

Hardfacing

Millions of dollars worth of equipment is thrown away each year because it no longer performs efficiently.

A large percentage of this equipment could, however, be protected by hardfacing or reclaimed by welding. In many cases, the degeneration of the equipment could have been stopped if preventative maintenance was carried out as a matter of routine.

There should be differentiation between repair welding, reclamation and preventative maintenance.

Repair Welding

Repair welding is aimed at repairing structural damage, such as fatigue, cracks, fractures etc. The principle governing repairs is normally based on either matching the welding consumable chemically or mechanically (tensile strength, proof stress, elongation etc) to the base metal.

Reclamation

Reclamation is aimed at restoring the dimensions of the components that have been altered due to wear, corrosion, thermal fatigue, machining defects etc.

Typical components that are normally reclaimed include:

- Steel mill rolls
- Idler rolls
- Track rolls
- Dragline jewellery
- Carrier rolls

Preventative Maintenance

Preventative maintenance is the pro-active use of welding to prevent excessive wear on components.

Hard surfacing is a form of preventative maintenance.

Typical components that are normally hard surfaced include:

- Front end loader buckets
- Crusher jaws and mantles
- Sugar mill rollers
- Agricultural tyres
- Brick and paver mixer paddles

Processes

The standard welding processes employed during both reclamation and preventative maintenance may include:

- 1 Manual metal arc welding (MMA)
- 2 Gas shielded metal arc welding (GMAW)
- 3 Submerged arc welding (SAW)
- 4 Flux cored arc welding (FCAW)
 - open arc
 - gas shielded
 - submerged arc

The biggest advances have been made in the area of flux cored welding consumables. It is also the area that has the widest selection of alloys available and a wide range of material properties.

Wear Mechanisms

For effective reclamation and preventative maintenance, a proper understanding of the mechanism causing the degeneration is required before welding consumables can be selected.

1. Abrasion

Abrasion is the single most important mechanism of all wear in industry.

Abrasion	50%
Impact	10%
Metal-to-metal wear	14%
Chemical (corrosion)	10%
Temperature	5%

Abrasion (or metal-to-mineral wear) is further subdivided into:

- a) High stress abrasion

This occurs when abrasive materials are deliberately broken into smaller sizes (i.e. crushing operations)
- b) Low stress abrasion

This occurs when abrasive materials are transported along the surface in both a sliding and rolling action, in such a way that a reduction in particle size does not normally take place (i.e. feed chutes slurry pipelines etc).

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

2. Metal-to-metal wear

This occurs when there is movement of one component relative to the other.

Typical examples of metal-to-metal wear are:

- a) Journal ends of steel mill rolls
- b) Track rolls of earth moving equipment

3. Temperature

Temperature, when it becomes sufficiently high, will cause oxidation and subsequent scaling.

More detrimental, however, are fluctuating temperatures, which lead to thermal fatigue cracking or fire cracking, as in steel mill roll applications.

4. Corrosion

This is the degradation of metals due to chemical reaction, whether by an acidic medium flowing through a pipe or the exposure of components to corrosive atmospheres (i.e. coastal operations).

5. Impact

This is the degradation of metals due to the repeated point loading of the component that causes the surface to fatigue rapidly and disintegrate (i.e. impact crusher or gyratory crushers).

Welding Consumables Classification

Welding consumables are further grouped in terms of alloy types, where each exhibits certain characteristics that would make them suitable to apply when certain tribological conditions are encountered.

1XXX Steels

Alloy type	Description	Features	Typical applications
11XX	Pearlitic Steel	Strong, multi-run capabilities	General rebuilding, butter layers, spindles, rollers, track lines, sprockets, tractor idler wheels
12XX	Austenitic manganese steel	Tough, work hardening, impact resistant	Crusher jaws, rolls, mantles, ball mill liners, railway points
13XX	Austenitic stainless steel	Tough, corrosion/heat resistant, forms strong welds between dissimilar steels	Crossings, bearings at medium temperatures, track grousers, anvils, pneumatic tools, butter layers under 2XXX hardfacing
14XX	Low carbon martensitic steel	Strong	Clutch parts, railway points and crossings, track components
15XX	Tool steel	Very hard, hot strength	Machine tools, shears, guillotine blades, metal forming tools
16XX	Martensitic stainless steel	Hard, corrosion/heat resistant	Cutting knives, punches, dies, steel mill rolls.
17XX	High carbon austenitic steel	Tough, work hardened	Crushing rolls, hammers, tractor grousers
18XX	High carbon martensitic steel	Very hard, abrasion resistant	Post-hole augers, earth scoops, conveyor screws, loader buckets, pump housings
19XX	High carbon martensitic steel with primary alloy carbide	Hard, check crack-free abrasion resistant	Clinker crushing rolls, hammers, drill collars

2XXX Chromium White Irons

Alloy type	Description	Features	Typical applications
21XX	Austenitic iron	Corrosion, abrasion and impact resistant	Crushing equipment (jaws, rolls, hammers, mantles) pump casings, impellers, pipeline elbows
22XX	Martensitic iron	Very hard, corrosion/erosion resistant	Agricultural plough shares, tines mill scraper blades, wear bars, bucket lips, crushing rolls
23XX	Austenitic chromium carbide iron	High abrasion resistance	Screen butt straps, quarry screen plates, chutes, grizzly bars, dragline teeth, dredge bucket lips, shovel teeth
24XX	Complex chromium carbide iron includes types containing up to 45% tungsten	Very highly abrasion resistant plus hot abrasion resistance	Sizing screens, ball mill liner plates, pump impellers, crusher jaws, agricultural implements, scrapers
25XX	Martensitic chromium carbide iron	Highly erosion resistant	Wet applications in mining and crushing industries (ball mill liners)
26XX	Low chromium white iron	Resistant to fine abrasion	Pug mill paddles, clay augers, screens and granulators

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3XXX Tungsten Carbide Composites (Minimum 45wt% Tungsten Carbide)

Alloy type	Description	Features	Typical applications
31XX	Carbide chips in Cu alloy matrix >4000 µm	Protruding carbides useful as individual cutting edges	Rock drills, oil drills, oil well tools
32XX	Tungsten carbide granules in an Fe rich matrix >850 µm	Cutting and wear resistant applications	Bucket teeth, ripper points, oil drill collars, auger blades and teeth, oil well drills, bulldozer end tips
33XX	425–850 µm	Gouging resistant	Rock drills, ditcher teeth, dry cement pump screws, suction dredge blades
34XX	150-425 µm	Gouging resistant	Ripper lines, ditcher teeth, cement pump screws, churn drills
35XX	<150 µm	Extreme abrasion resistance	Tool joints
36XX	Tungsten carbide granules in a Ni-B matrix < 75 µm	Hot abrasion resistance and cutting	Plough share edges, knives, boring bars, bottle machine parts, sand slingers, sand mixer blades

4XXX Cobalt Alloys

Alloy type	Description	Features	Typical applications
41XX	Complex Co-base solid solution	Tough, creep resistant, cavitation resistant	Hot shear blades, valve seats
42XX	Hypo-eutectic Co-Cr-W alloy	Strong, cavitation resistant	Exhaust valves in diesel engines, cold shear blades
43XX	Hypo-eutectic Co-Cr-W alloy	Hard, cavitation resistant	Scrapers, feeders, screws etc in chemical, mining and cement industries
44XX	Co-Cr-Ni-W alloy (powder)	Strong, cavitation resistant	Timber saw blades, valve seats, shear blades

5XXX Nickel Alloys

Alloy type	Description	Features	Typical applications
51XX	Complex Ni-base solid solution	Tough, creep resistant, hot hardness	Hoppers, forging dies and hammers, hot trimming and punching dies.
52XX	Low melting point Ni-B alloy	High hot erosion resistance	Slurry pumps and piping
53XX	Tungsten carbide (<45 wt%) in a Ni-B matrix	Lower abrasion resistance than 36XX	Hot forging dies, parts subjected to hot erosion in chemical plants
54XX	Solid solution	Highly corrosion resistant	Valve bodies and parts subject to oxidation

6XXX Copper Alloys

Alloy type	Description	Features	Typical applications
61XX	Phosphor bronze (4–6% Sn)	Soft corrosion resistant	Light load bearings
62XX	Phosphor bronze (7–9% Sn)	Good bearing properties, wear/corrosion resistant	Medium load bearings, crank press, transmission housings, pump rotors
63XX	High tensile brass (Cu-Zn-Mn)	Low friction bearing, wear/corrosion resistant	Light load bearings, hydraulic rams and pistons
64XX	Nickel bronze (9–13% Ni)	Low friction bearing, work hardens, corrosion resistant	Gear teeth, cams, bearings, percussion heads, slides, service where work hardening required
65XX	Aluminium bronze (9.5–14% Al)	Tough erosion/cavitation resistant	Heavy load bearings, valve seats, marine castings, overlay deposited on steel
66XX	Nickel aluminium bronze	Tough, work hardens, impact/corrosion resistant	Form dies, impellers, axles, valve seats, propellers
67XX	Complex aluminium bronze (Cu-Mn-Fe-Ni-Al)	Erosion/cavitation/corrosion resistant	Seawater pumps, impellers under heavy load, propellers and applications subject to severe cavitation

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Application and Finishing

The success of any reclamation or preventative maintenance repair does not lie only in the correct identification of the wear mechanism or choice of the consumable, but also in the application and finishing of the build-up material.

Preheating

Many components that can be reclaimed are made from either cast steel or alloyed steel plate.

As a precautionary step, components should never be welded cold, with the exception of manganese steel. The degree of preheating is highly dependant on the composition of the component (see page 326).

Buffer Layers

Buffer layers are applied when the base material has a low weldability or to reduce the dilution when welding highly alloyed consumables.

Austenitic buffers will stop cracks from progressing into the base material, but are not suitable for use under martensitic steels (14XX, 18XX, 19XX alloys).

Dilution

Deposit dilution occurs when base metals melted by the electric arc mix with the molten weld metal during the welding process.

Dilution can result in:

- a) The depletion of alloying elements in the weld metal, resulting in lower hardness figures or
- b) The absorption of elements like carbon into the deposited weld metal, with increased hardness and possible relief cracking in low-alloyed surfacing materials

Relief Checking

Relief checking occurs in high hardness and carbide bearing hardfacing alloys as a result of a large difference between the rate of expansion and contraction between it and the base material. Relief checking occurs only in the weld metal itself. Often the amount of relief checking can be minimised if high preheat temperatures are used and cooling occurs at a very slow rate.

Finishing

Reclaimed components are often re-machined. It is therefore necessary to establish, beforehand, the final hardness of the required reclamation.

Hardness of 450 HB can still be machined, although deposits harder than 480 HB are normally ground.

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Cobalarc Austex

- Metal enriched, rutile type electrode
- For joining dissimilar steels or as a buffer layer prior to hard surfacing
- Tough, machinable austenitic stainless steel deposit

Classifications	
AS/NZS 2576:1315-A4	
W.T.I.A. Tech. Note 4: 1315-A4	

Typical all weld metal deposit analysis (%)					
C	Mn	Si	Cr	Ni	
0.10	1.50	0.90	24.5	9.3	

Typical weld deposit hardness	HRC	HV30
All weld metal deposit	20	240
Work hardened deposit	40	400

Finishing recommendations
Machinable with carbide tools 3.2 mm size can be used for vertical welding by depositing overlapping horizontal stringer passes

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

Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
3.2	380	20	105–140	5	15 (3x5)	613973
4.0	380	13	140–180	5	15 (3x5)	613974
5.0	450	7	170–210	5	15 (3x5)	613975

Cobalarc Mangcraft

- Austenitic manganese steel electrode
- For building up and reinforcing 11–14% manganese steels
- Tough, impact resistant weld deposit
- Work hardens under heavy impact

Classifications	
AS/NZS 2576: 1215 - A4	
W.T.I.A. Tech. Note 4: 1215 - A4	

Typical all weld metal deposit analysis (%)		
C	Mn	Si
0.60	12.0	0.10

Typical weld deposit hardness	HRC	HV30
All weld metal deposit	15	–
Work hardened deposit	43	425

Finishing recommendations
Machinable with carbide tools

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

Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
4.0	380	17	130–170	5	15 (3x5)	611504
5.0	450	10	150–200	5	15 (3x5)	611505

Cobalarc 350

- Metal enriched, rutile type electrode
- For re-building worn steel components
- Tough, machinable low carbon martensitic steel deposit
- For the manual arc build-up and surfacing of steel gear, shafts, rails, shovel pads, track links, rolls and wheels etc

Classifications	
AS/NZS 2576: 1435-A4	
W.T.I.A. Tech. Note 4: 1435-A4	

Typical all weld metal deposit analysis (%)					
C	Mn	Si	Cr	Mo	
0.07	0.85	0.30	1.85	0.5	

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	28	290
All weld metal deposit	35	350

Finishing recommendations
Machinable

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

Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
3.2	380	25	100–150	5	15 (3x5)	611443
4.0	380	16	140–200	5	15 (3x5)	611444

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MMA Electrodes

Cobalarc 650

- Metal enriched, rutile type electrode
- For re-building or surfacing worn steel components
- Air hardening, crack free, martensitic steel deposit
- Typical applications include the surfacing of agricultural points, shears and tynes, grader and dozer blades, conveyor screws and post hole augers etc

Classifications					
AS/NZS 2576: 1855-A4					
W.T.I.A. Tech. Note 4: 1855-A4					

Typical all weld metal deposit analysis (%)					
C	Mn	Si	Cr	Mo	
0.58	1.1	0.6	5.3	0.25	

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	55	600
All weld metal deposit	57	640

Finishing recommendations
Not machinable/grinding only

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)					
3.2	380	31	105–135	5	15 (3x5)	611463
4.0	380	21	140–180	5	15 (3x5)	611464

Cobalarc 750

- Rutile type, AC/DC hard surfacing electrode
- Easy arc starting and stable running on portable AC welding sets (min. 45 OCV)
- Air hardening, crack free, martensitic steel deposit
- Typical applications include the surfacing of agricultural equipment and components including points, shears, post hole augers, ripper teeth and tynes etc

Classifications
AS/NZS 2576: 1860-A4
W.T.I.A. Tech. Note 4: 1860-A4

Typical all weld metal deposit analysis (%)					
C	Mn	Si	Cr	Mo	
0.60	0.46	0.75	5.9	0.40	

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	64	800
Two layers on mild steel*	62	750

* Not recommended for multi-pass welding heavier than 3 layers

Finishing recommendations
Not machinable/grinding only

3.2 mm and 4.0 mm sizes can be used for vertical welding by depositing overlapping horizontal stringer passes.

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

Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
3.2	380	26	95–130	5	15 (3x5)	611473
4.0	380	17	120–170	5	15 (3x5)	611474

Easyweld Blister Pack

10 x 3.2mm rod Cobalarc-750 Blister Pack	322218
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Cobalarc Toolcraft

- Versatile manual arc welding electrode
- Secondary hardening, shock resistant properties
- Crack free Cr-Mo steel deposit for repairing blades, dies, punches etc
- Also suitable for general hard surfacing in low stress abrasion conditions

Classifications
AS/NZS 2576: 1560-A4 W.T.I.A. Tech. Note 4: 1560-A4

Typical all weld metal deposit analysis (%)				
C	Mn	Si	Cr	Mo
0.58	0.10	0.20	5.5	6.8

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	55	600
All weld metal deposit	60	700

Finishing recommendations
Not machinable - grinding only
3.2mm size can be used for vertical welding by depositing overlapping horizontal stringer passes

Packaging and operating data — AC (min. 45 OCV) DC+ polarity						
Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
3.2	380	28	90–125	5	15 (3x5)	611523
2.5	300	54	60–90	20 Rod		322115

Cobalarc CR70

- Highly alloyed manual arc electrode
- High chromium carbide iron deposit
- Primary chromium iron carbides in a single layer
- Ideal for coarse abrasion and low to-moderate impact loading
- Typical applications of Cobalarc CR70 include the hard surfacing of crusher cones and mantles, swing hammers, bucket teeth and lips, dozer end plates and sugar mill rolls etc

Classifications
AS/NZS 2576: 2355-A4 W.T.I.A. Tech. Note 4: 2355-A4

Typical weld deposit analysis (%)			
Single layer on mild steel			
C	Mn	Si	Cr
3.3	1.5	1.0	25
All weld metal deposit			
C	Mn	Si	Cr
4.0	1.8	1.2	31

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	55	600
All weld metal deposit	59	690

Deposits contain chromium carbides with hardness up to 1,500 HV

Finishing recommendations
Grinding only
3.2 and 4.0mm sizes can be used for vertical welding by depositing overlapping horizontal stringer passes.

Packaging and operating data — AC (min. 50 OCV) DC+ polarity						
Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
3.2	380	18	90–140	5	15 (3x5)	613493
4.0	380	11	130–200	5	15 (3x5)	613494
5.0	450	6	180–250	5	15 (3x5)	613495

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MMA Electrodes

Cobalarc Borochrome

- Highly alloyed manual arc electrode
- Martensitic chromium carbide iron deposit
- Ideal for fine particle (wet or dry) abrasion and low impact loading
- Primary chromium iron carbides in a hard, martensitic matrix
- Typical applications include the hard surfacing of sand chutes, dredge components, ripper shanks, screens, grizzly bars, scraper blades and bucket lips and teeth

Classifications

AS/NZS 2576: 2560-A4
W.T.I.A. Tech. Note 4: 2560-A4

Typical weld deposit analysis (%)						
Single layer on mild steel						
C	Mn	Si	Cr	V	B	
2.7	0.4	1.8	20.0	1.4	1.0	
All weld metal deposit						
C	Mn	Si	Cr	V	B	
3.2	0.4	2.4	24.0	1.7	1.2	

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	58	660
All weld metal deposit	60	700

Deposits contain chromium carbides with hardness up to 1,500 HV

Finishing recommendations

Grinding only

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

Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
4.0	380	11	140–180	5	15 (3x5)	613964
5.0	450	6	170–210	5	15 (3x5)	613965

Stoody Tube Borium AC/DC

Replaces Cobalarc 4

- Highly alloyed tubular electrode
- Partially dissolved tungsten carbides bonded in an iron rich matrix
- Resistant to extreme abrasion and low impact loading

Classifications

AS/NZS 2576: 3460-A4.
W.T.I.A. Tech Note 4: 3460-A4.

Operational characteristics/welding parameters				
Dia. (mm)	4.0	4.8	6.4	
Mesh Size	20–30	20–30	10–30	
Position	Flat	Flat	Flat	

Typical weld deposit analysis (%)*					
	C	Mn	W	Cr	
Single Layer on Mild Steel	3.1	0.9	44	6	
All weld metal deposit	3.7	1	53	7	

Typical weld deposit hardness		
	HRC	HV30
Single Layer on Mild Steel	62	750
All weld metal deposit	64	800

Deposits contain Tungsten Carbides with hardness up to 2,200 HV

* Actual weld deposit consists of undissolved tungsten carbide particles in a eutectic matrix of C-W-Cr-Fe. The analysis of the matrix will vary with the proportion of tungsten carbides dissolved during welding.

Finishing recommendations

Grinding only

Packaging and operating data

AC (min 50 OCV), DC+ polarity.

Electrode		Electrodes/kg	Current Range (A)	Packet	Carton	Part No.
Size (mm)	Length (mm)					
5.5	350	9	120–150	4.5kg vac pack		10229500

NOTE: one size only

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Cobalarc 9e

- Highly alloyed extruded electrode
- Versatile, complex carbide iron deposit
- Resistant to both coarse and fine abrasion and moderate to heavy impact loading
- Typical applications include the hard surfacing of railway ballast tampers, dredge buckets and lips, earth-moving equipment, power shovels, rolling mill guides, sizing screens, ripper teeth and crushing equipment

Classifications
AS/NZS 2576: 2460-A4
W.T.I.A. Tech. Note 4: 2460-A4

Typical weld deposit analysis (%)							
Single layer on mild steel							
C	Mn	Si	Cr	Ni	Mo	V	
4.0	0.9	1.1	25.0	0.4	1.5	0.2	
All weld metal deposit							
C	Mn	Si	Cr	Ni	Mo	V	
4.8	1.1	1.4	30.0	0.5	1.7	0.2	

Typical weld deposit hardness		
	HRC	HV30
Single layer on mild steel	58	660
All weld metal deposit	63	780

Deposits contain complex chromium carbides with hardness up to 1,500 H.

Finishing recommendations
Grinding only

Identification colours
White (Single dot near holder end)
3.2mm and 4.0mm sizes can be used for vertical surfacing by depositing overlapping horizontal stringer passes

Packaging and operating data — AC (min. 50 OCV) DC+ polarity						
Electrode		Approx No. (rods/kg)	Current range (A)	Packet (kg)	Carton (kg)	Part No.
Size (mm)	Length (mm)					
3.2	380	17	60–120	5	15 (3x5)	613350
4.0	380	10	70–150	5	15 (3x5)	613360
5.0	450	5	150–300	5	15 (3x5)	613370

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FCAW Wire

Stoody Super Build Up G/O

- Gas (-G) and self shielded (-O), tubular hardfacing wires
- Tough, machinable low carbon martensitic steel deposit
- Recommended for the build-up and surfacing of steel track rolls, idler wheels, track pads, drive sprockets, pins, links and other components subject to abrasion and/or metal-to-metal wear

Classifications		
	1.2* and 1.6 mm	2.4† mm
AS/NZS 2576:	1435-B5	1435-B7
W.T.I.A. Tech. Note 4:	1435-B5	1435-B7

*1.2 mm and 1.6 mm Stoody Super Build Up-G wires are B5 type wires which require a shielding gas.

†2.4 mm Stoody Super Build Up-O is a B7 type open arc wire which requires no shielding gas.

Stoody 965 G/O

- Gas (-G) and self shielded (-O), tubular hardfacing wires
- Air hardening, crack free, martensitic steel deposit
- Resistant to hard particle abrasion and moderate impact loading
- Typical applications include the surfacing of agricultural points, shares and tynes, sand dredge cutter heads, dredge rollers and tumblers, conveyor screws, bucket lips etc

Classifications		
	1.2* and 1.6 mm	2.4† mm
AS/NZS 2576:	1855-B5	1855-B7
W.T.I.A. Tech. Note 4:	1855-B5	1855-B7

*1.2 mm and 1.6 mm Stoody 965-G wires are B5 type wires which require a shielding gas.

†2.4 mm Stoody 965-O is a B7 type open arc wire which requires no shielding gas.

Typical all weld metal deposit analysis (%)		
C: 0.10	Mn: 1.50	Si: 0.40
Cr: 2.60	Mo: 0.70	Fe: balance

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	30	300
All weld metal deposit	35	350

Finishing recommendations
Machinable carbide tools recommended

Recommended shielding gases
1.2 mm and 1.6 mm Cobalarc 350-G
Stainshield®
2.4 mm Cobalarc 350-O
Open arc or Industrial grade CO ₂

1.2 mm and 1.6 mm sizes can be used for vertical surfacing by depositing overlapping horizontal stringer passes.

Packaging and operating data DC electrode positive						
Dia. (mm)	Current range (A)	Voltage (V)	Rec. stick-out ESO (mm)	Pack type	Pack weight (kg)	Part No.
1.2	120–220	18–24	15–20	300 mm Spool	15	11423600
1.6	140–260	23–26	15–25	300 mm Spool	15	11946200
2.4	250–450	24–28	20–35	Coil	27	11183600

Typical all weld metal deposit analysis (%):		
C: 0.50	Mn: 1.70	Si: 1.40
Cr: 6.20	Fe: balance	

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	55	600
All weld metal deposit	57	640

Finishing recommendations
Not machinable - grinding only

Recommended shielding gases
1.2 mm and 1.6 mm Cobalarc 650-G
Stainshield®
2.4 mm Cobalarc 650-O
Open arc or Industrial grade CO ₂

1.2 mm and 1.6 mm sizes can be used for vertical surfacing by depositing overlapping horizontal stringer passes.

Packaging and operating data DC electrode positive						
Dia. (mm)	Current range (A)	Voltage (V)	Rec. stick-out ESO (mm)	Pack type	Pack weight (kg)	Part No.
1.2	120–250	18–24	15–20	300 mm Spool	15	11423100
1.6	140–260	23–26	15–25	300 mm Spool	15	11501500
2.4	250–450	24–28	20–35	Coil	27	11946100

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Stoody 850-O

- Self shielded (-O), tubular hardfacing wire
- Air hardening, crack prone high carbon, martensitic steel deposit
- Resistant to severe abrasion and low impact loading
- Typical applications include the hard surfacing of agricultural, mining and materials handling equipment, such as tynes, points, conveyor screws, dredge buckets, cane harvester cutters/elevators and sugar mill scraper plates

Classifications
AS/NZS 2576: 1865-B7.
W.T.I.A. Tech. Note 4: 1865-B7

Typical all weld metal deposit analysis (%)		
C: 0.95	Mn: 0.6	Si: 0.9
Cr: 6.5	Mo: 3.5	B: 1.5
Typical weld deposit hardness		
Single layer on mild steel	HRC	HV30
	62	750
All weld metal deposit	65	830

Finishing recommendations
Grinding only
Recommended shielding gas
Open arc or welding grade CO ₂
1.2mm size can be used for vertical surfacing by depositing overlapping horizontal stringer passes.

Packaging and operating data — DC electrode positive						
Dia. (mm)	Current range (A)	Voltage (V)	Rec. stick-out ESO (mm)	Pack type	Pack weight (kg)	Part No.
1.2	120–250	18–24	15–20	300mm Spool	15	11945500

Stoody Dynamang-O

- Self shielded (-O), tubular hardfacing wire
- Tough, work hardening austenitic manganese steel deposit
- Typical applications include the repair of manganese steel crusher rolls, jaw and hammer crushers, gyratory mantles, blow bars and dredge pump cutters etc.

Classifications
AS/NZS 2576: 1215-B7
W.T.I.A. Tech. Note 4: 1215-B7

Typical all weld metal deposit analysis (%)		
C: 0.90	Mn: 13.40	Si: 0.37
Ni: 2.7	Cr: 2.50	
Typical weld deposit properties		
Yield stress	480 MPa	
Tensile strength	810 MPa	
Elongation	42%	

Typical weld deposit hardness	HRC	HV30
All weld metal deposit	17	220
Work hardened	52	540
Finishing recommendations	Machinable as deposited.	
Recommended shielding gas	Open arc or welding grade CO ₂	
1.6mm size can be used for vertical surfacing by depositing overlapping horizontal stringer passes.		

Packaging and operating data — DC electrode positive						
Dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out (mm)	Pack type	Pack weight (kg)	Part No.
1.6	150–220	22–26	15–25	Spool	15	11446700
2.8	200–375	25–28	20–35	Coil	27	11249900

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FCAW Wire

Stoody 101 HC G/O

1.2 and 1.6 mm

- High alloy, tubular hardfacing wire
- High chromium carbide iron deposit or ground engaging applications
- Resistant to severe abrasion and low to moderate impact loading
- Typical applications include the hard surfacing of crusher cones and mantles, swing hammers, earthmoving buckets, scarifier points and sugar harvesting and milling equipment

Classifications	1.2* mm	1.6† mm
AS/NZS 2576:	2360-B5	2360-B
W.T.I.A. Tech. Note 4:	2360-B5	2360-B7

*1.2 mm Stoody 101 HC-G is a B5 type wire which requires a shielding gas.

†1.6 mm Stoody 101 HC-O is a B7 type wire which requires no shielding gas

Typical weld metal deposit analysis (%)

Single layer on mild steel:

C: 4.0 Mn: 0.7 Si: 0.7 Cr: 14.0

All weld metal deposit:

C: 5.2 Mn: 0.7 Si: 0.7 Cr: 19.0

Typical weld deposit hardness

	HRC	HV30
Single layer on mild steel	55	600
All weld metal deposit	60	700

Single layer on mild steel

All weld metal deposit

Deposits contain chromium carbides with hardness up to 1,500 HV (80 HRc)

Finishing recommendations

Grinding only

Recommended shielding gas

1.2 mm Coarseclad-G

Stainshield®

1.6 mm Coarseclad-O

Open arc or Industrial grade CO₂

1.2 mm size is suitable for vertical-up surfacing using a wide weaving technique.

Packaging and operating data — DC electrode positive

Dia. (mm)	Current range (A)	Voltage (V)	Rec. stick-out ESO (mm)	Pack type	Pack weight (kg)	Part No.
1.2	150–200	22–26	12–20	Spool	15	11436300
1.6	200–260	24–28	15–25	Spool	15	11304700
1.6	200–260	24–28	15–25	Handi Spool	4.5	11945600

Stoody 100 HC-O

2.4 and 2.8 mm

- Self shielded (-O), tubular hardfacing wire
- High chromium carbide iron deposit or ground engaging applications
- Resistant to coarse abrasion and low to moderate impact loading
- Typical applications include hard surfacing of crusher cones and mantles, swing hammers, earthmoving buckets, blades and rippers

Classifications
AS/NZS 2576: 2360-B7
W.T.I.A. Tech. Note 4: 2360-B7

Typical weld metal deposit analysis (%)

Single layer on mild steel:

C: 4.2 Mn: 0.7 Si: 0.7 Cr: 20

All weld metal deposit:

C: 5.5 Mn: 1.0 Si: 0.9 Cr: 25

Typical weld deposit hardness

	HRC	HV30
Single layer on mild steel	55	600
All weld metal deposit	63	780

Single layer on mild steel

All weld metal deposit

Deposits contain chromium carbides with hardness up to 1,500 HV (80 HRc)

Finishing recommendations

Grinding only

Recommended shielding gas

Open arc or welding grade CO₂

Packaging and operating data — DC electrode positive

Dia. (mm)	Current range (A)	Voltage (V)	Rec. stick-out ESO (mm)	Pack type	Pack weight (kg)	Part No.
2.4	250–350	25–30	35–55	Coil	27	11313400
2.8	300–450	27–33	35–55	Coil	27	11001000

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Stoody Fineclad-O

- Self shielded (-O), tubular hardfacing wire
- Chromium iron carbides in a hard, martensitic matrix
- Resistant to fine, wet or dry abrasion
- Typical applications include the surfacing of sand chutes, dredge components, ripper shanks, screens, grizzly bars, scraper blades, and bucket teeth and lips etc

Classifications
AS/NZS 2576: 2565-B7
W.T.I.A. Tech. Note 4: 2565-B7

Typical weld deposit analysis (%)		
Single layer on mild steel:		
C: 3.5	Mn: 0.3	Si: 0.4
Cr: 14	B: 0.5	
All weld metal deposit:		
C: 4.8	Mn: 0.5	Si: 0.6
Cr: 20	B: 0.75	

Typical weld deposit hardness	HRC	HV30
Single layer on mild steel	62	750
All weld metal deposit	65	830
Deposits contain chromium carbides with hardness up to 1,500 HV (80 HRc)		

Finishing recommendations
Grinding only
Recommended shielding gas
Open arc or welding grade CO ₂
1.6 mm size can be used for vertical surfacing by depositing overlapping horizontal stringer passes

Packaging and operating data — DC electrode positive

Wire dia. (mm)	Current range (A)	Voltage (V)	Electrode stick-out (mm)	Pack type	Pack weight (kg)	Part No.
1.6	200–260	24–28	15–25	Spool	15	11945800
2.4	250–350	25–30	35–55	Coil	27	11945900

Stoody 104

(Replaces Cobalarc 104-SA)

- Submerged arc (-SA) tubular build-up wire.
- Tough, machinable, low carbon pearlitic steel deposit.
- Resistant to high compressive loading.
- For the unlimited build-up of worn steel components.

Classifications
AS/NZS 2576: 1125-B1.
W.T.I.A. Tech Note 4: 1125-B1.

Typical weld deposit analysis (%)				
C	Mn	Si	Cr	Fe
0.07	2.9	1.25	1.15	bal

Typical weld deposit hardness		
	HRC	HV30
All weld metal deposit	29	290

Finishing recommendations
Machinable.

Recommended flux
Stoody S

Deposit characteristics	
Abrasion resistance	Low
Impact resistance	Excellent
Compressive strength	Excellent
Hardness	29 HRc
Surface cross checks	No
Magnetic	Yes
Deposit Layers	Unlimited
Machinability	Yes

Comparable cigweld products
Stoody Build Up-O self shielded tubular wire AS/NZS 2576:1125-B7

Packaging and operating data — AC, DC electrode positive or negative

Wire dia. (mm)	Current Range (A)	Voltage Range (V)	Electrode Stick-out (ESO) mm	Pack Type	Weight (kg)	Part No.
3.2	350–400	26–30	25–35	Coil	27	11820300
3.2	350–400	26–30	25–35	Half Pack	90	11040900
3.2	350–400	26–30	25–35	Drum	226	11039500

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FCAW Wire

ChainLinc

A self shielded, flux cored electrode for rebuilding heavily worn components such as dragline chains. It is characterised by a soft, low penetrating arc and is suitable for semi-auto or auto welding. It produces a tough low alloy deposit.

Classifications		
AS 2576: 1125-B7 (metal-to-metal wear), 26-29 Rc. DIN 8555 Part 1: MF1-250		
Size (mm)	Weight (kg)	Part No.
2.8	25 Coil	032401

Lincore 36LS

A highly versatile wire for semi and fully automatic rebuilding of metal-to-metal wearing parts. For rebuilding drill rods, rail car wear surfaces, mining machinery, gears and pins.

Classifications		
AS 2576: 1440-B7. DIN 8555 Part 1: UP2-GF-880M-350 (with 880M flux)		
Size (mm)	Weight (kg)	Part No.
1.6	12.5 Spool	032510

Lincore 40-O

Open arc version of the above product, used in similar applications, in areas where submerged arc welding is not practical.

Classification	AS 2576: 1440-B7	
Size (mm)	Weight (kg)	Part No.
2.8	22.68 Coil	ED025908

Lincore 30-S

Extremely tough and forgeable deposit for rebuilding mild and alloy steels. For rebuilding idlers, crane and mine car wheels, build-up of steel rolls.

Classifications (with 802, 860 or 880 flux)		
AS 2576: 1130-B1. 29-31 Rc. DIN 8555 Part 1: UP1-GF-802/860/880-300		
Size (mm)	Weight (kg)	Part No.
3.2	22.68 Coil	032403
3.2	272.16 Speed feed drum	032413

Lincore 40-S

A long-lasting alloy steel that resists metal-to-metal and abrasive wear. For final overlay on tractor idlers, rollers and mine car wheels.

Classifications (with 802 or 880 flux)		
AS 2576: 1440-B1 (metal-to-metal wear) 38-41 Rc. DIN 8555 Part 1: UP2-GF-802/880-40		
Size (mm)	Weight (kg)	Part No.
3.2	22.68 Coil	ED015892

Lincore 50

Hardfacing protection of parts that must resist both abrasion and moderate impact. For crusher rolls and grinding equipment, agricultural points and digger teeth.

Classifications		
AS 2576: 2150-B7 (or 802 flux) 2155-B1 (with 880 flux)		
Size (mm)	Weight (kg)	Part No.
1.2	9.98 Readi reel	ED020826
1.6	9.98 Readi reel	ED020827
2.8	22.68 Coil	ED011275

Lincore 33

A hard wearing low alloy steel for rebuilding and hardfacing heavily worked machinery components. For rebuilding gears, idlers, pins, chains and trunnions.

Classifications		
AS 2576: 1130-B7. DIN 8555 Part 1: UP1-GF-880M-300 (with 880M flux)		
Size (mm)	Weight (kg)	Part No.
1.6	9.98 Readi reel	ED016872
2.0	6.35* Coil	ED011237
2.0	25 Coil	ED011238
2.8	25 Coil	ED011240
1.6	11.34 reel	ED031117

*4 per box

Lincore 42-S

Multi-layer weld deposit resistant to metal-to-metal wear. For final overlay on tractor idlers, rollers, shafts etc.

Classifications (with 802 or 880 flux)		
AS 2576: 1440-B1 (metal-to-metal wear)		
Size (mm)	Weight (kg)	Part No.
3.2	22.68 Coil	ED029159
3.2	136.2 Drum	ED029264

Lincore 55

An excellent general purpose deposit for protection against metal-to-metal and abrasive wear. For earthmoving equipment, high hardness gears, augers and agricultural tools.

Classifications		
AS 2576: 1855-B1. DIN 8555 Part 1: UP6-GF-880M-55 (with 880M flux)		
Size (mm)	Weight (kg)	Part No.
2.0	6.35 Coil	ED011277
2.0	22.68 Coil	ED031122
2.8	22.68 Coil	ED011280

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Lincore 60-O

High alloy, abrasion resistant deposit for crushing equipment, mixing paddles, ground engaging tools, hammers and augers.

Classifications

AS 2576: 2355-B7 (severe abrasion and moderate impact), 56-60 Rc. DIN 8555 Part 1 1983: MF10-60-RGNZ

Size (mm)	Weight (kg)	Part No.
1.2	9.98 Readi reel	ED031131
1.6	9.98 Readi reel	ED031132
2.0	22.68 Coil	ED019887

Lincore 65-O

Self-shielded, flux-cored wire that resists severe abrasion with light impact. Higher carbon and chrome deposits than Lincore 60-O. Use on wear plate, coal pulveriser rolls, earth engaging tools, and on slurry pipe and elbows.

Size (mm)	Weight (kg)	Part No.
2.8	22.68 Coil	ED026077
3.2	22.68 Coil	ED026076
2.8	226.8 Drum	ED026083

Lincore 15CrMn

Premium austenitic manganese steel for joining manganese steel to itself or dissimilar metals, or as a build-up prior to hardfacing with Lincore 50 or Lincore 60-O.

Classifications

AS 2576: 1720(b)-B7 (severe impact). Work hardens to 50 Rc DIN 8555 Part 1: MF8-250RKNP

Size (mm)	Weight (kg)	Part No.
2.0	11.34 Spool	ED031126
2.8	22.68 Coil	ED022061

Lincore M

Produces austenitic manganese steel deposit. For crusher cones, jaws and manganese rail points.

Classifications

AS 2576: 1220-B7 (severe impact). Work hardens to 50 Rc DIN 8555 Part 1: MF7-250KNP

Size (mm)	Weight (kg)	Part No.
2.0	11.34 Spool	ED031130
2.8	22.68 Coil	ED011164

Crushcore

Specifically designed for roller arcing on rotating sugar crushing rolls.

Classifications

AS 2576: 2155-B7 (impact and abrasion)* 54-58 Rc. DIN 8555 Part 1: MF10-55GRN

Size (mm)	Weight (kg)	Part No.
2.0	25 Coil	032601
2.8	25 Coil	032600

*Note: deposit carbon content may exceed classifications limits.

Lincore T and D

Hot tool steel deposit for rebuilding cutting tools, dies, blades and edges. Can be temper hardened to above 55 Rc.

Classifications

AS 2576: 1550-B7 (severe metal-to-metal wear) 52-55 Rc. DIN 8555 Part 1: MF3-50-T

Size (mm)	Weight (kg)	Part No.
1.6	11.34 Spool	ED031134

Submerged Arc Wire

Lincore 420

A high hardness, crack free 420 type stainless steel deposit that resists heat, corrosion and frictional wear. For steel mill rolls, cable sheaves and stainless steel cladding.

Classifications (with 802 or 880 flux)

AS2576 1650-B1 (multi-purpose hardfacing)
48-51 Rc. DIN8555 Part 1 1983: UP5-
GF802/880 50-CR

Size (mm)	Weight (kg)	Part No.
3.2	22.68 Coil	032505
3.2	230 Drum	032523

Lincore 423Cr

A high chromium wire giving excellent corrosion resistance. Also resists softening while tempering due to alloying with vanadium and molybdenum. For steel mill castor rolls and other applications where low coefficients of friction are required.

Classifications (with 802 flux)

AS2576 1640-B1 (metal-to-metal wear)
41-45 Rc. DIN8555 Part 1-1983:
UP5-GF-802-40-CR

Size (mm)	Weight (kg)	Part No.
2.4	22.68 Coil	ED018553

Lincore 424A

Metal-cored wire with higher nickel content than 41NiMo alloy. Flux recommendation is 801 / 880.

Size (mm)	Weight (kg)	Part No.
3.2	22.68 Coil	ED018560

Lincore 96S

A martensitic 420 type of stainless steel deposit that resists heat corrosion and metal-to-metal wear. For steel with rolls, cable sheaves and stainless steel cladding.

Classification (with 802 or 880 flux)

AS2576 4650-B1: 51-53HRC

Size (mm)	Weight (kg)	Part No.
3.2	22.68 Coil	032507
3.2	230 Drum	032522

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Unalloyed Submerged Arc Flux

802

A neutral flux designed for use with solid stainless steel electrodes and some Lincore build-up and 400 series martensitic stainless steel hardfacing wires.

Classification	AS1858.1 FBL	
Weight (kg)		Part No.
40	Bag	KC802040

880

A neutral flux that may be used with some hardfacing and build-up wires.

Classification	AS1858.1 FBL	
Weight (kg)		Part No.
45	Bag	KC880045
260	Drum	KC880260

801

A neutral flux that may be used with some hardfacing and build-up wires.

Weight (kg)		Part No.
45	Bag	KC80104

Alloyed Submerged Arc Flux

H535

Versatile hardfacing flux for abrasive wear resistance that still allows for some machinability. Can also be used for build-up. Applications include steel mill rolls, crane wheels, idlers and tractor rollers.

Classification (with L-60 wire)		
AS2576 1435-B4 (metal-to-metal wear) 25-45 Rc. DIN 8555 Part 1: UP1-GZ-H535-350		
Weight (kg)		Part No.
45	Bag	KC535045

QR8045

Low alloy flux for semi-automatic or automatic submerged arc surfacing with L-50 or L-60 wire. Applications include rebuilding and hardsurfacing worn low alloy and carbon steel wheels, rolls, rails and other components where metal-to-metal friction is the major cause of wear.

Classification (with L-50 wire)		
AS2576 1440-B4 (metal to metal wear) DIN 8555 Part 1:UP1-GZ-QR8045-40		
Classification (with L-60 wire)		
AS2576 1125-B4 (metal-to-metal wear) 28-30 Rc. DIN 8555 Part 1: UP1-GZ-QR8045-300		
Weight (kg)		Part No.
50	Bag	KCQR8045050

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

Submerged Arc Flux

Stoody 'S' Flux

Stoody 'S' Flux is an active fused flux designed for use with Stoody Submerged Arc Welding Wires (other than the ThermaClad® wire).

As the deposit composition is significantly altered from the wire composition, care should be exercised in the matching of this flux to the right wire.

Weight (kg)		Part No.
22	Bag	11008400

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