Storage

Electrodes, once the seal is broken, should be stored in heated cabinets at 40–50°C.

Re-Drying/Conditioning

BOC Smootharc™ 13 electrodes are sealed from moisture during manufacture, but all fluxes are hydroscopic and, when left in the opened state for a period of time, will absorb moisture. Moisture is indicated by a noisy or 'digging' arc, high spatter, tight slag, undercut or excessive 'cup' on the end of an electrode. Re-dry damp electrodes for 2 hours at 80–90°C.

Welding Positions



Specifications

Coating Type	Rutile	
Classification	AWS/ASME-SFA A5.1	E6013
	AS/NZS 1553.1	E4113-0
Approvals	Lloyds Register of Shipping	Grade 2
	Det Norske Veritas	Grade 2
	American Bureau of Shipping	Grade 2
Welding Current*	AC, OCV >50V or DC+-	
Metal Recovery	95%	

* DC– is recommended for root passes.

Chemical Composition, wt% – All Weld Metal	C	Si	Mn
Typical	0.06	0.4	0.5

Mechanical Properties – All Weld Metal	Typical (as welded)
Yield strength	470 MPa
Tensile strength	540 MPa
Elongation	25%
Impact energy, CVN	70J @ 0°C

Packaging Data					
Dia. (mm)	2.5	3.2	2.5	3.2	4.0
Part No.	187143	187144	187145	187146	187147
Weight packet (kg)	1.0	1.0	5.0	5.0	5.0
Weight carton (kg)	10.0	10.0	15.0	15.0	15.0
Electrodes pkt (approx)	46	34	230	170	106

Welding Parameters			
Dia. (mm)	2.5	3.2	4.0
Length (mm)	350	350	350
Current (A)	60–95	110–130	140–165
Voltage (V)	25	25	25

Deposition Data			
Dia. (mm)	2.5	3.2	4.0
Kg weld metal/kg electrodes	0.53	0.59	0.56
No. of electrodes/kg weld metal	86	57	38
Kg weld metal/hour arc time	0.6	1.0	1.4
Burn off time/electrode (sec)	60	63	73

Data for Welding Horizontal Fillet Joints			
Dia. (mm)	2.5	3.2	4.0
Throat thickness	2.0	3.5	5.0
Leg length	2.8	5.0	7.0
Amps	65	125	165
Arc time (sec)	48	54	62
Bead length/electrode (mm)	203	198	208
Weld speed (m/hr)	15.2	12.4	11.2

Note: operator technique will influence the values shown.

Smootharc™ 24

Description

Smootharc™ 24 is a rutile-coated iron powder electrode with 160% recovery designed for high productivity welding in heavier section mild steel. Excellent profile mitre fillets are produced, having a smooth transition with the base material and ensuring excellent slag detachability.

Application

Smootharc™ 24 has been designed to produce the highest possible productivity when depositing fillet welds with a leg length in the 4 to 6 mm range in the heavier section construction steels. This electrode performs exceptionally well when welding 'inside corner' fillets. Fillet welds can also be made in primer treated material without porosity or fusion defects along the top edge.

Technique

The best results are obtained using the touch welding technique, with the electrode held at a sufficient angle to prevent the molten slag from crowding the arc. AC is recommended, as it reduces arc blow, particularly at the high currents required with large diameter electrodes.

Storage

Electrodes, once the seal is broken, should be stored in heated cabinets at 40–50°C.

Re-Drying/Conditioning

BOC Smootharc™ 24 electrodes should be re-dried at 100–120°C for 2 hours.

Welding Positions

Specifications

Coating Type	Rutile, Iron powder	
Classification	AWS/ASME-SFA	A5.1 E7024
	AS/NZS 1553.1	E4824-0
Approvals	Lloyds Register of Shipping	Grade 2
	Det Norske Veritas	Grade 2
	American Bureau of Shipping	Grade 2
Welding Current	AC, OCV >50V or DC+-	
Metal Recovery	160%	

Chemical Composition, wt% – All Weld Metal

	C	Si	Mn
Typical	0.07	0.5	0.7

Mechanical Properties – All Weld Metal

	Typical (as welded)
Yield strength	470 MPa
Tensile strength	560 MPa
Elongation	24%
Impact energy, CVN	50J @ 0°C

Packaging Data			
Dia. (mm)	3.2	4.0	5.0
Part No.	186166	186167	186168
Weight packet (kg)	6.0	6.0	5.5
Weight carton (kg)	18.0	18.0	16.5
Electrodes pkt (approx)	91	60	36

Welding Parameters			
Dia. (mm)	3.2	4.0	5.0
Length (mm)	450	450	450
Current (A)	130–160	150–235	200–320
Voltage (V)	28	31	31

Deposition Data			
Dia. (mm)	3.2	4.0	5.0
Kg weld metal/kg electrodes	0.72	0.71	0.71
No. of electrodes/kg weld metal	21	14	9
Kg weld metal/hour arc time	2.2	3.0	4.1
Burn off time/electrode (sec)	72	78	86

Data for Welding Horizontal Fillet Joints			
Dia. (mm)	3.2	4.0	5.0
Throat thickness	3.1	3.8	4.1
Leg length	5.0	7.0	8.4
Amps	135	200	275
Arc time (sec)	88	93	98
Bead length/electrode (mm)	360	432	525
Weld speed (m/hr)	14.7	16.6	18.6

Note: operator technique will influence the values shown.

Smootharc™ 16

Description

Smootharc™ 16 is a basic coated 105% recovery electrode intended for general welding applications where controlled hydrogen and medium tensile properties are required. It has excellent mechanical and X-ray properties.

Application

For the welding of all section steels, tank work and general fabrication. Suitable for unalloyed, micro alloyed and low alloyed steels.

Technique

As with all hydrogen-controlled electrodes, as short an arc as possible should be kept at all times. When starting with a new electrode the arc should be initiated ahead of the start of the weld or crater and worked back over this distance before continuing the weld in the required direction. On larger size joints, several stringer beads should be used in preference to one large weave bead to ensure optimum mechanical properties. DC– should be used for root passes where poor fit-up is a factor that should be taken into account.

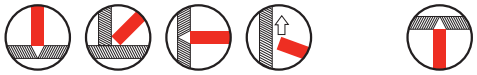
Storage

BOC Smootharc™ 16 electrodes, when removed from a freshly opened tin, will have <4 ml/100g hydrogen. Once the seal is broken, electrodes should be stored in heated cabinets at 80–120°C.

Re-Drying/Conditioning

Basic (low hydrogen) type electrodes are redried at temperatures of 350–400°C for 1–2 hours to achieve a hydrogen level of 5–10 ml/100g of weld metal and restricted to 5 redries. To achieve extreme low hydrogen levels, <4 ml/100g, 420–440°C is recommended for 1–2 hours and restricted to 1 re-dry.

Welding Positions



Specifications

Coating Type	Basic	
Classification	AWS/ASME-SFA A5.1	E7016-1 H4
	AS/NZS 1553.1	E4816-4 H5
Approvals	Lloyds Register of Shipping	Grade 3, 3Ym H5
	Det Norske Veritas	Grade 3Y H5
	American Bureau of Shipping	Grade 3, 3Y HH
Welding Current*	AC, OCV 60V or DC+-	
Metal Recovery	105%	
Hydrogen content/100g weld metal	<4ml	

* DC– is recommended for root passes.

Chemical Composition, wt% – All Weld Metal					
	C	Si	Mn	P	S
Typical	0.06	0.5	1.0	0.015	0.005

Mechanical Properties – All Weld Metal		
	Typical (as welded)	PWHT Typical*
Yield strength	470 MPa	420 MPa
Tensile strength	560 MPa	515 MPa
Elongation	25%	31%
Impact energy, CVN	70J @ -46°C	150J @ -40°C

*PWHT 620°C 1 hour

Packaging Data				
Dia. (mm)	2.5	3.2	4.0	5.0
Part No.	184143	184144		
Weight packet (kg)	1.0	1.0		
Weight carton (kg)	10.0	10.0		
Electrodes pkt (approx)	51	29		
Part No.	186145N	186146N	186147N	186148
Weight packet (kg)	3.5	3.5	3.5	5.5
Weight carton (kg)	10.5	10.5	10.5	16.5
Electrodes pkt (approx)	178	101	66	54

Welding Parameters				
Dia. (mm)	2.5	3.2	4.0	5.0
Length (mm)	350	350	350	450
Current (A)	60–90	80–160	110–210	155–290
Voltage (V)	24	26	25	25

Deposition Data				
Dia. (mm)	2.5	3.2	4.0	5.0
Kg weld metal/kg electrodes	0.64	0.66	0.66	0.70
No. of electrodes/kg weld metal	80	44	29	14
Kg weld metal/hour arc time	0.9	1.2	1.7	2.4
Burn off time/electrode (sec)	50	65	70	96

Data for Welding Horizontal Fillet Joints				
Dia. (mm)	2.5	3.2	4.0	5.0
Throat thickness	3.2	4.2	5	6
Leg length	4.5	6	7	8.5
Amps	75	115	170	220
Arc time (sec)	55	67	73	98
Bead length/electrode (mm)	135	160	200	270
Weld speed (m/hr)	0.64	0.72	0.72	0.76

Note: operator technique will influence the values shown.

Smootharc™ 18

Description

Smootharc™ 18 is a basic-coated low hydrogen AC/DC electrode for which the outstanding all round operability has been optimised. The smooth, soft arc, easy slag control, all positional welding with low spatter and excellent slag removal provide maximum operator appeal. The electrode is suitable for welding mild and higher strength steels. It combines strength and toughness and is particularly suitable for heavily restrained sections where there can be risk of cracking due to weld stress.

Application

With its excellent general operability and good positional welding characteristics, the Smootharc™ 18 is used for general fabrication work as well as pipe welding where the fine spray transfer provides precise weld pool control. The fine arc spray also makes it an ideal electrode for the experienced welder, and for positional work in demanding applications.

The electrode produces a finely rippled bead surface and smooth transition with the base material. This, together with the exceptionally good slag detachability, even in root runs, gives the Smootharc™ 18 superior radiographic quality. It is also an ideal electrode for use on AC machines with an OCV of 70V.

Technique

As with all basic hydrogen-controlled electrodes, as short an arc as possible should be kept at all times. When starting with a new electrode, the arc should be initiated ahead of the start of the weld or crater and worked back over this distance before continuing the weld in the required direction. On larger size joints, several stringer beads should be used in preference to one large weaved bead to ensure optimum mechanical properties.

DC– should be used for root passes where poor fit-up is a factor that should be taken into account.

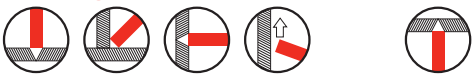
Storage

BOC Smootharc™ 18 electrodes, when removed from a freshly opened tin, will have <4 ml/100g weld metal hydrogen. Once the seal is broken, electrodes should be stored in heated cabinets at 80–120°C.

Re-Drying/Conditioning

Basic (low hydrogen) type electrodes are re-dried at temperatures of 350–400°C for 1–2 hours to achieve a hydrogen level of 5–10 ml/100g of weld metal and restricted to 5 re-dries. To achieve extreme low hydrogen levels, <4 ml/100g, 420–440°C is recommended for 1–2 hours and restricted to 1 re-dry.

Welding Positions



Specifications

Coating Type	Basic	
Classification	AWS/ASME-SFA AS.1	E7018-1 H4
	AS/NZS1553.1	E4818-4 H5
Approvals	Lloyds Register of Shipping	Grade 3, 3Y, H5
	Det Norske Veritas	Grade 3YH5
	American Bureau of Shipping	Grade 3, H5, 3Y
Welding Current*	AC, OCV 70V or DC+-	
Metal Recovery	120%	
Hydrogen content/100g weld metal	<4ml	

* DC– is recommended for root passes.

Chemical Composition, wt% – All Weld Metal

	C	Si	Mn	P	S
Typical	0.05	0.6	1.4	0.015	0.010

Mechanical Properties – All Weld Metal

	Typical (as welded)	PWHT Typical*
Yield strength	530 MPa	490 MPa
Tensile strength	600 MPa	510 MPa
Elongation	26%	29%
Impact energy, CVN	60J @ -40°C 40J @ -46°C	130J @ -20°C

*PWHT 620°C 1 hour

Packaging Data				
Dia. (mm)	2.5	3.2	4.0	5.0
Part No.	184155N	184156N	184157N	184158
Weight packet (kg)	3.5	3.5	3.5	5.5
Weight carton (kg)	10.5	10.5	10.5	16.5
Electrodes pkt (approx)	148	89	64	55

Welding Parameters				
Dia. (mm)	2.5	3.2	4.0	5.0
Length (mm)	350	350	350	450
Current (A)	80–110	110–155	140–205	200–285
Voltage (V)	23	24	25	25

Deposition Data				
Dia. (mm)	2.5	3.2	4.0	5.0
Kg weld metal/kg electrodes	0.71	0.72	0.74	0.75
No. of electrodes/kg weld metal	60	35	25	13
Kg weld metal/hour arc time	1.0	1.6	2.1	2.9
Burn off time/electrode (sec)	54	57	73	91

Data for Welding Horizontal Fillet Joints				
Dia. (mm)	2.5	3.2	4.0	5.0
Throat thickness	3.0	4.2	5.0	6.0
Leg length	4.3	6.0	7.0	8.5
Amps	85	125	175	225
Arc time (sec)	61	74	81	104
Bead length/electrode (mm)	163	215	226	287
Weld speed (m/hr)	9.6	10.6	10.1	9.7

Note: operator technique will influence the values shown.

Ferrocraft 11

- Cellulose pipe welding electrode
- All positional, AC / DC capabilities
- High penetration, root pass applications
- White flux colour for easy identification
- Recommended for root pass welding where the 'stovepipe' or 'flick' techniques can be used to achieve full root penetration
- The root, hot fill and capping pass welding of pipelines, pressure vessels, storage tanks, workshop and field construction

Classifications
AS / NZS 1553.1: E4111-2
AWS / ASME-SFA A5.1: E6011

Typical all weld metal mechanical properties	
Yield stress	415 MPa
Tensile strength	500 MPa
Elongation	28%
CVN impact values	90J av @ -20°C

Typical all weld metal analysis (%)				
C	Mn	Si	S	P
0.12	0.47	0.10	0.01	0.01

Approvals	
Lloyds Register of Shipping	Grade 3, 3Y
American Bureau of Shipping	Grade 3
Det Norske Veritas	Grade 3
American Bureau of Shipping	AWS A5.1 E6011

Packaging and operating data — AC (min. 65 OCV) DC+ or DC- polarity						
Electrode		Approx No.	Current			
Size (mm)	Length (mm)	(rods / kg)	Range (A)	Packet (kg)	Carton (kg)	Part No.
2.5	300	62	65–85	5	15 (3 x 5)	611132
3.2	380	33	95–125	5	15 (3 x 5)	611133
4.0	380	22	130–160	5	15 (3 x 5)	611134

PipeArc 6010P

- User-friendly pipe welding electrode
- Lower spatter levels and easy slag removal
- Excellent reverse bead formation on butts
- Versatile 'out-of-position' capabilities
- Batch numbered for on-the-job traceability
- Used to weld out (root, fill and cap) steel pipes such as API 5L, 5LX grades X42 to-X52
- Welding of 'V' butt (groove weld) joints in higher strength steels, including 5LX grades X60, X65 and X70. Recommended for root pass welding only

Classifications
AS / NZS 1553.1: E4110-2
AWS / ASME-SFA A5.1: E6010

Typical all weld metal mechanical properties	
Yield stress	400 MPa
Tensile strength	510 MPa
Elongation	30%
CVN impact values	65J av @ -20°C 40J av @ -30°C

Typical all weld metal analysis (%)				
C	Mn	Si	S	P
0.11	0.46	0.15	0.011	0.012

Approvals	
Lloyds Register of Shipping	Grade 3
American Bureau of Shipping	AWS A5.1 E6010
Det Norske Veritas	Grade 3
American Bureau of Shipping	Grade 3

Packaging and operating data DC+ (Direct Current Electrode Positive) polarity						
Electrode		Approx no.	Current			
Size (mm)	Length (mm)	(rods / kg)	Range (A)	Packet (kg)	Carton (kg)	Part No.
2.5	300	66	45–85	5	15 (3 x 5)	615602
3.2	350	39	70–125	5	15 (3 x 5)	615603
4.0	350	25	120–190	5	15 (3 x 5)	615604
4.8	350	18	160–250	5	15 (3 x 5)	615605

The results quoted in this data sheet are obtained from the listed Shipping Societies (ABS, DNV, LRS) Conformance Tests and Procedures. Actual weld metal mechanical properties achieved with PipeArc 6010P are influenced by many factors, including base metal analysis, welding parameters / heat input used, number of weld passes and run placement etc. On-the-job mechanical tests may produce different results. Please consult your nearest BOC branch for welding procedure recommendations.

GP 6012

- Versatile general purpose electrode
- All positional welding capabilities
- Ideal for the vertical-down welding of thin steel sections
- Wrought iron furniture
- Suitable for welding mild steel plate, sheet metal and galvanised iron sheet, ducting, hoppers, tanks, pipes and low pressure pipelines
- Excellent for welding joints with poor fit-up

Classifications
AS/NZS 1553.1: E4112-0 AWS/ASME-SFA A5.1: E6013

Typical all weld metal mechanical properties	
Yield stress	430 MPa
Tensile strength	490 MPa
Elongation	29%
CVN impact values	80J av @ 0°C

Typical all weld metal analysis (%)		
C	Mn	Si
0.07	0.45	0.30

Approvals	
Lloyds Register of Shipping	Grade 2
American Bureau of Shipping	Grade 2
Det Norske Veritas	Grade 2

Packaging and operating data — AC (min. 45 OCV) DC+ or DC- polarity

Electrode Size (mm)	Length (mm)	Approx No. (rods/kg)	Current Range (A)	Packet (kg)	Carton (kg)	Part No.
2.5	300	55	55–80	5	15 (3×5)	611142
3.2	380	30	90–130	5	15 (3×5)	611143
4.0	380	19	130–180	5	15 (3×5)	611144

Ferrocraft 12XP

- General purpose 'XP series' electrode
- Easy striking – hot or cold
- Xtra smooth performance (XP)
- Versatile – all positional capabilities
- Ideal for vertical-down fillet welding
- All positional fillet welding of steel furniture, plates, fences, gates, pipes and tanks etc
- Red flux colour for easy identification

Classifications
AS/NZS 1553.1: E4112-0 AWS/ASME-SFA A5.1: E6013

Typical all weld metal mechanical properties	
Yield stress	460 MPa
Tensile strength	500 MPa
Elongation	27%
CVN impact values	75J av @ 0°C

Typical all weld metal analysis (%)		
C	Mn	Si
0.07	0.60	0.50

Approvals	
Lloyds Register of Shipping	Grade 2, 2Y
American Bureau of Shipping	Grade 2, 2Y
Det Norske Veritas	Grade 2
American Bureau of Shipping	AWS A5.1 E6013

Packaging and operating data — AC (min. 45 OCV) DC+ or DC- polarity

Electrode Size (mm)	Length (mm)	Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Easyweld Handipack	Part No.
2.0	300	95	40–70	half pack 2.5	15 (6×2.5)	–	612231
2.0	300	95	40–70	–	–	90 rods	322128
2.5	300	55	60–100	5	15 (3×5)	–	611232
2.5	300	55	60–100	half pack 2.5	15 (6×2.5)	–	612232
2.5	300	55	60–100	–	–	50 rods	322129
3.2	380	30	90–130	5	15 (3×5)	–	611233
3.2	380	30	90–130	half pack 2.5	15 (6×2.5)	–	612233
3.2	380	30	90–130	–	–	25 rods	322138
4.0	380	19	130–180	5	15 (3×5)	–	611234
Easyweld Blister pack							
10 x 2.5 mm, 5 x 3.2 mm Rod Blister Pack							322213

Satincraft 13

- General purpose, rutile type electrode
- Outstanding operator appeal
- Versatile – all positional capabilities
- Smooth mitre fillet welds with low spatter
- Developed and manufactured in Australia
- Blue flux colour for instant identification
- General workshop, field and structural welding of mild or galvanised steel components such as pipes, tanks, frames, fences and gates etc

Classifications
AS/NZS 1553.1: E4113-0
AWS/ASME-SFA A5.1: E6013

Typical all weld metal mechanical properties	
Yield stress	460 MPa
Tensile strength	520 MPa
Elongation	28%
CVN impact values	60J av @ 0°C

Typical all weld metal analysis (%)		
C	Mn	Si
0.07	0.60	0.50

Approvals	
Lloyds Register of Shipping	Grade 2
American Bureau of Shipping	Grade 2
Det Norske Veritas	Grade 2
American Bureau of Shipping	AWS A5.1 E6013

Packaging and operating data — AC (min. 45 OCV) DC+ or DC- polarity.

Electrode		Approx no.	Current			Easyweld	
Size (mm)	Length (mm)	(rods/kg)	Range (A)	Packet (kg)	Carton (kg)	Handipack	Part No.
2.5	300	53	55–90	5	15 (3x5)	–	611182
2.5	300	53	55–90	half pack 2.5	15 (6x2.5)	–	612182
2.5	300	53	55–90	1	–	–	610182
2.5	300	53	55–90	–	–	50 rods	322135
3.2	380	29	90–135	5	15 (3x5)	–	611183
3.2	380	29	90–135	half pack 2.5	15 (6x2.5)	–	612183
3.2	380	29	90–135	1	–	–	610183
3.2	380	29	90–135	–	–	25 rods	322136
4.0	380	20	135–180	5	15 (3x5)	–	611184
Easyweld Blister pack							
10 x 2.5 mm, 5 x 3.2 mm Rod Blister Pack							322203

Weldcraft

- Rutile – basic type electrode
- Higher radiographic quality
- Excellent mechanical properties
- Versatile 'out-of-position' capabilities
- 'On-site' and workshop welding where better mechanical properties are required and the work cannot be re-positioned to allow welding in the downhand. The electrode is recommended for welding joints subject to radiographic examination in pressure vessel, ship building, bridge and storage tank fabrications

Classifications
AS/NZS 1553.1: E4113-2
AWS/ASME-SFA A5.1: E6013.

Typical all weld metal mechanical properties	
Yield stress	420 MPa
Tensile strength	490 MPa
Elongation	28%
CVN impact values	60J av @ -20°C

Typical all weld metal analysis (%)		
C	Mn	Si
0.07	0.60	0.50

Approvals	
Lloyds Register of Shipping	Grade 3
American Bureau of Shipping	Grade 3
Det Norske Veritas	Grade 3

Packaging and operating data — AC (min. 50 OCV) DC+ or DC- polarity

Electrode		Approx No.	Current			
Size (mm)	Length (mm)	(rods/kg)	range (A)	Packet (kg)	Carton (kg)	Part No.
2.5	300	51	60–95	5	15 (3x5)	611202
3.2	380	27	95–135	5	15 (3x5)	611203
4.0	380	17	130–185	5	15 (3x5)	611204

Ferrocraft 21

- Rutile type, medium iron powder electrode
- Excellent operator appeal
- Versatile – all positional capabilities
- Easy striking – hot or cold
- Ideal for vertical-down fillet welding
- Workshop or 'on-site' repair, maintenance and fabrication welding jobs where the iron powder addition gives improved usability over conventional E4112 rutile type electrodes
- Ideal vertical-down fillet welding electrode for thinner steel sections using 'touch welding' techniques

Classifications
AS/NZS 1553.1: E4814-2 AWS/ASME-SFA A5.1: E7014

Typical all weld metal mechanical properties	
Yield stress	430 MPa
Tensile strength	500 MPa
Elongation	30%
CVN impact values	90J av @ -20°C

Typical all weld metal analysis (%)		
C	Mn	Si
0.06	0.65	0.30

Approvals	
Lloyds Register of Shipping	Grade 3
American Bureau of Shipping	Grade 3
Det Norske Veritas	Grade 3
American Bureau of Shipping	AWS A5.1 E7014

Packaging and operating data — AC (min. 45 OCV) DC+ or DC- polarity

Electrode		Approx No.	Current	Packet		Easyweld	
Size (mm)	Length (mm)	(rods/kg)	range (A)	(kg)	Carton (kg)	Handipack	Part No.
2.5	300	50	55–100	5	15 (3x5)	–	611242
2.5	300	50	55–100	–	–	20 rods	322130
3.2	380	26	95–140	5	15 (3x5)	–	611243
4.0	380	17	140–195	5	15 (3x5)	–	611244
5.0	450	9	200–260	5	15 (3x5)	–	611245
Easyweld Blister pack							
10 x 2.5 mm, 5 x 3.2 mm Rod Blister Pack							322205

Ferrocraft 22

- Rutile type high iron powder electrode
- High productivity fillet and butt welding in all downhand positions
- Self releasing slag
- Recommended for high production welding where large standing fillet welds are required
- Ideal electrode for heavy structural welding – tanks, frames, girders, beams, ship structures, rolling stock and general fabrication in the workshop or 'on-site'

Classifications
AS/NZS 1553.1: E4824-0 AWS/ASME-SFA A5.1: E7024.

Typical all weld metal mechanical properties	
Yield stress	440 MPa
Tensile strength	512 MPa
Elongation	25%
CVN impact values	60J av @ 0°C

Typical all weld metal analysis (%)		
C	Mn	Si
0.05	0.75	0.25

Approvals	
Lloyds Register of Shipping	Grade 2Y
American Bureau of Shipping	Grade 2
Det Norske Veritas	Grade 2
American Bureau of Shipping	AWS A5.1 E7024

Packaging and operating data — AC (min. 45 OCV) DC+ or DC- polarity

Electrode		Approx No.	Current	Packet		
Size (mm)	Length (mm)	(rods/kg)	range (A)	(kg)	Carton (kg)	Part No.
2.5	350	34	85–120	4	12 (3x4)	611252
3.2	380	18	130–170	5	15 (3x5)	611253
4.0	450	11	185–235	5	15 (3x5)	611254
5.0	450	7	260–320	5	15 (3x5)	611255

Ferrocraft 22 is formulated to operate with AC (min 45 OCV), DC+ or DC- polarity.
The preferred polarity for DC fillet welding is DC+.

Ferrocraft 16TXP

- Now in hermetically sealed 3kg cans
- 'XP series' E4816/E7016 type electrode
- Great operator appeal/hydrogen controlled
- Longer 350mm x 2.5mm size for fewer electrode change-overs and less wastage
- Easy operation, reliable Grade 3 weld metal properties and low hydrogen status of Ferrocraft 16TXP make the electrode ideal for maintenance welding jobs, including the repair of earth-moving equipment and the 'buttering' of steel sections prior to the application of hard surfacing.

Classifications
AS/NZS 1553.1 E4816-2 H10 AWS/ASME-SFA A5.1: E7016 H8

Typical all weld metal mechanical properties	
Yield stress	460MPa
Tensile strength	550MPa
Elongation	27%
CVN impact values	90J av @ -20°C

Typical all weld metal analysis (%)				
C	Mn	Si	S	P
0.07	1.50	0.65	0.010	0.015

Typical diffusible hydrogen levels to AS 3752
7.0–7.5ml of hydrogen/100 gm of deposited weld metal*
*Reconditioned for 2 hours maximum at 300°C

Approvals	
Lloyds Register of Shipping	Grade 3, 3Y H15
American Bureau of Shipping	Grade 3H10, 3Y
Det Norske Veritas	Grade 3Y H10

Packaging and operating data — AC (min. 45 OCV) DC+ or DC- polarity

Electrode Size (mm)	Length (mm)	Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
2.5	350	56	50–90	3	12 (4x3)	613562
3.2	350	30	85–140	3	12 (4x3)	613563
4.0	350	21	135–190	3	12 (4x3)	613564
Easyweld blister pack						
10 x 2.5mm, 5 x 3.2mm rod Ferrocraft 16TXP Blister Pack						322214

Ferrocraft 16TXP is formulated to operate with AC (45 OCV min) DC+ or DC- polarity. The preferred polarity for fillet welding and fill and capping passes is DC+.

Ferrocraft 7016

- Fully basic hydrogen controlled E4816/E7016 type electrode
- Excellent operator appeal in all positions
- Ideal for fill and capping passes
- Excellent impact toughness to -30°C
- Applications include pressure vessel fabrication, bridge, ship building, equipment repair and maintenance work

Classifications
AS/NZS 1553.1: E4816-3 H10 AWS/ASME-SFA A5.1: E7016 H8 BS EN 499: E42 4 B 12 H10

Typical mechanical properties	
Yield stress	480MPa
Tensile strength	570MPa
Elongation	25%
CVN impact values	125J av @ -20°C 100J av @ -30°C

Typical all weld metal analysis (%)				
C	Mn	Si	S	P
0.08	1.10	0.65	0.009	0.019

Typical diffusible hydrogen levels to AS 3752
5.0–6.0 mls of hydrogen / 100 gm of deposited weld metal*
*Reconditioned for 2 hours maximum at 300°C

Approvals	
Lloyds Register of Shipping	Grade 3Y H10
American Bureau of Shipping	Grade 3H10, 3Y
Det Norske Veritas	Grade 3Y H10
American Bureau of Shipping	AWS A5.1 E7016

Packaging and operating data — AC (min. 50 OCV) DC+ or DC- polarity

Electrode Size (mm)	Length (mm)	Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
3.2	380	29	90–130	5	15 (3x5)	611743
4.0	380	19	120–180	5	15 (3x5)	611744

Ferrocraft 7016 is formulated to operate with AC (55 OCV), DC+ or DC- polarity. The preferred polarity for fillet welding and fill and capping passes is DC+.

Ferrocraft 55U

- Basic, hydrogen controlled E4816/E7016 type electrode
- Thin coated for easier joint access
- Purple end tip colour for instant identification
- Designed specifically for the all positional (except vertical-down) root pass welding of steel pipes and plates

Classifications
AS/NZS 1553.1: E4816-2 H10 AWS/ASME-SFA A5.1: E7016 H8

Typical all weld metal mechanical properties	
Yield stress	460 MPa
Tensile strength	570 MPa
Elongation	29%
CVN impact values	70J av @ -20°C

Typical all weld metal analysis (%)				
C	Mn	Si	S	P
0.07	0.80	0.77	0.007	0.013

Typical diffusible hydrogen levels to AS 3752
7.0–7.5 ml of hydrogen / 100 gm of deposited weld metal*

*Reconditioned for 2 hours maximum at 300°C

Approvals	
Lloyds Register of Shipping	Grade 3, 3Y H15
Det Norske Veritas	Grade 3Y H10

Packaging and operating data — AC (min. 70 OCV) DC+ or DC- polarity

Electrode		Approx no. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
2.5	350	53	40–90	5	15 (3x5)	611492
3.2	380	31	60–140	5	15 (3x5)	611493
4.0	380	19	90–180	5	15 (3x5)	611494

Ferrocraft 55U is formulated to operate on a low welding current to accommodate poor joint fit-up and large root gaps. The electrode is suitable for AC (minimum 70 O.CV), DC+ or DC- polarity. The preferred polarity for ease of use in root pass welding is DC-. Where it is necessary to maximise weld metal toughness, fill and capping passes should be deposited with DC+ polarity.

Ferrocraft 61

- Basic coated, hydrogen controlled E4818/E7018 type electrode
- Excellent out-of-position welding
- Reliable impact properties to -30°C
- Batch number identification
- Designed for all positional (especially vertical-up) fillet and butt welding applications on heavier steel sections under high restraint, such as machinery parts, pressure vessels, mining equipment, pipework, ship construction and all maintenance and repair work

Classifications
AS /NZS 1553.1: E4818-3 H10 AWS/ASME-SFA A5.1: E7018

Typical all weld metal mechanical properties	
Yield stress	450 MPa
Tensile strength	545 MPa
Elongation	29%
CVN impact values	160J av @ -20°C 130J av @ -30°C

Typical all weld metal analysis (%)				
C	Mn	Si	S	P
0.06	1.45	0.45	0.010	0.012

Typical diffusible hydrogen levels to AS 3752
8.5–9.0 ml of hydrogen / 10 gm of deposited weld metal*

*Reconditioned for 2 hours maximum at 300°C

Approvals	
Lloyds Register of Shipping	Grade 3, 3Y H15
American Bureau of Shipping	Grade 3H15, 3Y
Det Norske Veritas	Grade 3Y H10
American Bureau of Shipping	AWS A5.1 E7018

Packaging and operating data — AC (min. 55 OCV) DC+ or DC- polarity

Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
2.5	350	42	65–100	5	15 (3x5)	611342
3.2	380	24	95–150	5	15 (3x5)	611343
4.0	380	16	145–220	5	15 (3x5)	611344
5.0	450	9	195–270	5	15 (3x5)	611345

Ferrocraft 61 is formulated to operate with AC (55 O.CV min), DC+ or DC- polarity. The preferred polarity for fillet welding and fill and capping passes is DC+.

Ferrocraft 61 H4

- Hermetically sealed cans
- Highly basic, E4818/E7018 type hydrogen controlled electrode
- Advanced moisture resistant flux coating
- Very low 'H5/H4' diffusible hydrogen class
- C-Mn weld deposit for reliable impact properties to -40°C
- Recommended for critical DC welding applications
- Batch number identification

Classifications
AS /NZS 1553.1: E4818-5 H5R
AWS/ASME-SFA A5.1: E7018-1 H4R

Typical All Weld Metal Mechanical Properties	
Yield Stress	450 MPa.
Tensile Strength	545 MPa.
Elongation	28%.
CVN Impact Values	150J av @ -20°C 100J av @ -40°C 80J av @ -50°C

Typical All Weld Metal Analysis (%)				
C	Mn	Si	S	P
0.07	1.50	0.35	0.07	0.012

Typical Diffusible Hydrogen Levels To AS 3752
3.0–3.5 mls of hydrogen/100gms of deposited weld metal

Approvals	
Lloyd's Register of Shipping	Grade 3, 3YH5
American Bureau of Shipping	Grade 3H5, 3Y
Det Norske Veritas	Grade 3YH5

Packaging and operating data — AC (min. 55 OCV), DC+ or DC- polarity

Electrode		Approx no.	Current			
Size (mm)	Length (mm)	rods/kg	Range (A)	Can (kg)	Carton	Part No.
2.5	350	42	65–100	3	12 (4x3)	614342
3.2	380	24	95–150	3	12 (4x3)	614343
4.0	380	16	145–220	3	12 (4x3)	614344

MMA Electrodes | Cellulosic

Fleetweld 5P

All position, deep penetration welding of pipelines and critical refinery work. X-ray quality.

Classification
AS/NZS 1553.1: E4110-2 AWS A5.1: E6010

Size (mm)	Weight (kg)	Part No.
2.4	22.68 Can	ED010211
3.2	22.68 Can	ED010203
4.0	22.68 Can	ED010216
4.8	22.68 Can	ED010207

Fleetweld 5P+

Similar to traditional Fleetweld 5P, plus quick striking, easy slag removal and improved final appearance.

Classifications
AS/NZS 1553.1: E4110-2 AWS A5.1: E6010

Size (mm)	Weight (kg)	Part No.
2.4	22.68 Can	ED010283
3.2	22.68 Can	ED010278
4.0	22.68 Can	ED010285
4.8	22.68 Can	ED010281

MMA Electrodes | Hydrogen Controlled

Jetweld LH-70

Controlled hydrogen, semi-iron powder type for X-ray quality, all positional welding with mechanical properties in 495–555 MPa (72,000–80,000 psi) range.

Classifications
AS/NZS 1553.1: E4818-4H5, AWS A5.1: E7018

Size (mm)	Weight (kg)	Part No.
2.4	22.68 Can	ED010568
3.2	22.68 Can	ED010561
4.0	22.68 Can	ED010575
4.8	22.68 Can	ED010564
5.6	27.2 Can	ED010577

Conarc 49C

The offshore electrode if Ni-alloying is not allowed, good CTOD at -10°C. Good pipe welding properties. Reliable impact toughness at -40°C. Excellent X-ray soundness. Basic, extremely low hydrogen (HDM <5ml/100g) coated electrode with 120% recovery.

Classification
AWS. A5.1: E7018-1-H4R

Size (mm)	Packet (kg)	Product No
3.20	4.40	509243
4.00	4.70	509359
2.50	1.40	511420
3.20	2.00	511437
4.00	1.60	511505

EMR-Sahara product.(Hermetically sealed packaging, i.e. requires no pre-baking)

BOC Mild Steel MIG Wire

Description

BOC Mild Steel MIG Wire is a premium quality copper coated MIG wire produced from high quality double deoxidised rod. The higher manganese and silicon levels ensure improved weld metal deoxidation, making BOC Mild Steel MIG Wire an excellent choice for welding on metal with a medium to high presence of mill scale or rust. The higher silicon levels promote a smooth bead surface and a flat fillet bead profile with equal leg length and uniform wetting is easily achieved.

The wire is designed for both single- and multiple-pass welding in all positions.

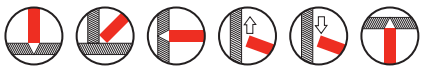
The wire is copper coated for increased shelf life and to ensure good electrical conductivity with reduced friction during high speed welding.

BOC Mild Steel MIG Wire has excellent, smooth wire feedability and is suitable for welding with dip (short circuit), spray arc and pulsed arc transfer using Ar / CO_2 or CO_2 shielding gases.

Application

BOC Mild Steel MIG Wire is recommended for welding of mild and medium tensile strength steels and is an excellent choice for general steel construction, sheet metal applications, pressure vessel fabrication, structural welding and pipe welding.

Welding positions



Specifications		
Classifications	AWS / ASME-SFA A5.18	ER70S-6
	AS / NZS 2717.1	ES6-GC / M-W503AH
Approvals*	Lloyds Register of Shipping	Grade 3S, 3YS

*with Ar / CO_2 shielding gas.

Recommended Shielding Gases
Argoshield Light
Argoshield Universal
Argoshield Heavy
Argoshield 40
Argoshield 52
Argoshield 54
Argoshield 100
Welding Grade CO_2
Flow rate 15-20 L/min.

Chemical composition, wt% – Wire			
Typical	C	Si	Mn
	0.07	0.85	1.45

Mechanical Properties – All Weld Metal		
	Typical (as welded)	
	Using Argoshield	Using CO2
Yield strength	452 MPa	420 MPa
Tensile strength	560 MPa	525 MPa
Elongation	27%	31%
Impact energy, CVN	84J min av @ –30°C	72J min av @ –30°C

Packaging Data – Mini spool (100 mm Ø)			
Dia. (mm)	0.6	0.8	0.9
Part No.	1061108	1081108	1091108
Winding	Random	Random	Random
Spool weight (kg)	1	1	1

Packaging Data – Handi spool (200 mm Ø)			
Dia. (mm)	0.6	0.8	0.9
Part No.	1061150	1081150	1091150
Winding	Random	Random	Random
Spool weight (kg)	5	5	5

Packaging Data – Spool (300 mm Ø)					
Dia. (mm)	0.6	0.8	0.9	1.0	1.2
Part No.	1061155	1081155	1091155	1101155	1121155
Winding	Random	Precision PLW	Precision PLW	Precision PLW	Precision PLW
Spool weight (kg)	15	15	15	15	15
Pallet weight (kg)	810	810	810	810	810

Packaging Data – Smoothpak Drum			
Dia. (mm)	0.9	1.0	1.2
Part No.	1091250	1101250	1121250
Drum weight (kg)	250	250	250

Welding Parameters					
Dia. (mm)	0.6	0.8	0.9	1.0	1.2
Current range (A)	40–100	60–150	90-220	100-240	120-320
Voltage (V)	12–22	15–24	16-30	17-30	18-32

WARNING Welding can give rise to electric shock, excessive noise, eye and skin burns due to the arc rays, and a potential health hazard if you breathe in the emitted fumes and gases. Read all the manufacturer's instructions to achieve the correct welding conditions and ask your employer for the Materials Safety Data Sheets. Refer to www.boc.com.au or www.boc.co.nz

Autocraft Super Steel

- A low carbon, triple deoxidised steel wire for GMA welding
- For use with welding grade CO_2 or argon based shielding gases
- Triple deoxidised for superior weld deposit quality and resistance to porosity
- The ideal choice for the welding of rusty or mill scaled plates and pipes and the root pass welding of pipes, tanks and heavy walled joints

Classifications
AS/NZS 2717.1: ES2-GC/M-W503AH
AWS/ASME-SFA A5.18: ER70S-2

Typical all weld metal mechanical properties	Argon 20–25% CO_2
Yield stress	425 MPa
Tensile strength	520 MPa
Elongation	34%
CVN impact values	75J av @ -20°C

Typical wire analysis (%)		
C: 0.05	Mn: 1.10	Si: 0.55
Ti: 0.10	Zr: 0.06	Al: 0.08
S: 0.007	P: 0.008	Fe: Balance

Typical diffusible hydrogen levels to AS 3752
1.0–2.0 ml of hydrogen/100 gm of deposited weld metal.

Recommended shielding gas
Argoshield® Universal
Argoshield® 52
Argoshield® Heavy
Argoshield® Light
Industrial Grade CO_2

Packaging and operating data						
Dia. (mm)	Voltage (V)	Wire feed speed (m/min)	Current Range (A)	Pack type*	Pack weight (kg)	Part No.
1.2	18–32	3.5–15	120–350	Spool	15	720054

* Spool (ø300 mm)

Autocraft LW1

- A premium quality low carbon steel wire for GMA welding
- Suitable for the all positional multi-pass GMA welding of mild, low alloy and medium strength steels, as used in general fabrication, pressure vessels and structural work.

Recommended shielding gas
Argoshield® Universal
Argoshield® 52
Argoshield® Heavy
Argoshield® Light
Industrial Grade CO_2

Classifications
AS/NZS 2717.1: ES4-GC/M-W503AH
AWS/ASME-SFA A5.18: ER70S-4

Typical all weld metal mechanical properties	Argon 10–25% CO_2	Industrial Grade CO_2
Yield stress	420 MPa	390 MPa
Tensile strength	520 MPa	500 MPa
Elongation	30%	31%
CVN impact values	110J @ -20°C	100J @ -20°C

Typical wire analysis (%)				
C	Mn	Si	S	P
0.08	1.16	0.70	0.010	0.015

Typical diffusible hydrogen levels to AS 3752
1.0–2.0 ml of hydrogen/100 gm of deposited weld metal

Approvals	
CO_2 and Argon 10–25% CO_2	
Lloyds Register of Shipping	Grade 3S
American Bureau of Shipping	Grade 3SA
Det Norske Veritas	Grade 3YMS

Packaging and operating data						
Dia. (mm)	Voltage (V)	Wire feed speed (m/min)	Current range (A)	Pack type*	Pack (kg)	Part No.
0.9	15–26	3.5–15	70–230	Spool	15	720115
1.2	18–32	2.5–15	120–350	Spool	15	720116

* Spool (ø300 mm)

Autocraft LW1-6

- A higher manganese/silicon steel wire for GMA welding
- Use with CO_2 and argon based shielding gases
- Wide range of minispool, handispool and autopak packaging options
- Suitable for the positional gas metal arc welding (GMAW) of mild and low alloy steels used in general fabrication and structural work.

Recommended shielding gas
Argoshield® Universal
Argoshield® 52
Argoshield® Heavy
Argoshield® Light
Industrial Grade CO_2

Classifications
AS/NZS 2717.1: ES6-GC/M-W503AH
AWS/ASME-SFA A5.18: ER70S-6

Typical all weld metal mechanical properties	Welding Grade CO_2	Argon 20–25% CO_2
Yield stress	410 MPa	450 MPa
Tensile strength	525 MPa	550 MPa
Elongation	32%	29%
CVN impact values	110J @ -20°C	120J @ -20°C

Typical wire analysis (%)				
C	Mn	Si	S	P
0.07	1.55	0.88	0.012	0.015

Typical diffusible hydrogen levels to AS 3752
1.0–2.0 ml of hydrogen / 100 gm of deposited weld metal

Approvals	
CO_2 and Argon 20–25% CO_2	
Lloyds Register of Shipping	Grade 3S, 3YS
American Bureau of Shipping	Grade 3SA, 3YSA
Det Norske Veritas	Grade 3YMS

*Approvals do not include 0.6 mm and 0.8 mm Autocraft LW1-6 wires

Packaging and operating data

Dia. (mm)	Voltage (V)	Wire feed speed (m/min)	Current range (A)	Pack type*	Pack weight (kg)	Part No.
0.6	12–14	3.5–14	35–100	Mini Spool – Packs of 4	4 x 0.8	721104
0.6	12–14	3.5–14	35–100	Handi Spool	5	720108
0.6	12–14	3.5–14	35–100	Spool	15	720103
0.8	14–22	3.5–14	50–180	Mini Spool – Packs of 4	4 x 0.8	721105
0.8	14–22	3.5–14	50–180	Handi Spool	5	720109
0.8	14–22	3.5–14	50–180	Spool	15	720114
0.9	15–26	3.5–15	70–230	Handi Spool	5	720161
0.9	15–26	3.5–15	70–230	Spool	15	720090
0.9	15–26	3.5–15	70–230	AutoPak	250	720122A
1.0	16–29	3.5–15	100–280	Spool	15	720094
1.0	16–29	3.5–15	100–280	AutoPak	250	720123A
1.2	18–32	2.5–15	120–350	Spool	15	720096
1.2	18–32	2.5–15	120–350	AutoPak	250	720124A
1.6	18–34	2.5–10	180–390	Spool	15	720095
1.6	18–34	2.5–10	180–390	AutoPak	350	720125A

* Mini Spool (ø100 mm); Handi Spool (ø200 mm); Spool (ø300 mm); AutoPak (ø510 mm x H.770 mm)

GMAW Wire

Ultramag S4

Copper coated 'S4' steel wire for gas metal arc welding. Suitable for use with carbon dioxide or argon based shielding gases for welding mild and medium strength steels.

Classifications
AS 2717.1: ES4; AWS A5.18: ER70S-4

Size (mm)	Weight (kg)	Part No.
0.9	15 Spool	812855
1.0	15 Spool	812879
1.2	15 Spool	812862
1.6	15 Spool	812809

Ultramag S6

Premium quality copper coated 'S6' high manganese, high silicon steel wire for gas metal arc welding. Suitable for use with carbon dioxide or argon based shielding gases for welding mild and medium strength steels. Low spatter.

Classifications
AS 2717.1: ES6, AWS A5.18: ER70S-6

Size (mm)	Weight (kg)	Part No.
0.6	5 Spool	801231
0.8	5 Spool	801248
0.8	15 Spool	8180815
0.9	15 Spool	8180915
1.0	15 Spool	8181015
1.2	15 Spool	8181215

SmoothCor™ 711

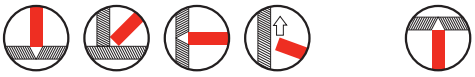
Description

SmoothCor™ 711 is a general purpose, rutile flux cored wire that performs exceptionally well in the downhand, vertical-up and overhead positions at the same parameter settings. It is suitable for use with both Ar/CO_2 or CO_2 shielding gases. Designed for single and multi pass welding, SmoothCor™ 711 produces weld metal that is consistently free of inclusions and porosity for X-ray soundness. The wire has Grade 3 shipping society approval for improved weld deposit impact toughness. SmoothCor™ 711 welds with a very smooth running, low spatter arc and a fine spray type transfer to give excellent weld pool control. Bead surface is extremely smooth with excellent slag detachability. Flat fillet bead profile with equal leg length and uniform wetting is easily achieved. SmoothCor™ 711 has a very wide operating window, excellent feedability and easy arc starting characteristics.

Application

SmoothCor™ 711 is recommended for welding of mild and medium tensile strength steels and is an excellent choice for general steel construction, ship building, pressure vessel fabrication and structural welding.

Welding Positions



Specifications

Flux Type	Rutile	
Classification	AWS/ASME-SFA A5.20	E71T-1 H8, E71T-1M H8 E71T-9 H8, E71T-9M H8
	AS 2203.1	ETP-GMp-W503A.CM1 H10 ETP-GCp-W503A.CM1 H10
Approvals*	Lloyds Register of Shipping	Grade 3
	Det Norske Veritas	Grade 3
	American Bureau of Shipping	Grade 3
Welding Current	DC+	

*With Ar/CO_2 and CO_2 shielding gas

Recommended Shielding Gases:
Argoshield® 52 or Ar+20–25% CO_2 mixtures Welding Grade CO_2 Flow rate 15–20 L/min

Chemical Composition, wt% – All Weld Metal			
Typical	C	Si	Mn
Argoshield® 52	0.05	0.60	1.35
CO_2	0.04	0.54	1.27

Mechanical Properties – All Weld Metal		
As Welded	Using Argoshield® 52	Using CO_2
Yield strength	440 MPa min	430 MPa min
Tensile strength	500–620 MPa	490–580 MPa
Elongation	25% min	25% min
Impact energy, CVN	95J min av @ -18°C 65J min av @ -29°C	90J min av @ -18°C 60J min av @ -29°C

Diffusible Hydrogen
1.2 mm, 100% CO_2, DC+, 230 amps, 27 volts, 20 mm stick-out: <8ml/100g (vacuum packed)
1.2 mm, Argoshield® 52, DC+, 230 amps, 27 volts, 20 mm stick-out: <8ml/100g (vacuum packed)

Packaging Data		
Dia. (mm)	1.2	1.6
Part No.	1071112	1071116
Type	Spool (vacuum packed)	Spool (vacuum packed)
Weight (kg)	15	15

Welding Parameters

Welding Position	Flat, Horizontal		Vertical-up		Overhead	
Dia. (mm)	1.2	1.6	1.2	1.6	1.2	1.6
Current Range (A)	150–290	180–400	150–250	180–300	150–250	180–310
Voltage (V)	23–30	25–34	22–26	21–27	23–26	22–27
Electrode Stick-out (mm)	15–20	20–25	15–20	20–25	15–20	20–25

Deposition Data

Dia. (mm)	Current (A)	Voltage (V)	Approx. Wire Feed Speed (m/min)	Deposition Rate (kg/h)	Efficiency (%)
1.2	150	28	5.08	1.91	86
	210	29	7.62	2.86	86
	250	30	10.16	3.86	87
	290	33	12.70	4.85	87
	330	34	15.24	5.76	87
1.6	190	27	3.81	2.77	87
	300	30	6.35	4.63	87
	365	33	7.62	5.58	86
	410	33	8.89	6.35	88

SmoothCor™ 715

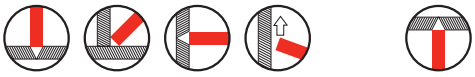
Description

SmoothCor™ 715 is a basic flux cored wire for which the all round operability has been optimised. It is suitable for use with both Ar/CO_2 or CO_2 shielding gases. Using DC-, the wire can be used for welding in all positions. Designed for single and multi pass welding, SmoothCor™ 715 produces low temperature, high toughness, microscopically clean weld metal with very low H4 hydrogen content and superior hot and cold crack resistance. SmoothCor™ 715 welds with particularly stable running characteristics and has a thin, easily remelted slag cover that, with its excellent feedability and easy arc starting characteristics, enhances operator appeal and minimises spatter.

Application

SmoothCor™ 715 is an excellent choice for a wide range of critical applications, including pressure vessels, offshore oil and gas platforms and heavy earth moving and mining equipment. SmoothCor™ 715 is suitable for welding mild and higher carbon and difficult-weld-steels. It combines strength and toughness and is particularly suitable for heavily restrained sections where there can be a risk of cracking due to weld stress.

Welding Positions



Specifications		
Flux Type	Basic	
Classification	AWS/ASME-SFA A5.20	E71T-5 H4, E71T-5MJ H4
	AS 2203.1	ETP-GMn-W504A.CM1 H5 ETP-GCn-W504A.CM1 H5
Approvals*	Lloyds Register of Shipping	Grade 3
	Det Norske Veritas	Grade 3
	American Bureau of Shipping	Grade 3
Welding Current	DC-	

*With Ar/CO_2 shielding gas.

Recommended Shielding Gases
Argoshield® 52 or Ar+20–25% CO_2 mixtures Welding Grade CO_2 Flow rate 15–20 L/min

Chemical Composition, wt% – All Weld Metal			
Typical	C	Si	Mn
Argoshield® 52	0.07	0.70	1.50
CO_2	0.06	0.60	1.35

Mechanical Properties – All Weld Metal		
As Welded	Using Argoshield® 52	Using CO_2
Yield strength	430 MPa min	420 MPa min
Tensile strength	500–620 MPa	490–580 MPa
Elongation	29% min	28% min
Impact energy, CVN	70J min av @ -40°C	60J min av @ -40°C

Diffusible Hydrogen
1.2 mm, 100% CO_2, DC-, 230 amps, 27 volts, 20 mm stick-out: <4ml/100g (vacuum packed)
1.2 mm, Argoshield® 52, DC-, 230 amps, 27 volts, 20 mm stick-out: <4ml/100g (vacuum packed)

Packaging Data		
Dia. (mm)	1.2	1.6
Part No.	1071512	1071516
Type	Spool (vacuum packed)	Spool (vacuum packed)
Weight (kg)	15	15

Welding Parameters		
Dia. (mm)	1.2	1.6
Current Range (A)	150–290	180–400
Voltage (V)	23–30	25–34
Electrode Stick-out (mm)	15–20	20–25
Welding Position		Flat, Horizontal

Deposition Data					
Dia. (mm)	Current (A)	Voltage (V)	Approx. Wire Feed Speed (m/min)	Deposition Rate (kg/h)	Efficiency (%)
1.2	170	29	7.24	3.20	96
	250	30	11.91	4.90	91
	300	32	15.39	6.44	92
1.6	300	30	5.74	4.45	92
	400	32	9.37	7.30	92
	450	32	10.72	8.40	93

SmoothCor™ 70C6

Description

SmoothCor™ 70C6 is a metal cored wire producing 40% less fume than conventional metal cored products. It is suitable for use with both Ar/CO_2 or CO_2 shielding gas. Designed for single and multi pass welding, the wire can be used in both the flat and horizontal positions. SmoothCor™ 70C6 welds with a very smooth running, low spatter arc. Deposition efficiency is high and slag islands minimal. With its wide range of welding parameters, excellent feedability and easy arc starting characteristics, SmoothCor™ 70C6 has superb welder appeal.

Application

SmoothCor™ 70C6 is ideal for a wide range of high speed fillet and butt welding applications where high productivity is required. SmoothCor™ 70C6 has better wetting action than solid wire, minimising cold lap on heavier sections of steel. SmoothCor™ 70C6 is recommended for general fabrication of mild and medium tensile steels. It is also suitable for use on pressure vessel work and structural welding.

Welding Positions

Specifications		
Type	Metal cored	
Classification	AWS/ASME-SFA A5.18	E70C-6C H8, E70C-6M H8
	AS 2203.1	ETD-GMp-W503A.CM1 H10
		ETD-GCp-W503A.CM1 H10
Approvals*	Lloyds Register of Shipping	Grade 3
	Det Norske Veritas	Grade 3
	American Bureau of Shipping	Grade 3
Welding Current	DC+	

*With Ar/CO_2 and CO_2 shielding gas

Recommended Shielding Gases:
Argoshield® 52 or Ar+10–25% CO_2 mixtures Welding Grade CO_2 Flow rate 15–20 L/min

Chemical Composition, wt% – All Weld Metal			
Typical	C	Si	Mn
Argoshield® 52	0.03	0.62	1.68
CO_2	0.03	0.59	1.66

Mechanical Properties – All Weld Metal		
As Welded	Using Argoshield® 52	Using CO_2
Yield strength	420 MPa min	410 MPa min
Tensile strength	500–640 MPa	490–600 MPa
Elongation	22% min	22% min
Impact energy, CVN	27J min av @ -29°C	27J min av @ -29°C

Diffusible Hydrogen
1.2 mm, 100% CO_2, DC+, 230 amps, 27 volts, 20 mm stick-out: <8ml/100g (vacuum packed)
1.2 mm, Argoshield® 52, DC+, 230 amps, 27 volts, 20 mm stick-out: <8ml/100g (vacuum packed)

Packaging Data		
Dia. (mm)	1.2	1.6
Part No.	1070C612	1070C616
Type	Spool (vacuum packed)	Spool (vacuum packed)
Weight (kg)	15	15

Welding Parameters		
Dia. (mm)	1.2	1.6
Current Range (A)	150–350	300–500
Voltage (V)	24–32	26–34
Electrode Stick-out (mm)	10–20	10–20
Welding Position	Flat, horizontal	Flat, horizontal

Deposition Data

Dia. (mm)	Current (A)	Voltage (V)	Approx. Wire Feed Speed (m/min)	Deposition Rate (kg/h)	Efficiency (%)
1.2	250	28	8.38	3.63	90
	275	30	10.92	5.03	94
	300	32	11.79	5.26	94
	350	32	13.00	5.76	96
1.6	300	30	4.60	3.90	89
	350	30	6.12	5.40	94
	400	32	7.44	6.62	94
	450	34	8.46	7.35	94

WARNING Welding can give rise to electric shock, excessive noise, eye and skin burns due to the arc rays, and a potential health hazard if you breathe in the emitted fumes and gases. Read all the manufacturer's instructions to achieve the correct welding conditions and ask your employer for the Materials Safety Data Sheets. Refer to www.boc.com.au or www.boc.co.nz

Satin-Cor XP

- A rutile type flux cored wire formulated exclusively for CO_2 shielding gas
- For high speed, downhand welding applications
- Excellent operator appeal
- Superior fillet shape and slag lift
- Recommended for the downhand fillet welding of structural steels of 6 mm thickness or heavier
- 1.6 mm Satin-Cor XP is now qualified for both CO_2 and mixed gas
- Now precision layer wound

Classifications
AS/NZS 2203.1: ETD-GCp-W502A. CM1 H10 AWS/ASME-SFA A5.20: E70T-1H8

*1.6 mm only ETD-GMp-W502A CM1H10 and ETD-GCp-W502A CM1 H10

Typical all weld metal mechanical properties	
Using welding grade CO_2	
Yield stress	485 MPa
Tensile strength	595 MPa
Elongation	27%
CVN impact values	84J av @ 0°C

Typical all weld metal analysis (%) using CO_2 shielding gas				
C	Mn	Si	S	P
0.08	1.38	0.55	0.011	0.016

Typical diffusible hydrogen levels to AS 3752
5.0–6.0 ml of hydrogen/100 gm of deposited weld metal*

* for 'as manufactured' product using welding grade CO_2 shielding gas

Approvals*	
Lloyds Register of Shipping	Grade 2YS H15

* with welding grade CO_2 shielding gas

Packaging data			
Wire dia. (mm)	Pack type	Pack (kg)	Part No.
1.6	Spool	13	720904
2.4	Coil	25	720906

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode positive and welding grade CO_2 shielding gas with a flow rate of 15–20 L/min.

Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out ESO (mm)	Optimum amps	Volts	Welding positions
1.6	350–450	28–33	25–30	380	30	Flat
2.4	400–550	28–33	25–35	450	30	
1.6	300–400	26–30	25–30	330	29	HV Fillet
2.4	350–450	26–30	25–30	400	29	
1.6	270–350	25–29	25–30	300	28	Horizontal
2.4	320–420	25–29	25–30	360	28	

Verti-Cor XP

- Now upgraded to Grade 3 on CO_2 and Mixed Gas
- A general purpose, rutile type flux cored wire
- Versatile, all positional capabilities
- Excellent operator appeal
- Now precision layer wound
- Recommended for general steel construction/fabrication

Classifications
AS/NZS 2203.1: ETP-GMp-W503A. CM1 H10
ETP-GCp-W503A. CM1 H10
AWS/ASME-SFA A5.20: E71T-1H8/E71T-1M H8

Recommended shielding gases
Argoshield® 52
Welding Grade CO_2

Typical all weld metal mechanical properties		
	Argon	CO_2
Yield stress	550 MPa	510 MPa
Tensile strength	630 MPa	600 MPa
Elongation	26%	26%
CVN impact values	70J av @ 0°C	60J av @ 0°C

Typical diffusible hydrogen levels to AS 3752
6.0–7.0 ml of hydrogen/100 gm of deposited weld metal*

* for 'as manufactured' product using Argoshield® 52 shielding gas

Approvals*	
Lloyds Register of Shipping	Grade 3YS H15
American Bureau of Shipping	Grade 3SA, 3YSA
Det Norske Veritas	Grade 3YMS

*Argon +20–25% CO_2 and CO_2 shielding gas combinations

Typical all weld metal analysis (%)				
C	Mn	Si	S	P
Argon +20–25% CO_2				
0.07	1.55	0.65	0.007	0.014
Using CO_2				
0.06	1.45	0.60	0.010	0.015

Packaging data			
Dia. (mm)	Pack type	Pack (kg)	Part No.
1.2	Spool	15	720915
1.6	Spool	15	720917
1.2	Drum	200	720915A
1.6	Drum	200	720917A

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode positive and Argon +20–25% CO_2 shielding gas with a flow rate of 15–20 L/min.

Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out ESO (mm)	Optimum amps	Volts	Welding positions
1.2	250–300	27–31	20–25	280	31	Flat
1.6	350–400	27–31	25–30	360	31	
1.2	230–280	26–30	20–25	260	28	HV Fillet
1.6	310–360	26–30	25–30	320	29	
1.2	170–220	24–28	15–20	200	24	Vertical-up
1.6	200–250	24–28	15–20	240	25	
1.2	160–210	24–28	15–20	200	24	Overhead
1.6	190–240	24–28	15–20	220	24	

Verti-Cor Ultra

- A rutile type flux cored wire formulated exclusively for CO_2 shielding gas
- Versatile, all positional capabilities
- Excellent operator appeal
- Grade 2 shipping society approvals
- Low spatter and fume levels
- Designed for the single and multi pass welding of mild and medium strength steels in the downhand, vertical-up and overhead positions
- Precision layer wound

Classifications
AS/NZS 2203.1:
ETP-GCp-W502A. CM1 H10
AWS/ASME-SFA A5.20: E71T-1H8

Recommended shielding gas
Welding Grade CO_2

Typical all weld metal mechanical properties	
Using welding grade CO_2	
Yield stress	480 MPa
Tensile strength	560 MPa
Elongation	28%
CVN impact values	80J av @ 0°C

Typical all weld metal analysis (%)		
using CO_2 shielding gas		
C: 0.04	Mn: 1.24	Si: 0.70
Ti: 0.035	B: 0.005	

Typical diffusible hydrogen levels to AS 3752
5.0–6.0 ml of hydrogen/100 gm of deposited weld metal*

* for 'as manufactured' product using welding grade CO_2 shielding gas

Approvals*	
Lloyds Register of Shipping	Grade 2YS H15
American Bureau of Shipping	Grade 2YSA H10
Det Norske Veritas	Grade 2YMS H10

*with welding grade CO_2 shielding gas

Packaging data			
Wire dia.(mm)	Pack type	Pack weight/kg	Part No.
1.2	Spool	13	720900
1.6	Spool	13	720902

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode positive and welding grade CO_2 shielding gas with a flow rate of 10–15 L/min.

Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out ESO (mm)	Optimum (A)	Volts	Welding positions
1.2	250–300	27–31	20–25	250	28	Flat
1.6	350–400	27–31	25–30	300	29	
1.2	230–280	26–30	20–25	230	27	HV Fillet
1.6	310–360	26–30	25–30	270	27	
1.2	170–220	24–28	15–20	190	24	Vertical-up
1.6	200–250	24–28	15–20	210	25	
1.2	160–210	24–28	15–20	215	26	Overhead
1.6	190–240	24–28	15–20	250	27	

Verti-Cor 3XP

- A micro-alloyed, rutile type flux cored wire
- Versatile, all positional capabilities
- Excellent operator appeal
- Grade 3 shipping society approvals
- Formulated to give smooth (low spatter) arc transfer, flat mitre fillet welds and excellent slag lift in all positions (except vertical-down), on a wide range of mild and medium strength steels
- Precision layer wound

Classifications
AS/NZS 2203.1 ETP-GMp-W503A. CM1 H10 ETP-GCp-W503A. CM1 H10
AWS/ASME-SFA A5.20: E71T-1 H8 , E71T-12M H8

Typical all weld metal mechanical properties		
	Using Argoshield® 52	Using CO_2
Yield stress	480 MPa	460 MPa
Tensile strength	560 MPa	530 MPa
Elongation	28%	30%
CVN impact values	110J av @ 0°C	90J av @ 0°C
	90J av @ -20°C	75J av @ -20°C

Typical all weld metal analysis (%)		
Using Argon +20–25% CO_2		
C: 0.07	Mn: 1.16	Si: 0.52
Ti: 0.035	B: 0.008	
Using CO_2		
C: 0.06	Mn: 1.05	Si: 0.42
Ti: 0.035	B: 0.007	

Typical diffusible hydrogen levels to AS 3752
5.0–6.0 ml of hydrogen/100 gm of deposited weld metal*

* For 'as manufactured' product using Argoshield® 52 shielding gas

Approvals*	
Lloyds Register of Shipping	Grade 3S, 3YS H
American Bureau of Shipping	Grade 3SA, 3YSA H
Det Norske Veritas	Grade 3YMS H

* With Argon +20–25% CO_2 shielding gas combinations

Recommended shielding gases
Argoshield® Universal
Argoshield® 52
Argoshield® Heavy
Welding Grade CO_2

Packaging data			
Dia. (mm)	Pack type	Pack (kg)	Part No.
1.2	Spool	13	720919
1.6	Spool	13	720921

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode positive and Argon +20–25% CO_2 shielding gas with a flow rate of 15–20 L/min.

Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out ESO (mm)	Optimum (A)	Volts	Welding positions
1.2	250–300	27–31	20–25	280	31	Flat
1.6	350–400	27–31	25–30	360	31	
1.2	230–280	26–30	20–25	260	28	HV Fillet
1.6	310–360	26–30	25–30	320	29	
1.2	170–220	24–28	15–20	200	24	Vertical-up
1.6	200–250	24–28	15–20	240	25	
1.2	160–210	24–28	15–20	200	24	Overhead
1.6	190–240	24–28	15–20	220	24	

Verti-Cor 3XP H4

- Next generation technology flux cored wire
- Copper coated for smooth consistent feedability and current pick up
- Rutile, all positional capabilities producing a flat mitre fillet bead shape
- Ultra low splatter and fume levels
- H4 diffusible hydrogen class with a typical weldmetal of 2.2 mls of hydrogen/100 gms
- Excellent Operator Appeal
- Grade 3 Shipping Society Approvals

Classifications
AS/NZS 2203.1: ETP-GMp-W503A. CM1 H5. AWS/ASME-SFA A5.20: E71T-12M H4.

Typical all weld metal mechanical properties	
Using Argon + 20–25% CO_2 :	
Yield Stress	510 MPa
Tensile Strength	570 MPa
Elongation	30%
CVN, Impact Values	105J av @ -20°C

Typical all weld metal analysis (%)				
Using Argon +20–25% CO_2				
C	Mn	Si	P	S
0.05	1.25	0.43	0.009	0.007

Typical diffusible hydrogen levels to as3752
2.2 mls of hydrogen / 100gms of deposited weld metal *

* for 'as manufactured' product using Argon + 20–25% CO_2 shielding gas.

Approvals*	
Lloyds Register of Shipping	Grade 3S, 3YS H5
American Bureau of Shipping	Grade S3A, 3YSA H5

*With Argon +20–25% CO_2 shielding gas combinations.

Recommended shielding gases
Argoshield® 52

Packaging data			
Wire Dia. (mm)	Pack Type	Weight (kg)	Part No.
1.2	Spool	12.5	722919
1.6	Spool	12.5	722921

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode positive and Argon +20–25% CO_2 shielding gas with a flow rate of 15–20 L/min

Wire Dia. (mm)	Current Range (A)	Voltage Range (V)	CTWD	Optimum Amps	Volts	Welding Positions
1.2	250–300	27–31	20–25	280	31	Flat
1.6	350–400	27–31	25–30	360	31	Flat
1.2	230–280	26–30	20–25	260	28	HV Fillet
1.6	310–360	26–30	25–30	320	29	HV Fillet
1.2	170–220	24–28	15–20	200	24	Vertical-up
1.6	200–250	24–28	15–20	240	25	Vertical-up
1.2	160–210	24–28	15–20	200	24	Overhead
1.6	190–240	24–28	15–20	220	24	Overhead

These machine settings are a guide only. Actual voltage, welding current and CTWD used will depend on machine characteristics, plate thickness, run size, shielding gas and operator technique etc.

Supre-Cor XP H4

- Fully basic seamless tubular flux cored wire
- Low temperature impact toughness to -40°C
- Available in 2.4 mm size only
- Now precision layer wound
- Recommended for the fillet and butt welding of heavy earthmoving and mining equipment
- Suitable for use with CO_2 and Argon + 20–25% CO_2 or equivalent shielding gases

Classifications
AS/NZS 2203.1:
ETD-GCn/p-W503A. CM1 H5, ETD-GMn/p-W503A. CM1 H5
AWS/ASME-SFA A5.20:
E70T-5 H4, E70T-5M H4

Typical all weld metal mechanical properties	Using Argon +20–25% CO_2
Yield stress	456 MPa
Tensile strength	555 MPa
Elongation	24%
CVN impact values	100J av @ -40°C

Typical all weld metal analysis (%)		
Using Argoshield® 52		
C: 0.08	Mn: 1.34	Si: 0.63
P: 0.20	S: 0.015	

Typical diffusible hydrogen levels to AS 3752
1.5–2.0 ml of hydrogen/100 gm of deposited weld metal *

* For 'as manufactured' product using Argon +20–25% CO^2

Approvals*	
Lloyds Register of Shipping	Grade 3S, 3YS H15

*With Argon +20 –25% CO_2

Recommended shielding glasses
Argoshield® 52
Welding Grade CO_2

Packaging data			
Dia. (mm)	Pack type	Pack (kg)	Part No.
2.4	Coil	25	720911

Operating data						
All welding conditions recommended below are for use with semi-automatic operation and DC electrode positive. Argon +20-25% CO_2 shielding gas with a flow rate of 15–20 L/min was used.						
Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out ESO (mm)	Optimum (A)	Volts	Welding positions
2.4	350–500	27–33	25–30	450	31	Flat
2.4	350–500	27–33	25–30	400	30	HV Fillet

Supre-Cor 5

- Second generation, fully basic flux cored wire
- Improved low temperature impact toughness to -50°C
- Improved positional capabilities of 1.2 mm and 1.6 mm sizes
- DC electrode negative operation
- Suitable for a wide range of critical applications including the fillet and butt welding of pressure vessels, offshore oil and gas platform structures and heavy earthmoving equipment
- Precision layer wound

Classifications
AS/NZS 2203.1: ETP-GCn/p-W505A. CM1 H5, ETP-GMn/p-W505A. CM1 H5 AWS/ASME-SFA A5.20: E71T-5 H4, E71T-5MJ H4

Typical all weld metal mechanical properties	
Using Argon +20-25% CO_2	
Yield stress	445 MPa
Tensile strength	550 MPa
Elongation	29%
CVN impact values	160J av @ -20°C 100J av @ -40°C 90J av @ -50°C
Using CO_2	
Yield stress	430 MPa
Tensile strength	530 MPa
Elongation	30%
CVN impact values	150J av @ -20°C 90J av @ -40°C 80J av @ -50°C

Typical all weld metal analysis (%)				
Using Argoshield® 52				
C	Mn	Si	P	S
0.10	1.45	0.42	0.012	0.015
Using CO_2				
C	Mn	Si	P	S
0.09	1.25	0.32	0.012	0.015

Typical diffusible hydrogen levels to AS 3752
1.5–2.0 ml of hydrogen / 100 gm of deposited weld metal *

* For 'as manufactured' product using Argoshield® Argon +20–25% CO_2

Approvals*	
Lloyds Register of Shipping	Grade 3S, 3YS H10
American Bureau of Shipping	Grade 3SA,3YSA H10
Det Norske Veritas	Grade 3YMS H10

*With Argon +20 -25% CO_2 and CO_2 shielding gas combinations

Recommended shielding gases
Argoshield® 52
Welding Grade CO_2

Packaging data			
Dia. (mm)	Pack type	Weight (kg)	Part No.
1.2	Spool	13	720982
1.6	Spool	13	720983

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode negative and Argon +20–25% CO_2 shielding gas with a flow rate of 15–20 L/min.

Dia. (mm)	Current range (A)	Voltage range (V)	Electrode stick-out ESO (mm)	Optimum Amps	Volts	Welding positions
1.2	250 – 300	27 – 31	20 – 25	280	29	Flat
1.6	350 – 400	27 – 31	25 – 30	320	31	
1.2	230 – 280	26 – 30	20 – 25	250	27	HV Fillet
1.6	310 – 360	26 – 30	25–30	315	30	
1.2	170 – 220	24 – 28	15 – 20	140	21	Vertical-up
1.6	200 – 250	24 – 28	15 – 20	N/A	N/A	
1.2	160 – 210	24 – 28	15 – 20	120	20	Overhead
1.6	190 – 240	24 – 28	15 – 20	N/A	N/A	

Metal-Cor XP

- Low slag, metal cored wire
- Grade 3 shipping society approvals
- High deposition efficiency = 95%
- High deposition rates
- For the high productivity fillet and butt welding of mild and medium strength steels in all downhand positions
- Precision layer wound

Classifications
AS/NZS 2203.1: ETD-GMn/p-W503A. CM1 H5 ETP*-GMn/p-W503A. CM1 H5 (*1.2 mm only)
AWS/ASME-SFA A5.18: E70C-6M*

*The classifications of metal cored wires to the American Welding Society (AWS) has changed. Detailed information about these changes are available in the technical section of the Cigweld pocket guide.

Typical all weld metal mechanical properties	
Using Argon +20–25% CO_2	
Yield stress	460 MPa
Tensile strength	575 MPa
Elongation	28%
CVN impact values	100J av @ 0°C 85J av @ -20°C 40J av @ -30°C

Typical all weld metal analysis (%)*		
C: 0.05	Mn: 1.42	Si: 0.75
S: 0.012	P: 0.014	

* Using Argon +20–25% CO_2 shielding gas

Approvals*	
Lloyds Register of Shipping	Grade 3YS
American Bureau of Shipping	Grade 3SA, 3YSA
Det Norske Veritas	Grade 3YMS

*With Argon +20–25% CO_2 shielding gas combinations

Recommended shielding gases
Argoshield® 52
Argoshield® Universal

Packaging data			
Dia. (mm)	Pack type	Pack (kg)	Part No.
1.2	Spool	15	720912
1.2	Autopak	200	720912A
1.6	Spool	15	720913
1.6	Autopak	200	720913A

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode positive and Argon +20 –25% CO_2 shielding gas with a flow rate of 15–20 L/min.

Wire Dia. (mm)	Current range (A)	Voltage Range (V)	Electrode stick-out ESO (mm)	Optimum (A)	Volts	Welding positions
1.2	280–350	28–33	20–25	330	32	Flat
1.6	350–450	29–33	25–30	420	31	Flat
1.2	250–300	27–31	20–25	280	30	HV Fillet
1.6	300–380	27–31	25–30	360	28	HV Fillet
1.2	250–300	27–31	20–25	250	30	Horizontal
1.6	300–380	27–31	25–30	280	26	Horizontal

Metal-Cor 5

- High efficiency metal cored wire with excellent operator appeal
- Grade 4 shipping society approvals
- Very low slag formation
- Outstanding low temperature impact properties
- High deposition efficiency
- High deposition rates
- Precision layer wound

Classifications
AS 2203.1: ETD-GMp-W505A. CM1 H5. ETP*-GMp-W505A. CM1 H5. (*1.2 mm only) AWS/ASME-SFA A5.18: E70C-6M H4

Typical All Weld Metal Mechanical Properties	
Using Argon + 20–25% CO_2	
Yield Stress.	460 MPa.
Tensile Strength	530 MPa.
Elongation	32%
CVN Impact Values	135J av @ -20°C.
	135J av @ -40°C
	80J av @ -60°C.

Typical All Weld Metal Analysis (%)*			
Using Argon + 20–25% CO_2			
C	Mn	Si	S
0.07	0.9	0.56	0.014
P	Ni	Cr	
0.013	0.04	0.03	

Approvals*:	
Lloyds Register of Shipping	Grade 3S, 4YS H5
American Bureau of Shipping	Grade 4SA, 4YSA H5
Det Norske Veritas	Grade 4YMS H5

*with Argon + 20–25% CO_2 shielding gas or equivalent.

Typical Diffusible Hydrogen Levels to AS3752:
<3.5 mls of hydrogen / 100gms of deposited weld metal

Recommended Shielding Gases:
Argoshield® 52

Packaging data			
Wire Dia. (mm)	Pack Type	Weight (kg)	Part No.
1.2	Spool	15	720552
1.2	Autopak	230	720552A
1.6	Spool	15	720553
1.6	Autopak	230	720553A

Operating data

All welding conditions recommended below are for use with semi-automatic operation, DC electrode positive using Argon +20–25% CO_2 shielding gas with a flow rate of 15–20 L/min.

Wire Dia. (mm)	Current Range (A)	Voltage Range (V)	Electrode stick-out ESO (mm)	Welding Positions
1.2	280–350	28–33	20–25	Flat
1.6	350–450	29–33	25–30	Flat
1.2	250–300	27–31	20–25	HV Fillet
1.6	300–380	27–31	25–30	HV Fillet
1.2	250–300	27–31	20–25	Horizontal
1.6	300–380	27–31	25–30	Horizontal

These machine settings are a guide only. Actual voltage, welding current and CTWD used will depend on machine characteristics, plate thickness, run size, shielding gas and operator technique etc.

Shield-Cor 11

- Self-shielded flux cored wire
- Versatile, all positional capabilities
- Excellent tolerance to joint misalignment or poor joint fit-up
- Smooth rippled fillets with good edge wetting
- Ideal for welding thin section mild and galvanised steels

Classifications
AS/NZS 2203.1: ETP-GNn-W500A. CM2
AWS/ASME-SFA A5.20: E71T-11

Typical all weld metal mechanical properties	
Yield stress	445 MPa
Tensile strength	620 MPa
Elongation	22%

Typical all weld metal analysis (%)		
C: 0.25	Mn: 0.70	Si: 0.40
Al: 1.65	S: 0.004	P: 0.007

Typical diffusible hydrogen levels to AS 3752
15.0–20.0 ml of hydrogen /100gm of deposited weld metal*

* For 'as manufactured' product using the recommended ESO lengths

Recommended shielding gas
Not required

Packaging data			
Dia. (mm)	Pack type	Pack (kg)	Part No.
1.2	Spool	15	720923
1.6	Spool	15	720925

Operating data

All welding conditions recommended below are for use with semi-automatic operation and DC electrode negative only.

Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out ESO (mm)	Welding positions
1.2	150–200	16–18	15–20	Flat
1.2	130–180	16–18	15–20	HV Fillet
1.2	130–180	16–18	15–20	Vertical-up
1.2	180–230	16–18	15–20	Overhead

Shield-Cor 15

- Self-shielded flux cored wire
- For single pass applications only
- Versatile, all positional capabilities
- Excellent tolerance to joint misalignment or poor joint fit-up
- Smooth rippled fillets with good edge wetting
- Ideal for welding thin section mild and galvanised steels

Classifications
AS/NZS 2203.1:ETPS-GNn-W500A. CM2
AWS/ASME-SFA A5.20: E71T-14

Typical all weld metal mechanical properties	
Yield stress	430 MPa
Tensile strength	600 MPa
Elongation	21%

Typical all weld metal analysis (%)					
C:	Mn:	Si:	Al:	S:	P:
0.25	0.70	0.40	2.10	0.004	0.007

Typical diffusible hydrogen levels to AS 3752
15.0–20.0 ml of hydrogen/100gm of deposited weld metal*

* For 'as manufactured' product using the recommended ESO lengths

Recommended shielding gas
Not required

Packaging data			
Dia. (mm)	Pack type	Pack (kg)	Part No.
0.8	100 spool	0.45 x (4/ctn)	721956
0.8	200 handispool	4.5	721923
0.9	100 minispool	0.45 x (4/ctn)	721976
0.9	200 handispool	4.5	721924
1.2	200 handispool	4.5	720302

Operating data

All welding conditions recommended below are for use with semi-automatic operation and DC electrode negative only.

Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out ESO (mm)	Welding positions
0.8	90–150	14–16	10–12	Flat
0.8	80–140	14–16	10–12	HV Fillet
0.8	60–120	14–16	10–12	Vertical-up
0.8	60–120	14–16	10–12	Overhead
0.9	110–180	15–17	12–15	Flat
0.9	100–175	15–17	12–15	HV Fillet
0.9	80–150	15–17	12–15	Vertical-up
0.9	80–150	15–17	12–15	Overhead
1.2	180–230	16–18	15–20	Flat
1.2	150–200	16–18	15–20	HV Fillet
1.2	130–180	16–18	15–20	Vertical
1.2	130–180	16–18	15–20	Overhead

Gas Assisted General Purpose | FCAW Wire

Outershield 70

A wire with excellent bead wetting, low spatter and fast follow. Especially recommended for applications requiring deep penetration. For use in the down-hand and horizontal positions.

Classifications
AS 2203.1: ETD-GCp-W502A. CM1.H10, AWS A5.20: E70T-1

Size (mm)	Weight (kg)	Part No.
1.6	22.68 Coil	ED012782
2.0	22.68 Coil	ED012785

Outershield 71MX

Designed and manufactured in Australia, Outershield 71MX is an all positional rutile based micro-alloyed electrode, providing excellent operator appeal and producing sound welds with a clean surface finish under mixed gas.

Classifications
AWS. A5.20 E71T-1M H8, E71T-9M-H8 and E71T-12M H8

Size (mm)	Weight (kg)	Part No.
1.2	13	033502
1.6	13	033506

Outershield 71CX

Designed and manufactured in Australia, Outershield 71CX is an all positional rutile based micro-alloyed electrode. 71CX provides an extremely smooth arc transfer, with excellent 'ease of use', making good out-of-position welds with a clean surface finish under 100% CO_2 shielding gas.

Classifications
AWS. A5.20 E71T-1 H8, E71T-9 H8 and E71T-12 H8

Size (mm)	Weight (kg)	Product No
1.2	13	033602
1.6	13	033606

Metal Cored | FCAW Wire

Outershield MC710

Metal cored wire that has a good deposition rate and excellent operator appeal with minimal slag and spatter. Dip transfer mode can be used for positional welding. Suitable for automatic applications, including robotic welding.

Classifications
AS 2203.1: ETP-GMp-W503A.CM1.H10; AWS A5.20: E71T-1

Size (mm)	Weight (kg)	Part No.
1.2	15 Readi reel	033101
1.6	15 Coil	033102

Outershield MC710-H

For welding with high efficiency in all positions. Excellent arc characteristics give outstanding operator appeal. Little slag and spatter, fast travel speed and excellent wire feeding 'robotic' quality. Superior on scale plate, good resistance to porosity. Very good mechanical properties (CVN >47J @ -30°C). Superior product consistancy with optimal alloy control

Classification
AWS. A5.18: E70C-6M H4

Size (mm)	Weight (kg)	Product No
1.6	200	941937

Outershield MC460VD-H

Metal cored wire for welding with high efficiency. Especially for vertical-down welding in thin plate. Excellent arc characteristics give outstanding operator appeal. Little slag and spatter, fast travel speed, good wire feeding. Superior product consistency with optional alloy control.

Classification
AWS. A5.18: E70C-6M H4

Size (mm)	Weight (kg)	Product No
1.2	15	941859

NR-152

Designed primarily for single pass welds on carbon steel up to 5 mm maximum thickness. Especially suited for the welding of galvanised and zinc coated steels.

Classifications
AS 2203.1: ETPS-GNn-W500A.CM2; AWS A5.20: E71T-GS

Size (mm)	Weight (kg)	Part No.
1.7	22.68 Coil	ED012186

NR-211-MP

General purpose, all position wire. Smooth spray arc is easy to control, with good visibility, low heat and glare. Suitable for sheet metal, mild steel, galvanised and zinc coated steels up to 12 mm thickness (8 mm for 0.9 and 1.2 mm sizes).

Classifications
AS 2203.1: ETP-GNn-W500A.CM2.H15; AWS A5.20: 71T-11

Size (mm)	Weight (kg)	Part No.
0.9	4.54 Spool	ED016354
1.2	4.54 Spool	ED016363
1.2	11.34 Readi reel	ED030638
1.7	6.0* Coil	KC211176MP
1.7	12.5 Spool	KC2111712MP
2.0	6.0* Coil	KC211206MP
2.0	25 Coil	KC211205MP
2.0	12.5 Spool	KC2112012MP

*4 per box

NR-212

The operating characteristics of NR 212 are similar to those of NR 211MP. It has the ability to handle poor fit-up, with very little tendency for burn through on sheet metal and can be used on galvanised and mild steel over 12 mm thickness.

Classifications
AS2203.1; ETP-GNn-W500A. G.H10: AWS A5.20; E71TG-G

Size (mm)	Carton (kg)	Part No.
1.2	11.34	ED030639
1.7	11.34	ED030642
2.0	11.34	ED030646

NR-232

General purpose smooth running wire that produces high deposition rates in all positions. Excellent choice for out-of-position welding, requiring high productivity and good impact properties.

Classifications
AS 2203.1: ETP-GNn-W503A.CM1.H15; AWS A5.20: E71T-8

Size (mm)	Weight (kg)	Part No.
1.7	6.0* Coil	ED012518
1.7	11.34 Coil	ED030634
1.7	22.68 Coil	ED012519
2.0	6.0* Coil	ED012525
2.0	11.34 Coil	ED030647
2.0	22.68 Coil	ED012526

*4 per box

NR-233

NR-233 is an advanced technology, self-shielded flux-cored electrode designed for high deposition rate welding - even when welding out-of-position in seismic and non-seismic structural steel applications. It is also great for fillet welding for ship and barge fabrication. The electrode is welder-friendly, making it easier to pass tough qualification tests and deposit great looking beads.

Classification	AWS. E71T-8

Size (mm)	Weight (kg)	Product No
1.6	11.34	ED030934
1.8	11.34	ED031030

NR-311

General purpose wire for high deposition rates, fast travel speeds and good penetration in the flat and horizontal positions.

Classifications
AS 2203.1: ETD-GNn-W500A. CM2; AWS A5.20: E70T-7

Size (mm)	Weight (kg)	Part No.
2.0	6 Coil	KC311206
2.4	25 Coil	KC3112425
2.8	25 Coil	KC3112825

*4 per box

NS-3M

Extremely high deposition rates. Has low penetration, which makes it particularly useful for poor fit-up. Can be used for both single and multiple pass welds.

Classifications
AS 2203.1: ETD-GNp-W500A.CM2.H15; AWS A5.20: E70T-4

Size (mm)	Weight (kg)	Part No.
2.0	12.5 Coil	KCNS32012
2.0	25 Coil	KCNS32025
2.4	25 Coil	KCNS32425
3.0	25 Coil	KCNS33025

Comweld Super Steel

- Low carbon steel filler rod for gas tungsten arc (TIG) welding
- Triple deoxidised for superior weld deposit quality and resistance to porosity
- End stamped with AWS class 'ER70S-2'
- Ideal for TIG welding rusty or mill scaled plates and pipes and the root pass welding of pipes, tanks and heavy walled joints

Classifications
AS/NZS 1167.2: R2
AWS/ASME-SFA A5.18: ER70S-2

Typical rod analysis (%)		
C: 0.06	Mn: 1.08	Si: 0.52
Ti: 0.08	Zr: 0.07	Al: 0.08
S: 0.007	P: 0.008	Fe: Balance

Joining process
Gas tungsten arc (TIG) welding

Recommended shielding gases
Argon Welding Grade

Packaging data			
Rod Size (mm)	Weight (kg), Pack type	Approx No. (rods/kg)	Part No.
1.6 x 915	5 kg cardboard tube*	70	321370
2.4 x 915	5 kg cardboard tube*	31	321373

*Resealable

Comweld LW1-3

- Copper coated, low carbon steel rod for gas TIG and oxy welding applications
- End stamped with 'ER70S-3' for easy identification
- Resealable 5kg cardboard tube

Classifications
AS 1167.2: R3.
AWS/ASME-SFA A5.18: ER70S-3.

Joining Process
Gas (Fusion) and Gas Tungsten Arc (TIG) welding.

Typical rod analysis (%)					
C	Mn	Si	S	P	Fe
0.07	1.1	0.5	0.012	0.015	bal

Typical All Weld Metal Mechanical Properties	
Yield Stress	400 MPa.
Tensile Strength	500 MPa.
Elongation	30%
CVN Impact Values	100 J av @ -20°C

Packaging data			
Rod Size (mm)	Weight (kg), Pack type	Approx No. (rods/kg)	Part No.
1.6 x 1000	5 kg cardboard tube*	64	321423
2.4 x 1000	5 kg cardboard tube*	29	321424

*Resealable

Comweld LW1

- Copper coated, low carbon steel rod for gas tungsten arc welding applications
- Green end tip for instant identification
- Ideal for root pass welding applications where tough and ductile welds are produced

Classifications
AS/NZS 1167.2: R4
AWS/ASME-SFA A5.18: ER70S-4

Typical rod analysis (%)		
C: 0.08	Mn: 1.16	Si: 0.75
S: 0.010	P: 0.015	Fe: Balance

Joining process
Gas (fusion) and gas tungsten arc (TIG) welding

Recommended shielding gases
Argon welding grade

Packaging data			
Rod Size (mm)	Weight (kg), Pack type	Approx No. (rods/kg)	Part No.
1.6 x 750	5 kg cardboard tube*	84	321411
2.4 x 750	5 kg cardboard tube*	34	321412

*Resealable

Comweld LW1-6

- Copper coated, low carbon steel rod for gas TIG and oxy welding applications
- End stamped with 'ER70S-6' for easy ID
- Recommended for the TIG welding of steel pipes, plates and castings with a tensile strength in the 500 MPa class

Classifications
AS/NZS 1167.2: R6
AWS/ASME-SFA A5.18: ER70S-6

Typical rod analysis (%)		
C: 0.07	Mn: 1.55	Si: 0.88
S: 0.012	P: 0.015	Fe: Balance

Joining process
Gas (fusion) and gas tungsten arc (TIG) welding

Recommended shielding gases
Argon welding grade

Packaging data			
Rod Size (mm)	Weight (kg), Pack type	Approx No. (rods/kg)	Part No.
1.6 x 1000	5 kg cardboard pack*	64	321417
2.4 x 1000	5 kg cardboard pack*	29	321418

* Resealable

L-50

Recommended for high speed, single pass welding on mild steel 12 mm or thinner, because it gives better wetting action, straighter bead edges and better slag removal. Resists porosity due to rust or mill scale.

Classifications
AS 1858.1: EM13K; AWS A5.17: EM13K

Size (mm)	Weight (kg)	Part No.
2.0	27.2 Coil	ED011335
2.4	27.2 Coil	ED011328
3.2	27.2 Coil	ED011323

L-60

Primarily for multiple pass welding on steel under 25 mm thick using Lincoln 700 series fluxes.

Classifications
AS 1858.1: EL12; AWS A5.17: EL12

Size (mm)	Weight (kg)	Part No.
2.0	30 Coil	KC602030
2.4	30 Coil	KC602430
3.2	30 Coil	KC603230
4.0	30 Coil	KC604030
2.4	600 Bulk reel	KC6024600
3.2	600 Bulk reel	KC6032600
4.0	600 Bulk reel	KC6040600

L-61

General purpose wire recommended for both single pass welding with Lincoln 700 series fluxes and multiple pass welding with most Lincoln 800 series fluxes.

Classifications
AS 1858.1: EM12K; AWS A5.17: EM12K

Size (mm)	Weight (kg)	Part No.
2.0	30 Coil	KC612030
2.4	30 Coil	KC612430
3.2	30 Coil	KC613230
4.0	30 Coil	KC614030
4.8	30 Coil	KC614830
2.4	600 Bulk reel	KC6124600
3.2	600 Bulk reel	KC6132600
4.0	600 Bulk reel	KC6140600

L-S3

Designed for use with 880M or 8500 flux. Produces 480 MPa minimum tensile strength and good low temperature impacts at higher deposition rate procedures and after stress relief. Typically used for off-shore drilling platform leg fabrication and similar.

Classifications
AS 1858.1: EMH12K; AWS A5.17: EH12K

Size (mm)	Weight (kg)	Part No.
2.4	30 Coil	030401
3.2	30 Coil	030402
4.0	30 Coil	030403

Submerged Arc Flux

761

Recommended for single and some multiple pass welding. Provides excellent resistance to cracking. Slower freezing slag gives good appearance on large, flat fillet welds. Excellent impact properties can be produced when used with L61 wire.

Classifications	AS 1858.1: FGH

	Weight (kg)	Part No.
Bags	45	KC761045
Drums	250	KC761250

780

Excellent performance characteristics, including very good slag removal, make this flux suitable for all general purpose single run and some multiple pass applications. The faster freezing slag of 780 minimises spilling in circumferential welding applications.

Classifications	AS 1858.1: FGH

	Weight (kg)	Part No.
Bags	25	KC780025
Drums	280	KC780280

781

Recommended for high speed single pass welding on clean plate and sheet steel. The 'fast-follow' characteristics of 781 allow uniform welds to be made at high speeds without undercut or voids.

Classifications	AS 1858.1: FSH

	Weight (kg)	Part No.
Bags	25	KC781025
Drums	280	KC781280

860

For multiple pass welding. Has excellent operating characteristics and produces good impact properties when used with L60 and L61 wires.

Classifications	AS 1858.1: FMM

	Weight (kg)	Part No.
Bags	25	KC860025
Drums	260	KC860260

880

For multi-pass welding with stainless steel electrodes, solid low alloy steel electrodes containing a min. 0.20% Si and Lincoln's LAC series of low alloy flux cored electrodes. Not recommended for single arc AC welding or as a general purpose flux.

Classifications	AS 1858.1: FBL

	Weight (kg)	Part No.
Bags	25	KC880025
Drums	260	KC880260

880M

Suitable for multi-pass welding with solid carbon steel and low alloy steel electrodes. Produces excellent mechanical properties, including CTODs and low temperature impacts.

Classifications	AS 1858.1: FBL

	Weight (kg)	Part No.
Bags	25	KC880025M
Drums	220	KC880220M

882

For multiple pass welding with solid carbon and low alloy steel wires. Produces excellent low temperature impact properties when used with L61 wire.

Classifications	AS 1858.1: FBL

	Weight (kg)	Part No.
Bags	25	KC882025
Drums	250	KC882250

8500

Basic flux recommended for single and multiple pass welding with LS3 wire when excellent mechanical properties (including low temperature impacts and CTODs) are required.

Classifications	AS 1858.1: FBL

	Weight (kg)	Part No.
Drums	220	KC8500220

960

A low cost, general purpose flux for full and semi-automatic single and multiple pass butt and fillet welding. Welds have good impact strength and good slag removal.

Classifications	AS 1858.1: FMM

	Weight (kg)	Part No.
Drums	25	KC960025

ST-100

ST-100 is an alloy flux specifically for use with solid stainless steel wires. Contains chromium additions to compensate for chromium lost from the wire during transfer through the welding arc.

Classifications
AS 1858.1: FMMA (2Cr)

	Weight (kg)	Part No.
Bags	25	KCST100025

WARNING Welding can give rise to electric shock, excessive noise, eye and skin burns due to the arc rays, and a potential health hazard if you breathe in the emitted fumes and gases. Read all the manufacturer's instructions to achieve the correct welding conditions and ask your employer for the Materials Safety Data Sheets. Refer to www.boc.com.au or www.boc.co.nz