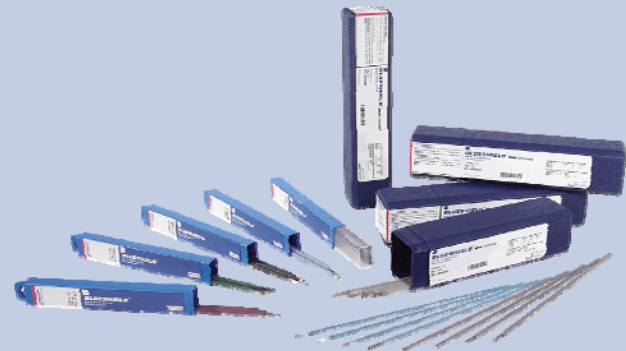
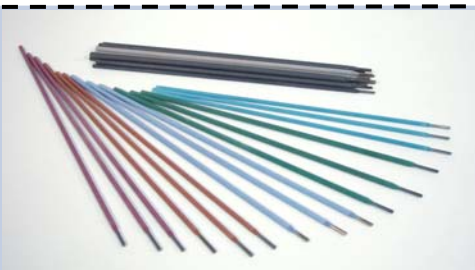


BLUESHIELDTM Specialty Welding Electrodes for Maintenance and Repair (MNR)



Welding; the science of joining by fusion of steel. Air Liquide has mastered welding for decades and is now offering a complete new line of advanced Stick electrodes for Maintenance & Repair (MNR), Hardfacing and many other applications where high quality welding technologies is required. If it can be welded, our **BLUESHIELD MNRTM** products will meet the challenge.

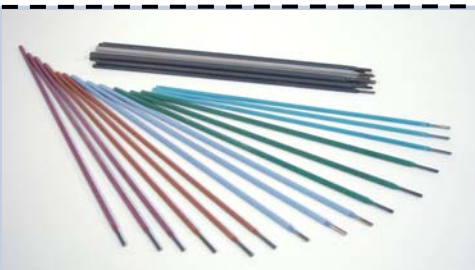
Our vision, to become the partner by choice; our commitment to be the best quality stick electrodes.



Specialty Welding Electrodes for Maintenance and Repair

Selection Chart

| ALLOY GROUP | NAME | DESCRIPTION | APPLICATION | PACKAGING | | | DIAMETER | | PART # |
|------------------|------------------|---|---|-----------|----|-------------------|----------|--------------|--------------|
| | | | | kg | lb | | mm | in | |
| MILD STEEL | 4 x 4 | <ul style="list-style-type: none"> General maintenance and adverse conditions mild steel electrode for "Off Road 4x4" welding Excels on rusty, greasy, misaligned parts and difficult to access component | <ul style="list-style-type: none"> Easily welds galvanized, painted, rusted or contaminated steels in service For maximum penetration and digging action on ornamental iron, steel furniture, heavy and farm machinery parts | 0.45 | 1 | Tube | 2.5 | 3/32 | BLU-53111025 |
| | | | | | | | 3.2 | 1/8 | BLU-53111032 |
| | Universal | <ul style="list-style-type: none"> Universal mild steel electrode for all around repair and general fabrication High speed welding on thin gauge, clean or new steel components | <ul style="list-style-type: none"> Universal is the most versatile general purpose electrode for maintenance and fabrication Welds all positions; flat, vertical up and down, and overhead at same amperage setting | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53111525 |
| | | | | | | | 3.2 | 1/8 | BLU-53111532 |
| | | | | | | | 4.0 | 5/32 | BLU-53111540 |
| | | | | 0.45 | 1 | Tube | 1.6 | 0.062 | BLU-53113016 |
| | | | | | | | 2.5 | 3/32 | BLU-53113025 |
| | | | | | | | 3.2 | 1/8 | BLU-53113032 |
| | | | | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53113525 |
| | | | | | | | 3.2 | 1/8 | BLU-53113532 |
| | | | | | | | 4.0 | 5/32 | BLU-53113540 |
| LOW ALLOY STEEL | Chinook | <ul style="list-style-type: none"> Unique "Double Coated" low hydrogen electrode with a "2 layers" coating Pure soft and stable spray arc with very fine droplet; soft as a "Chinook" breeze Special slag system support and shapes the weld | <ul style="list-style-type: none"> Perfect for all position welding of fine grained structural and construction steels Excellent mechanical properties and perfect for X-Ray work Unique, stable spray-type arc makes the Chinook excellent on root passes and positional welding | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53116525 |
| | | | | | | | 3.2 | 1/8 | BLU-53116532 |
| | | | | | | | 4.0 | 5/32 | BLU-53116540 |
| | Striker | <ul style="list-style-type: none"> Extra low hydrogen & Moisture resistant "18" type electrode Never miss a start weld or tack with the Striker | <ul style="list-style-type: none"> For welding 70 000 psi tensile steel such as boiler, pipe, shipbuilding, construction, structural and cast steels Great choice for welder appeal and weldability | 0.45 | 1 | Tube | 2.5 | 3/32 | BLU-53118025 |
| | | | | | | 3.2 | 1/8 | BLU-53118032 | |
| | | | | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53118525 |
| | | | | | | | 3.2 | 1/8 | BLU-53118532 |
| | | | | | | | 4.0 | 5/32 | BLU-53118540 |
| HIGH ALLOY STEEL | Rebel | <ul style="list-style-type: none"> High manganese stainless for "Difficult to weld", high strength, dissimilar and "Rebel" steel Very good resistance to corrosion and cavitations damage (Hydro turbines and pumps) | <ul style="list-style-type: none"> Use as build up buffer layers for maximum impact resistance prior to hardfacing Rebel also weld 14% manganese steels as well as alloyed structural and heat treatable steels | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53207525 |
| | | | | | | | 3.2 | 1/8 | BLU-53207532 |
| | | | | | | | 4.0 | 5/32 | BLU-53207540 |
| | Xtreme | <ul style="list-style-type: none"> For "Xtreme" resistance with exceptional strength and crack resistance The essential electrode for welding all types of steels An important maintenance and repair electrode in metal fabrication | <ul style="list-style-type: none"> Xtreme is ideal for tools, dies, spring steel and any dissimilar steel combinations Also recommended for underlay and hardfacing of worn parts "Must Have" electrode from broken bolt removal to welding "unknown" steel | 0.45 | 1 | Tube | 1.6 | 0.062 | BLU-53212016 |
| | | | | | | 2.5 | 3/32 | BLU-53212025 | |
| | | | | | | | 3.2 | 1/8 | BLU-53212032 |
| | | | | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53212525 |
| | | | | | | | 3.2 | 1/8 | BLU-53212532 |
| | | | | | | | 4.0 | 5/32 | BLU-53212540 |

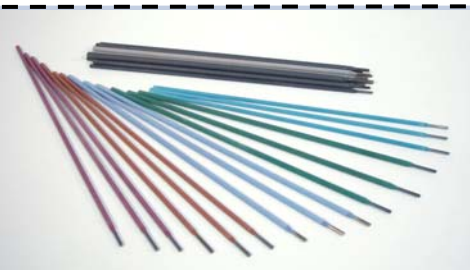


Specialty Welding Electrodes for Maintenance and Repair

Selection Chart

| ALLOY GROUP | NAME | DESCRIPTION | APPLICATION | PACKAGING | | | DIAMETER | | PART # | |
|---------------------|----------|---|--|-----------|----|-------------------|----------|-------|--------------|--------------|
| | | | | kg | lb | | mm | in | | |
| CUTTING AND GOUGING | Eraser | <ul style="list-style-type: none"> Very unique electrode for chamfering, gouging and cutting using standard stick electrode power source | <ul style="list-style-type: none"> Can gouge, bevel or cut all metals including stainless steels, aluminums and copper Eraser uses the power of the electrical arc and a special coating to remove and "Erase" metal | 2.5 | 5 | Heavy plastic box | 2.5 | 3/32 | BLU-53262325 | |
| | | | | | | | 3.2 | 1/8 | BLU-53262332 | |
| | | | | | | | 4.0 | 5/32 | BLU-53262340 | |
| | | | | | | | 5.0 | 3/16 | BLU-53262350 | |
| CAST IRON | Cast55 | <ul style="list-style-type: none"> A 55% Nickel cast iron but with actual nickel content increased to 60% Cast55 is "Barium Free" for joining dirty and contaminated cast irons | <ul style="list-style-type: none"> This flexible fero-nickel electrode welds a wide variety of ductile, nodular and malleable cast irons Extra nickel offers crack resistance and maximum machinability Strong arc penetrates surface contaminants, oil and grease easily out of the weld | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53455525 | |
| | | | | | | | | 3.2 | 1/8 | BLU-53455532 |
| | | | | | | | | 4.0 | 5/32 | BLU-53455540 |
| | | | | | | | | | | |
| Tri-Cast | | <ul style="list-style-type: none"> Special copper clad "Tri-metal" cast iron nickel based electrode Iron-nickel-copper chemistry Visually unique layer of copper on the electrode | <ul style="list-style-type: none"> Proprietary copper-nickel-iron deposit chemistry yields a unique combination of softness, ductility and tensile strength Higher welding speed creates extremely low heat affected zone and heat input | 0.45 | 1 | Tube | 2.5 | 3/32 | BLU-53460025 | |
| | | | | | | | | 3.2 | 1/8 | BLU-53460032 |
| Cast99 | | <ul style="list-style-type: none"> 99% nickel cast iron electrode with 100% non-conductive flux coating Very soft machinable welds, porosity free and excellent weldability | <ul style="list-style-type: none"> Cast99 is especially suited for welding in deep recesses or close access due to the non-conductive flux coating Cast99 is excellent for vertical-up welding | 5 | 11 | Heavy plastic box | 2.5 | 3/32 | BLU-53460525 | |
| | | | | | | | | 3.2 | 1/8 | BLU-53460532 |
| | | | | | | | 4.0 | 5/32 | BLU-53460540 | |
| ALUMINIUM | Lite | <ul style="list-style-type: none"> Coated aluminum electrode for arc welding and brazing of aluminum alloys 5% silicon aluminum electrode with self lifting slag, special "Lite Blue" coating | <ul style="list-style-type: none"> Lite welds aluminums alloyed with copper, silicon, and magnesium Excellent for joining dissimilar grades of aluminum | 0.45 | 1 | Tube | 2.5 | 3/32 | BLU-53543025 | |
| | | | | | | | | 3.2 | 1/8 | BLU-53543032 |
| | | | | | | | 2.5 | 3/32 | BLU-53543325 | |
| | | | | | | | 3.2 | 1/8 | BLU-53543332 | |
| SILVER BRAZING | Silver45 | <ul style="list-style-type: none"> Silver based flux-coated rod for low temperature brazing Super active flux-coated "cadmium free" silver brazing alloys with 45% silver | <ul style="list-style-type: none"> Silver45 joint many types of metals and dissimilar materials Special "Fast Flow" coating for maximum de-oxidation and protection of the weld Strong enough coating to clean oxidized stainless steel | 0.45 | 1 | Tube | 1.6 | 0.062 | BLU-53545016 | |
| | | | | | | | 2.5 | 3/32 | BLU-53545025 | |

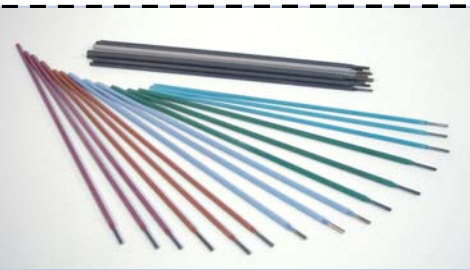
¹ "Vacuum Pack"



Specialty Welding Electrodes for Maintenance and Repair

Selection Chart

| ALLOY GROUP | NAME | DESCRIPTION | APPLICATION | PACKAGING | | DIAMETER | | PART # | |
|--|------------------|---|--|-----------|----|-------------------|--------------------------|-----------------------------|--|
| | | | | kg | lb | mm | in | | |
| HARDFACING IMPACT & HEAVY IMPACT BUILD UP | Builder38 | <ul style="list-style-type: none"> 38 Rockwell "C" electrode for impact resistant build-up on steels or prior to hardfacing <i>Builder38</i> offers superior toughness, compression and impact resistance | <ul style="list-style-type: none"> For tractor shoes, links, rollers, sprocket and idlers, crane & mine wheels and brake drums, shafts, gears, drive sprocket, track pads, mill hammer parts, buckets, etc. | 5 | 11 | Heavy plastic box | 3.2 4.0 5.0 | 1/8 5/32 3/16 | BLU-53738532 BLU-53738540 BLU-53738550 |
| | BuilderMN | <ul style="list-style-type: none"> Manganese (Mn) alloyed electrode for heavy impact resistant build-up or prior to hardfacing <i>BuilderMN</i> offers outstanding toughness, compression and impact resistance Deposit rapidly hardens under impact loading from 2-5 times the initial hardness | <ul style="list-style-type: none"> Joining and surfacing of wear plates and parts subjected to impact wear For crushing rolls, jaws and concaves; rail equipment, switches, railways couplers, crossing and frogs; construction equipment, manganese steel, hovel buckets, impact hammer, bucket, milling hammer, crusher jaws, dredge pump shells, armor plating, etc. | 5 | 11 | Heavy plastic box | 3.2 4.0 5.0 | 1/8 5/32 3/16 | BLU-53748532 BLU-53748540 BLU-53748550 |
| HARDFACING ABRASION + IMPACT & METAL-METAL | Hard58 | <ul style="list-style-type: none"> 58 Rockwell "C" General hardfacing electrode for combined abrasion and moderate impact <i>Builder38</i> or <i>BuilderMN</i> electrode can be used as under layer | <ul style="list-style-type: none"> Hardfacing of mining, rock and earth moving equipment, shovels, buckets, crawler shoes, bulldozer and scraper blades, crusher rolls, bucket teeth and lips, mixer blade, mill hammer, cutting edge, gyratory crusher, bucker liner, jaws, plowing implements; dipper lips, dredge pump, pump casing, etc. | 0.45 | 1 | Tube | 3.2 4.0 | 1/8 5/32 | BLU-53758032 BLU-53758040 |
| | Hard60 | <ul style="list-style-type: none"> 60 Rockwell "C" hardfacing electrode for moderate impact and moderate abrasion offering high deposition rate <i>Hard60</i> is a 180% recovery electrode for maximum efficiency and speed with low repair cost Especially suited for metal to metal wear applications involving steel, manganese steel and cast iron | <ul style="list-style-type: none"> Hardfacing of mining equipment, shovels, buckets, crawler shoes, plowing implements; bulldozer blades, crawler tractor shoes, links, rollers and idlers, crane & mine car wheels, shafts, gears, drive sprocket, track, etc. | 5 | 11 | Heavy plastic box | 3.2 4.0 5.0 | 1/8 5/32 3/16 | BLU-53760532 BLU-53760540 |
| HARDFACING MAXIMUM ABRASION & ABRASION + TEMPERATURE | Krome62 | <ul style="list-style-type: none"> Super hard 62 Rockwell "C" hardfacing electrode containing large amounts of chromium carbide Surfacing against severe abrasive wear and moderate impact <i>Krome62</i> offers smooth overlays and excellent weldability | <ul style="list-style-type: none"> Hardfacing of wear plates; shovel teeth; mechanical shovel buckets; bulldozer blades, mining equipment, road-building machinery, agricultural tools, earth moving equipment in abrasive soil, conveyor screw and chains, mixer, pipeline elbows, send chute, bucket lips and teeth, crushing hammer, roll crusher, steel mill guides, punch rolls, valves, pump casing and impellers, etc. | 5 | 11 | Heavy plastic box | 2.5 3.2 4.0 5.0 | 3/32 1/8 5/36 3/16 | BLU-53762525 BLU-53762532 BLU-53762540 BLU-53762550 |
| | Krome68 | <ul style="list-style-type: none"> Maximum hardness 68 Rockwell "C" deposits enriched with Niobium (Nb) and Chromium (Cr) Carbides <i>Krome68</i> offers the ultimate combination of abrasion resistance and high temperature hardness retention For protecting parts subject to severe fine particle abrasion at elevated temperatures | <ul style="list-style-type: none"> For protecting parts subject to severe fine particle abrasion at elevated temperatures Hardfacing of wear plates; shovel teeth; buckets; bulldozer blades, iron and steel making industry: ash plows, coke crusher, screw conveyor, rake teeth in furnaces, mineral crushers; screens, production of construction materials and various minerals: quarries; cement plants, agriculture grain threshers, valves, exhaust fan, agitator finger, mill guides, mixes blades, bucket lips, asphalt mixer, crusher hammer, etc. | 5 | 11 | Heavy plastic box | 3.2 4.0 5.0 | 1/8 5/36 3/16 | BLU-53768532 BLU-53768540 BLU-53768550 |



MNR Specialty Electrodes Technical Information

Choosing a BLUESHIELD MNR Cast Iron Electrode

| NAME | NEW CAST IRON | WORN CAST IRON | WELDABILITY AND POSITION WELDING | MACHINAILITY |
|-----------------|---------------|----------------|----------------------------------|--------------|
| <i>Cast55</i> | +++ | | | ++ |
| <i>Tri-Cast</i> | +++ | +++ | +++++ | +++ |
| <i>Cast99</i> | +++ | ++++ | +++ | ++++ |

SAE / AISI Steel Numbering System

FIRST DIGIT = CLASS OF STEEL:

- 1xxx - Plain Carbon Steels
- 2xxx - Nickel Steels
- 3xxx - Nickel Chrome Steels
- 4xxx - Chrome Moly Steels
- 5xxx - Chrome Steels
- 6xxx - Chrome Vanadium Steels
- 8xxx - Nickel Chrome Moly Steels
- 9xxx - Silicon Manganese Steels**

SECOND DIGITS = SUB CLASSES:

For Plain Carbon Steels (1xxx) the class breaks down into four sub classes

- 10xx - nothing added
- 11xx - sulphur added
- 12xx - sulphur and phosphorous added
- 13xx - extra manganese added**

LAST TWO DIGITS = CARBON CONTENT

Ex. SAE / AISI number 1040 stands for:

- 10 = Plain Carbon Steel (nothing added)
- 40 = Carbon Content 0.40%

Preheating Temperature

WELDABILITY OF NON-ALLOYED AND/OR LOW ALLOYED STEELS

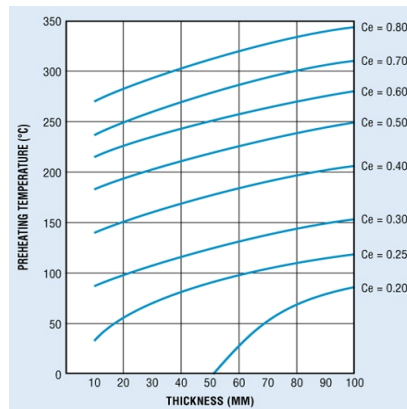
The metallurgical weldability of a steel can be relatively quantified by the "Equivalent Carbon" calculation which is used to determine a preheating temperature for this steel.

$$C_e = C + Mn/6 + (Cr+Mo+V)/5 + (Cu+Ni)/15$$

1. APPROXIMATED PRE-HEAT:

- $C_e < 0.45$ Pre-Heat: as you wish
- $0.45 < C_e < 0.6$ Pre-Heat: from 100 to 200 °C
- $C_e > 0.6$ Pre-Heat: from 200 to 370 °C

2. ACCORDING TO THE THICKNESS AND THE CARBON EQUIVALENT IN A GRAPH:



MNR Specialty Electrodes Technical Information

Identification of Ferrous Metals

| TEST / METAL | MAGNETISM | CHISEL | BREAKING | SPARKS |
|-----------------------------------|--|--|-------------------------------------|---|
| Mild steels | Very magnetic | Continuous shavings, smooth and easy to cut | Brilliant grey | Long yellow carrier lines (about 0.20% of C) |
| High carbon steels + Alloy steels | Very magnetic | Hard to cut, can be regular | Brilliant grey | Yellow lines with bright brilliant stars |
| Cast Iron | Very magnetic | Little cuttings of 3 mm, hard to chisel, breakable | Fragile | Red carrier lines (poor in carbon) |
| High manganese steels | No magnetism | Very hard to chisel | Rough grains | Brilliant white in fan shape |
| Austenitic stainless steels | Variable according to the chemical composition | Brilliantly colored continuous shavings | Brilliant depending on the material | <ol style="list-style-type: none"> 1. With nickel: black very close to the wheel 2. With molybdenum: short in the shape of a tongue |

Cross Reference for Hardnesses

| ULTIMATE TENSILE STRENGTH | | BRINELL HARDNESS | ROCKWELL HARDNESS | | VICKERS HARDNESS |
|---------------------------|-----|------------------|-------------------|-----|------------------|
| MPa | ksi | | HRB | HRC | |
| 300 | 46 | 85 | 42 | | 85 |
| 400 | 58 | 115 | 66 | | 115 |
| 500 | 72 | 145 | 80 | | 145 |
| 600 | 58 | 175 | 89 | | 175 |
| 700 | 58 | 205 | 95 | | 205 |
| 800 | 58 | 235 | | 20 | 235 |
| 900 | 58 | 265 | | 25 | 265 |
| 1000 | 58 | 290 | | 29 | 290 |
| 1100 | 58 | 320 | | 32 | 320 |
| 1200 | 58 | 350 | | 36 | 350 |
| 1600 | 58 | | | 47 | 480 |
| 2000 | 58 | 555 | | 52 | 570 |
| | | | | 55 | 620 |
| | | | | 60 | 720 |
| | | | | 65 | 840 |
| | | | | 68 | 940 |