

WELDING NON-FERROUS ALLOYS

NICKEL AND NICKEL ALLOYS

Nickel and nickel based alloys are used in industrial applications for:

- corrosion resistance
- heat resistance and high temperature properties
- cryogenic properties

Preheating is not normally required unless there is a risk of porosity from moisture condensation. PWHT is not usually needed to restore corrosion resistance.

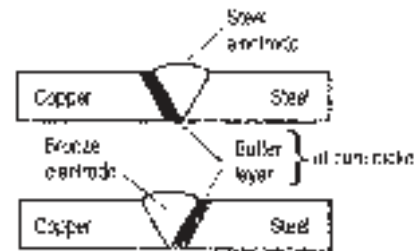
Inconel type of deposit is used for obtaining high temperature, high strength joints designed to perform at over 200°C such as on creep resistant chrome-molybdenum steels to stainless steels. These types are suitable when welding sections over 25 mm. For welding tool steels requiring toughness under repeated cyclic stress and oxidation resistance upto 1000°C, Hastalloy C type of deposit is regularly used. The drop in strength and hardness as the temperature goes up is very gradual.

COPPER AND COPPER ALLOYS

The main features of copper and its alloys;

- corrosion resistance
- electrical and thermal conductivity

In terms of weldability, the alloys have quite different welding characteristics. Copper needs substantial preheat to counteract the high thermal conductivity. But alloys like cupro-nickel can be fusion welded without any preheat, as the thermal conductivity is similar to low carbon steel.



Buttering technique should be used to join copper alloys to carbon/stainless steel. This is to take care of the copper migration to the HAZ and precipitation at the grain boundaries. The buffering, with a pure nickel electrode, can be applied on either the copper or the steel side. The groove has to be filled up a stainless or a bronze type of deposit.

The preheating should be 300-500°C when buttering copper or bronze whereas the preheating temperature has to be chosen according to the base material if the buttering is done on the steel side.

COBALT ALLOYS

Cobalt alloys are known for excellent wear resistance at high temperatures and the weld metal is used in cutting and shearing operations at temperatures exceeding 600°C. These deposits exhibit high shock resistance, high hardness at elevated temperatures and scaling resistance and can be used in stamping dies, trimming cutters, trimming punches, etc.

ESAB CN 1G

Excellent high temperature and corrosion resistance

Esab CN1 G is an electrode designed to deposit weld with excellent resistance to corrosion and oxidation. It provides superior strength at temperatures above 650°C.

ALLOY BASE: Ni, Cr, Fe, Mn, Mo

SPECIAL FEATURES

- Smooth and stable arc with low spatter loss.
- Excellent resistance to acid corrosion.
- Superior strength at higher temperatures.

APPLICATIONS

ESAB CN1 G is ideally suited for joining Inconel, Incoloy, etc. and their combination with stainless steels.

PROPERTIES

UTS	: 60-64kg/mm ²
YS	: 40-44 kg/mm ²
Elongation	: 30-40%

CURRENT RANGE : (AC 70, DC+)

Size (mm)	Length (mm)	Current Range (Amp)
3.15	350	80-120
4.00	350	100-160
5.00	350	140-190

ESAB CN 182

High temperature resistance ultimate bonding

Esab CN182 virtually bonds with everything like ferrous metals, stainless steels, nickel steels, chromium steels, cobalt-based alloys, carbides. It is perfectly suitable for re-buffering hardfaced layer and welding dissimilar alloys. It can be used for welding 5% and 9% nickel steels, Inconel, Incoloy, etc.

The weld metal is tough and ductile and can withstand severe thermal fluctuations.

ALLOY BASE: Ni, Cr, Mn, Fe, Nb

SPECIAL FEATURES

- Withstands stresses generated by thermal cycles.
- Tolerant to dilution and produces crack resistant welds/clads, even in massive sections.
- Superior bonding properties.

APPLICATIONS

Repair of rotary kiln tyres, heat treatment equipment such as trays, tongs, cryogenic equipment, and

fabrication of nickel steels for corrosion resistant tanks and containers, heat exchangers, furnace components and fittings, and low temperature applications.

It is suitable for welding of nickel, inconel, monel, stainless steels, heat-resisting steels and difficult-to-weld steels. This electrode is perfect for joining dissimilar metals and alloys like carbon steels, stainless steels, nickel and nickel alloys to each other.

PROPERTIES

UTS	: 60-64 kg/mm ²
Elongation	: 42-48%
Impact (CVN) at -196°C	: 45-55 J

CURRENT RANGE : (AC 70, DC+)

Size (mm)	Length (mm)	Current Range (Amp)
2.50	350	60-100
3.15	350	80-120
4.00	350	100-160
5.00	350	140-190

ESAB MONEL

Corrosion resistant surfacing and joining monel

Esab Monel is a nickel-copper electrode for welding monel and similar alloys to themselves and to steels and for corrosion resistant cladding. The electrode has very low heat input characteristics and deposits homogeneous welds of superior quality.

ALLOY BASE: Ni,Cu,Ti

SPECIAL FEATURES

- Weld metal is ductile and crack resistant.
- Resistance to marine corrosion.
- Deposits a weld with fine bead appearance and easy de-slagging properties.

APPLICATIONS

Ideally suited for welding monel and monel-plated steels and for repairing monel casting defects. Joining monel to carbon steels and for overlaying on steel to obtain superior corrosion resistance. Regularly used in chemical, food, dairy, and pharmaceutical industries.

PROPERTIES

UTS	: 48-54 kg/mm ²
Elongation	: 42-48%

CURRENT RANGE : (DC+)

Size (mm)	Length (mm)	Current Range (Amp)
2.50	350	40-70
3.15	350	60-90
4.00	350	90-125



OK 92.35

Strength, hardness and impact properties at high temperature and corrosive media

OK 92.35 is a nickel based superalloy electrode, which offers resistance to most common acids.

The weld metal obtained is machinable and retains hardness even after prolonged heating at high temperatures. Tensile strength of the weld metal at 800°C is about ten times higher than mild steel which implies that resistance to deformation from static and cyclic loading is much superior.

It has smooth and pleasing welding performance with low spatter and easy slag detachability.

ALLOY BASE: Ni, Cr, Mo, Fe, W

SPECIAL FEATURES

- Super hot strength.
- Bonds with all ferrous and Ni-base alloys.
- Super resistance to corrosion from oxidizing acids, mixed acids, chloride salts.

APPLICATIONS

Repair and hardfacing of hot pressing tools, hot forging dies, hot shear blades, hot trimming dies, joining of Nimonic and Inconel alloys, valves, stirrers and pump components requiring wear, oxidation and corrosion resistance.

Also recommended for overlaying or joining dissimilar superalloys like Hastalloy, Inconel, etc., and for joining these alloys to mild, low alloyed and stainless steels.

PROPERTIES

UTS : 54-62 kg/mm²
 Hardness : 25-30 HRC

CURRENT RANGE : (AC 70, DC+)

Size (mm)	Length (mm)	Current Range (Amp)
3.15	350	110-130
4.00	350	160-190
5.00	350	190-230

OK 93.60

Resistance to high temperature wear

A cobalt base electrode depositing a Co-Cr-Walloy high in carbon. The weld metal has excellent resistance to friction, abrasion, impact, corrosion, oxidation and abrasion at high temperature. The alloy resists spalling due to thermal cycling exceptionally and is characterized by its spatterless smooth arc and easy slag detachability.

ALLOY BASE: C, Cr, W, Fe, Co

SPECIAL FEATURES

- Only solution to complex wear system.
- Minimal loss of costly weld metal by minimizing spatter
- Shining bead finish.

APPLICATIONS

Hardfacing parts subject to wear at elevated temperatures, also in corrosive environment. Surfacing of hot rolls, kneading rolls, press screws, band screws, skid buttons, dies, valves, burner nozzles, drawing valves, seats, steam ends etc.

PROPERTIES

Hardness : at 20°C : 52-55 HRC
 : at 600°C : 40-44 HRC
 : at 800°C : 30-34 HRC

CURRENT RANGE : (DC+, AC)

Size (mm)	Length (mm)	Current Range (Amp)
3.20	350	70-110
4.00	350	110-160

OK 92.26

Extreme toughness, spalling and oxidation resistance joins dissimilar metal combinations

An electrode that joins any difficult-to-weld steels, dissimilar steels, Nickel, Chromium and Cobalt alloys with same or dissimilar metal. OK 92.26 yields a really crack proof weld metal. It is relatively tolerant to dilution. The weld metal has good impact strength down to -200°C, and good tensile strength up to 800°C. Corrosion and oxidation resistance of the deposit is remarkable. It can also be used for welding low temperature steels such as 5% and 9% nickel steel. The special formulation of the electrode is also suitable for overlaying previously

hardfaced layer before further hardfacing. It has high thermal spalling resistance.

ALLOY BASE: Ni, Cr, Fe, Mn, Nb, Ta, Mo, Cu, Si, C.

SPECIAL FEATURES

- Excellent resistance to corrosion, oxidation and thermal shock.
- Smooth and stable arc with low spatter loss.
- All positional welding electrodes.
- Redrying is not required due to vacuum packed.

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PROPERTIES

UTS	: 64-68kg/mm ²
YS	: 40-42 kg/mm ²
Elongation A4, %	: 40%

CURRENT RANGE : (DC+)

Size (mm)	Length (mm)	Current Range (Amp)
2.50	300	50-80
3.20	350	90-130
4.00	350	120-150
5.00	350	150-200

OK 92.05

Electrode for joining nickel

OK 92.05 is an electrode that is used extensively for joining nickel and nickel and nickel alloys. The weld deposit other than being highly ductile is resistant to most common acids. It has smooth and pleasing welding performance with low spatter and easy slag detachability.

SPECIAL FEATURES

- Corrosion resistance.
- Bonds with all ferrous and nickel-base metals.

APPLICATIONS

Joining nickel and nickel alloys, dissimilar joining of nickel with steels and copper as well as copper alloys. The

solubility of nickel makes it perfectly suitable for joining copper and copper alloys steels.

PROPERTIES

UTS	: 46-53 kg/mm ²
Elongation (l=4d)	: 25-30%

CURRENT RANGE : (DC+, AC70)

Size (mm)	Length (mm)	Current Range (Amp)
3.15	350	60-120
4.00	350	90-170

OK 93.62

Excellent wear resistance upto 600°C

The weld metal has excellent resistance to friction, abrasion, impact, corrosion & oxidation and abrasion at high temperature. The alloy resists spalling due to thermal cycling is exceptional. And is characterized by its spatterless smooth arc and easy slag detachability.

APPLICATIONS

Hardfacing of parts subject to wear at elevated temperatures, also in corrosive environment. Surfacing of hot rolls, kneading rolls, press screws, band screws, skid buttons, dies, valves, burner nozzles, drawing valves, valve seats, steam ends etc.

SPECIAL FEATURES

- Only solution to complex wear system.
- Minimal loss of costly weld metal by minimizing spatter.
- Slag is easily detachable.
- Shining bead finish.

WELDING PROCEDURE

- Clean weld area for oil, grease and other impurities.
- Preheat job wherever possible.
- Hold electrode perpendicular to work piece and weld in stringer beads.
- Interpass temperature should not exceed 300°C
- Cooling should be slow.

PROPERTIES

Hardness	: at 20°C	: 42-49 HRC
	at 300°C	: 42-49 HRC
	at 600°C	: 30-35 HRC

CURRENT RANGE : (AC 70, DC+)

Size (mm)	Length (mm)	Current Range (Amp)
3.20	350	70-100
4.00	350	110-160



OK 93.66

High temperature chemical inertness

OK 93.66 deposits a highly crack resistant weld metal of Stellite Gr. 6 type. The electrode is characterized by its spatter less smooth arc and easy slag detachability. The weld metal has excellent resistance to friction, abrasion, impact, corrosion and oxidation and abrasion at high temperature. These features make it suitable for combined wear conditions. The alloy resists spalling due to thermal cycling and has good sliding properties.

ALLOY BASE: Cr, Co, C, W

SPECIAL FEATURES

- Retains about 40 HRC hardness at 750°C.
- Only solution to complex wear system.
- Exceptional resistance to corrosion.

APPLICATIONS

Hardfacing of parts subject to wear at elevated temperatures and also in corrosive environment like hot forging tools, hot shear blades and dies, cutting edges, grab tongs, hot punches, knives, chemical valve seats, steam ends, pump sleeves, wear pads, screw conveyors, etc. in chemical, petroleum and sugar industries and also in steel plants.

WELDING PROCEDURE

- Clean weld area for oil, grease and other impurities.
- Preheat job wherever possible.
- Hold electrode perpendicular to work piece and weld in stringer beads.
- Maintain interpass temperature 300°C or lower.
- Cooling should be slow.

PROPERTIES

Hardness	: At 20°C As deposited	: 39-42 HRC
	Work Hardened	: 43-46 HRC
	At 750°C As deposited	: 19-22 HRC
	Work Hardened	: 38-43 HRC

CURRENT RANGE : (AC 70, DC+)

Size (mm)	Length (mm)	Current Range (Amp)
3.20	350	70-100
4.00	350	110-160

BRONZOID 1

Excellent welding of copper alloys

Bronzoid 1 is an electrode that provides an alloy suitable for welding brass, bronze, deoxidized copper, cast iron, steels and dissimilar metals.

It has easy slag detachability and produces homogeneous and sound weld metal free from porosity and cracks. Excellent colour match on bronze.

ALLOY BASE: Cu, Sn, P

SPECIAL FEATURES

- Smooth and stable arc with almost no spatter loss.
- The deposit can be machined to a smooth finish with low coefficient of friction.
- Resistance to marine and steam corrosion.

APPLICATIONS

Welding and surfacing of copper brass and bronze, cracked engine jackets, cylinder heads, electrical fittings, propeller blades, pump parts, bearing bushing, shaft, castings, stampings and valves. Filling cavities in copper alloy castings, joining copper and bronze to cast iron overlays and steel.

PROPERTIES

UTS	: 28-36 kgfmm ²
Elongation	: 18-26%

CURRENT RANGE : (DC+)

Size (mm)	Length (mm)	Current Range (Amp)
3.15	450	60-120
4.00	450	90-170
5.00	450	125-230