Hot Metal Spray Powders

POWDER SPRAYING

The powder welding process basically uses a simple oxy-acetylene torch where finely divided powder is fed into the flame from a hopper attached to the torch. The powder melts to give a dense coating and forms a strong bond with the base material by surface alloying and diffusion. Fluxing elements such as boron and silicon are necessary in the powders for good metallurgical bond. This process is typically used for deposits having thickness between 0.2-12 mm, in particular for smaller parts or repairs. The process is applicable only in iron-base, nickel-base or copper-base material.

Hot metal powder alloys are mostly nickel-based. Nickel when added with boron gives hardness due to formation of borides. The percentage of boron can be monitored to achieve a particular hardness range. Boron also brings down the melting point of nickel and helps the powder to fuse much below melting point of steel. For enhanced protection against wear and increased corrosion resistance, silicon along with other special alloys is added. Some cobalt-based powders are also available but are not as costeffective as nickel-based powders. Tungsten carbide is added to a nickel boride matrix to combat highpressure abrasion.

The flow of powder and spreading on base metal depends primarily on two characteristics: Powder particle shape and size. The mesh size determines the acceptability of the powder to be used by hot metal spray process. Usual range is between 15-160 microns. The shape of powder is very important for the welder as it solely determines the ease of flow of the powder through the nozzle of hot spray gun. The powder shape is dependent on the method of manufacture of the powders. Gas atomized powder have spherical particles resulting in a smooth flow through the nozzle and higher deposition rate. Ground powders have irregular shape and the flow characteristics are poor.

Advantages of powder spray:

- Thin layer can be given with hardness upto 65 HRC (upto 0.15 mm thickness).
- Coating is uniform; hardly any post-machining required.
- No heat treatment is required.
- Self-fluxing: no slag cleaning required.
- For machine parts, life obtained is much higher.

The limitations are:

- Not economic for thicker build-up on big jobs.
- Not applicable for aluminium, magnesium components.
- For big jobs furnace preheating and melting is required.

CAST COAT 20

Buffer for coating on cast irons and machinable build-up on steels

Cast Coat 20 extends the benefit of powder coating to cast irons. It has excellent machinability and can be used for original or worn out components. For higher hardness requirements, it can be used as buffer layer to be coated by harder alloy grades. This Cast Coat technology saves castings from being scraped and abraded. The wettability and fluidity adds to the advantage of being used for brazing and joining. The inertness of the base alloy can be utilized with much success to counter corrosion and oxidation related problems in the industry.

The powder can also be used as a superbly machinable build-up and buffer layer on steels for subsequent coating by harder powders or welded alloy deposits.

ALLOY BASE: Ni, B, Si, Fe

SPECIAL FEATURES

- Machinable deposit.
- Good resistance to corrosion and oxidation.
- Allowable build-up: 20 mm.
- Coverage for a 1 mm thick layer: 650 cm^2/500 gms.

APPLICATIONS

This powder is used for casting defect repairs, brazing and joining cast iron components, building up funnels or moulds in the glass industry, cast iron cylinder heads, engine blocks, housings, manifolds, and vessels handling acetic acid.

PROPERTIES

Hardness	: 20-22 HRC
Melting Point	: 1100°C

MULTI WELD 40

Good resistance to impact and corrosion

Multi Weld 40 allows reclamation of steel components which otherwise would have gone to the scrap yard as no other powder alloy has the fluidity and build-up capacity along with optimum properties for service.

It is the only powder with machinability along with wear resistance. The versatility and dependability of the alloy makes it an indispensable powder for all maintenance departments in different industries.

ALLOY BASE: Ni, B, Si, Fe

SPECIAL FEATURES .

- Machinable deposit.
- Good resistance to friction, corrosion and impact.
- Allowable build-up: 10 mm.
- Coverage for a 1 mm thick layer: 650 cm^2/500 gms.

APPLICATIONS

This powder is used for making hard deposit on gears and splines, cams and crankshafts, bearing surfaces, plungers and neckrings, automobile parts, railroad wheel burns, glass moulds, valve gates, sprockets and pistons, gauges, machine components.

PROPERTIES

Hardness	: As-welded	: 40-44 HRC
	At 500°C	: 36-38 HRC
Melting Point		: 1100°C

BOROSTRENGTH 60

Enhanced protection against abrasion and corrosion

BoroStrength 60 offers enhanced protection against friction, abrasion and corrosion for all machine components. Additionally, BoroStrength takes polish and resists oxidation at elevated temperature. The characteristic to produce very thin overlays obviates the necessity of machining later. The low coefficient of friction ensures simultaneous protection of matching parts if it is used in any such application.

ALLOY BASE: Ni, B, C, Cr, Fe

SPECIAL FEATURES

- Nil wear for metal-to-metal friction.
- Excellent resistance to acidic/alkaline corrosion and oxidation.
- Non-machinable deposit - can only be ground by silicon carbide or diamond wheel.
- Allowable build-up: 1.5 mm.
- Coverage for a 1 mm thick layer: 470 cm^2/500 gms.

APPLICATIONS

This spray powder is used for making hard deposits on components like cams and indexing heads, turbine blades, pump shafts, extruder screws, seal rings, rocker arms, fan blades and liners, timber cutting blades, bushings, brick dies, mandrels.

PROPERTIES

Hardness	: As-welded	: 60-62 HRC
	At 500°C	: 50-52 HRC
Melting Point		: 1100°C

TUNGSTRENGTH 70

Ultimate abrasion protection technology

A protective coating by TungStrength 70 can effectively enhance component life and reduce spares inventory holding. As it retains its hardness upto 450°C, it can solve regular abrasion problems faced by maintenance engineers. TungStrength 70 exhibits a slag free deposit and better surface coverage. The composite alloy system based on tungsten carbide ensures better microstructural properties and ease of bonding with any ferrous and nickel based material.

ALLOY BASE: Ni, B, W, C, Cr, Si, Fe

SPECIAL FEATURES

- Optimum matrix-carbide ratio prevents distortion during spraying.
- Economic repair in case of chronic abrasion related jobs.
- Non-machinable deposit - can only be ground by silicon carbide or diamond wheel. · Allowable build-up: 1.2 mm.
- Coverage for a 1 mm thick layer: 460 cm^2/500 gms.

APPLICATIONS

TungStrength 70 provides a hard deposit for prolonged life on machine parts viz. shear blades, die frames, wire drawing rolls, pulleys & capstans, wear rings, crusher teeth, guide rolls, conveyors, chains, mixer blades and paddles.

PROPERTIES

Hardness	: As-welded	: 62-64 HRC
	Retained upto	: 450^{O}C
Melting Point		: 1100°C

ESAB WEAR PLATES

ESAB wear plates are composite plates having a highly alloyed wear resistant surfacing on a low carbon steel base. These plates are manufactured by customized automatic hardfacing process resulting in a hard, tough and highly wear resistant surface. The mild steel base makes the plates amenable to easy forming, welding or bolting to the component surfaces. The superiority of the ESAB range of wear plates is a result of strict scientific and metallurgical control of all the stages of the production process backed up by the technical know-how of ESAB in welding consumables.

Advantages of using ESAB wear plates

1. Ease in fabrication of components viz. pipes, ducts, chutes, etc.
2. Ease of welding to carbon steel structures.
3. Available in cut shapes as per the drawing provided by the customer - No additional cutting operation involved
4. High concentration of carbides - excellent resistance to wear factors like abrasion, friction, erosion, impact, oxidation
5. Tough matrix ensures proper anchorage of the carbide particles
6. Very small heat - affected zone ensures minimum metallurgical degradation

Applications in Industry Sectors

Power	Wagon tippler, Burner nozzle, Ventury outlet, nozzle chutes, primary and secondary crushes, coal pipes, bunkers, apron feeders, mill vane wheel segments, boiler flue gas ducts, ash pipelines, screw conveyors.
Cement	DPC chute, Cage mill, ID fan blades, chutes, coal pipes, crushers, earth moving equipment, Y-ducts, clinker chutes, cyclones.
Steel	Sinter screen decks, Coke screen, Sinter fan, BLT hot discharge chutes, downcomer pipes, burden lines, rapper rolls, Sinter hammer, Grizzle bar.
Mining	Excavator bucket, Chute liners, shovel buckets, dragline buckets dumper bodies, dozer blades, crusher parts, apron feeders, conveyor systems, Crushing liners.

Type	Item Description	Alloy base	Hardness (HRC)	Applications
Chrome - C	Complex carbides in a tough matrix for resistance to severe abrasion and moderate impact loads	C, Cr, Mn, Mo	58-60 HRC	Crusher parts, bucket lips, conveyor screws
Micro - C	Dense micro carbides in a hard martensitic matrix resisting severe coarse and fine particles abrasion.	C, Mn, Cr, Mo, Ti	58-64 HRC	Mixer blades, scrapers, mill parts, pipes
Therm - C	High temperature carbides in an austenitic matrix to resist complex wear at elevated temperatures. Retains hardness upto 800^{O}C.	C, Cr, Mn, Mo, Nb, V	62 - 64 HRC	Sinter plant parts, chutes, boiler flue gas ducts
Esab Hard HT 4	Wear Plate is a quality, quenched and tempered plate designed for abrasion resistance and impact. This plate can be used for all material handling equipment.	C, Cr, Mn, Si, Mo, B	-380-440 BHN	Bodies, buckets & cuting edges, wear parts of mining machines, concrete mixing plants feeders & funnels, cutting edges wearing parts of concrete mixing plants feeders & funnels, cutting edges
Esab STH plate	Esab STH plates, by virtue of their superior manufacturing Process and metallurgy, have proved their excellence in the cut-throat world of abrasion, erosion, heat & corrosion. Compare to any stainless steel Esab STH plates exhibit high life factor. When overlaid plates, have sticking problem of material causes slow down in production ESAB STH plates exhibits higher Productivity factor.	C, Cr, Ni alloy	-450-480 BHN (Micro-hardness)	Screen Duct Liner Pipe wear plate
Esab Sinter MN	ESAB Sinter Mn wear plate is an Extremely high impact moderate abrasion resistant plate designed to sustain complex wear of impact & abrasion. Easily weld able metal which is Difficult to bend	C, Mn, Cr, Si, P	400 BHN-500 BHN (work hardened)	Hammer, Liners guide, Jaws crusher liners

CONVERSION CHART

	To Convert from	To	Multiply by
Mass	kg	lb	2.205
	metric tonne	ton	1.102
Force	N	kgf	0.102
		lbf	224.8
Stress	MPa	kgf/mm2	0.102
		ksi	0.145
	kgf/mm2	psi	1421.57
	bar	Pa	1 x 10^5
		atm	0.987
Energy	J	ft-lb	0.7376
		kg-m	0.102
Velocity	mm/sec	in/min	2.362
		m/hr	3.6
Flow rate	lit/min	cu.ft/hr	2.119
		cu.m/hr	0.06
Length	mm	in	0.039

Temperature F = C x 1.8 + 32

°C = (F-32)/1.8

PROPERTIES OF COMMON METALS

All the given values are correct for these elements in their pure form

Name	Symbol	Melting Point (°C)	Sp. Gravity
Aluminium	Al	658	2.58
Boron	B	2300	2.5
Cadmium	Cd	320	8.64
Chromium	Cr	1510	6.5
Cobalt	Co	1490	8.6
Copper	Cu	1083	8.9
Iron	Fe	1525	7.86
Manganese	Mn	1220	7.39
Nickel	Ni	1452	8.9
Niobium	Nb	1950	8.4
Silicon	Si	1370	2.0-2.4
Silver	Ag	960	10.5
Tin	Sn	232	7.3
Titanium	Ti	1850	4.54
Tungsten	W	3000	19.1
Vanadium	V	1710	5.5
Zinc	Zn	418	7.12

COMPARATIVE HARDNESS SCALES

This chart is given as an indicative guide

Vickers	Brinell	Rockwell	
VHN	BHN	HRB	HRC
80	76.0		
85	80.7	41.0	
90	85.5	48.0	
95	90.2	52.0	
100	95.0	56.2	
105	99.8		
110	105	62.3	
115	109		
120	114	66.7	
125	119		
130	124	71.2	
135	128		
140	133	75.0	
145	138		
150	143	78.7	
155	147		
160	152	81.7	
165	156		
170	162	85.0	
175	166		
180	171	87.1	
185	176		
190	181	89.5	
195	185		
200	190	91.5	
205	195	92.5	
210	199	93.5	
215	204	94.0	
220	209	95.0	
225	214	96.0	
230	219	96.7	
235	223		
240	228	98.1	20.3
245	233		21.3
250	238	99.5	22.2
255	242		23.1
260	247	(101)	24.0
265	252		24.8
270	257	(102)	25.6
275	261		26.4
280	266	(104)	27.1
285	271		27.8
290	276	(105)	28.5
295	280		29.2
300	285		29.8
310	295		31.0
320	304		32.2
330	314		33.3
340	323		34.4
350	333		35.5

Vickers	Brinell	Rockwell
VHN	BHN	HRC
360	342	36.6
370	352	37.7
380	361	38.8
390	371	39.9
400	380	40.8
410	390	41.8
420	399	42.7
430	409	43.6
440	418	44.5
450	428	45.3
460	437	46.1
470	447	46.9
480	(456)	47.7
490	(466)	48.4
500	(475)	49.1
510	(485)	49.8
520	(494)	50.5
530	(504)	51.1
540	(513)	51.7
550	(523)	52.3
560	(532)	53.0
570	(542)	53.6
580	(551)	54.1
590	(561)	54.7
600	(570)	55.2
610	(580)	55.7
620	(589)	56.3
630	(599)	56.8
640	(608)	57.3
650	(618)	57.8
660		58.3
670		58.8
680		59.2
690		59.7
700		60.1
720		61.0
740		61.8
760		62.5
780		63.3
800		64.0
820		64.7
840		65.3
860		65.9
880		66.4
900		67.0
920		67.5
940		68.0