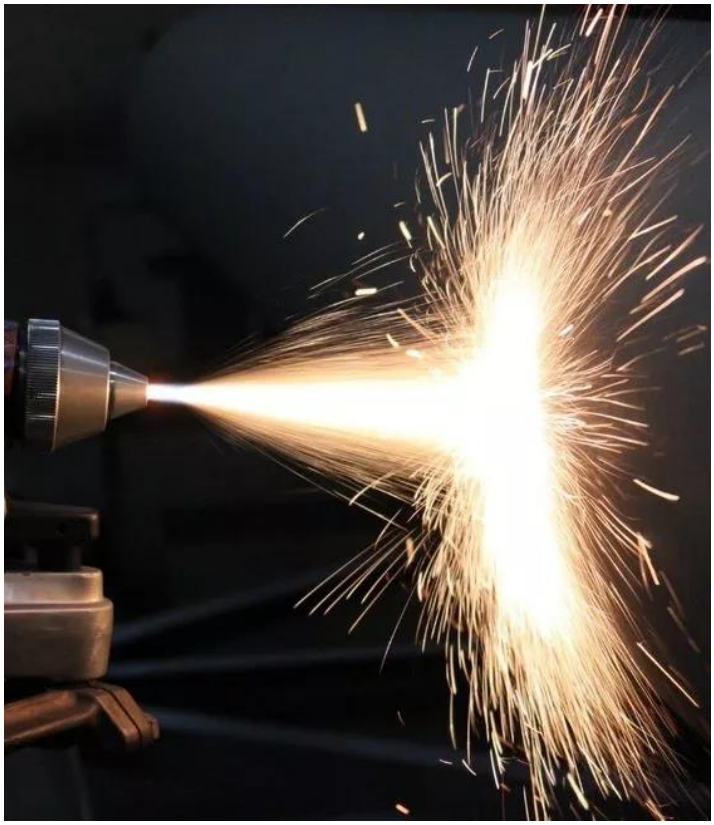
Who am I?

Atef Badr

Mechanical Engineer, with a specialization in the field of metals welding repairs and application of techniques to combat metals wear and failure.

What is Metal Spray Coating?

- Metal spray coating, is a technique used to improve or restore the surface properties of a material. by increasing resistance to wear, corrosion, and heat.

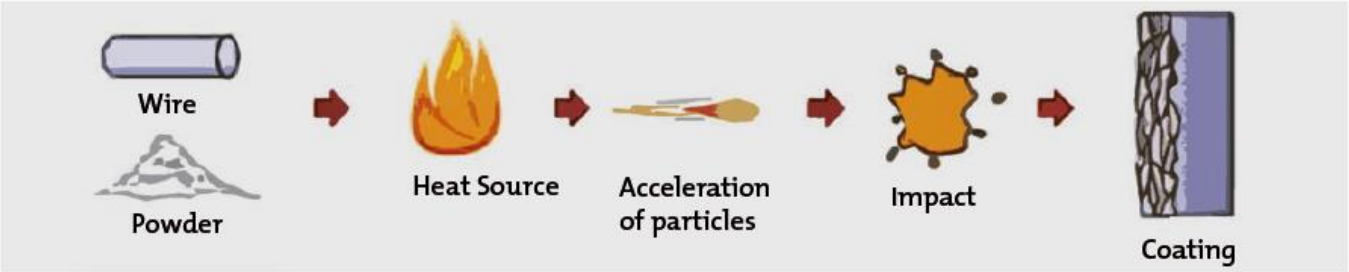


Global Market Value

- Market size was valued at USD 10.25 Billion in 2022.
- Projected to reach USD 17.1 Billion by 2031.
- Growing at a CAGR of 7.12% during the forecast period (2023-2031).

According to a new report by
IMIR Market Research

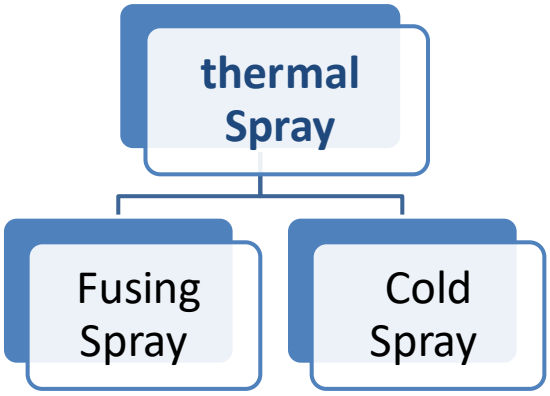
How is it works?

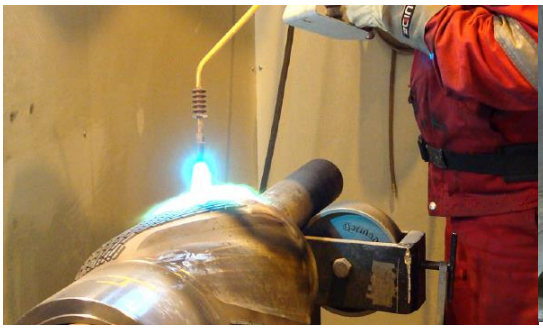


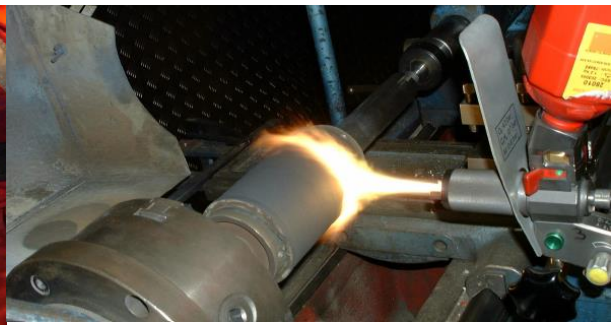
- It's coating process consisting of a heat source and a coating material melted into droplets that are sprayed at a high velocity.
- The coating material can be a powder, or wire.
- The coating material heated to a molten or semi-molten state and accelerated towards substrates in the form of micrometer-size particles.

Techniques Are Used

- Thermal flam Spray.
- Arc Spray.
- Plasma Transferred Arc.
- High Velocity Oxygen Fuel (HVOF).







Thermal Fusing Spray

- The powder is introduced into the torch flame and sprayed in a semi-molten state onto the preheated part, for fusion.
- Bonding is achieved by diffusion of the alloys into the base metal.

Thermal cold Spray

- The spraying material undergoes neither fusion nor melting during the procedure.
- These «cold» processes mean that the part should not exceed about 150°C during coating
- The flame heats the Ceramic powder particles and propels the droplets towards the substrate forming a dense coating with good bonding properties.

Product Type	Applications	Properties
Self-fluxing, nickel base alloy	Repair of mould damage on the seams or edges. Easy to machine or file.	~ 240 HV30 (~18 HRC) Grain size -106 µm. Low energy input for the fusion. Spot repairs.
Self-fluxing, nickel base alloy	Repair or protection of mould components: seams, blow heads, guide rings.	~ 270 HV30 (~22 HRC) Grain size -106 µm. Low energy input for the fusion. Small to medium repairs.
Self-fluxing, nickel base alloy	Brazing of tungsten carbides on stabilizers.Extensive repairs and preventive coatings on seams, edges and guides.	~26 HRC (~300 HV30) Grain size -106 µm. Low energy input for the fusion. Fast deposition.
Self-fluxing, nickel base alloy with addition of Cr and Mo	Fast repairs and extensive preventive coatings on mould edges and guides.	~31 HRC Grain size -106 µm. Low energy input for the fusion. Good wetting properties and fast.
Self-fluxing, nickel base alloy with addition of Cr and Mo	Extensive repairs and preventive coatings on neck rings or blow head.	~35 HRC Grain size -106 µm. Low energy input for the fusion. Enhanced fluidity and fast.
Self-fluxing, nickel base alloy with addition of Cr and Mo	Enhanced weldability at high hardness level on bottom plates, baffles and guide plates.	~40 HRC Grain size -106 µm. Low energy input for the fusion. Fast deposition with enhanced fluidity.

Alloy Ni-Cr-B-Si-Fe	Resurfacing cams, pushers, stops, guide wheels, filterpress cake stone remover for sugar mill, decanting screw, steam gate components. Coating elements subject to friction.	~63 HRC Low friction coefficient. Good resistance to corrosion, erosion and abrasion under light load.
Ni-Cr-B-Si-Fe alloy and tungsten carbide	Coating elements of chains, transport screw, wiper segments, brick die frames, claw excavators, rock drill, brush cutter rake, debarking knives	~65 HRC 80% tungsten carbides. Excellent resistance to abrasion by fine to coarse sized abrasives.
Ni-Cr-B-Si-Fe alloy and tungsten carbide	Coating of machine parts used in the transport, handling and processing of minerals: transport screws, clay mixers, dies, segments, wipers, turbine impeller, fan impeller, pump screw, etc.	~64 HRC 60% tungsten carbides. Excellent resistance to erosion and abrasion by fine to coarse sized abrasives.
Alloy Ni-B-Si	Coating of cast iron and steel molds for plastic material and glass. Recoating shafts, eccentrics, bearings Soldering tungsten carbide biscuits on drilling stabilizers, etc.	~390 HV30 Well suited for metal-to-metal friction. Excellent corrosion resistance. Machinable with cutting tool.
Alloy Ni-B-Si	Repairing glass mold edges, gear teeth, exhaust manifolds, pump bodies, brakes on drawing tools. Bonding layer before welding with electrode on cast iron that is difficult to weld, etc.	~250 HV30 Appropriate for new or worn cast iron. Good resistance to corrosion. Machinable with cutting tool.
Co-Ni-Cr-B-Si alloy and tungsten carbide	Resurfacing chemical transport screws, fan blades at cement works, augers, and extrusion screws. Blades and segments of mixers, etc.	~55 HRC 50% tungsten carbides. Excellent resistance to abrasion under pressure and to corrosion.
Alloy Ni-B-Si	Repair of gears, cast iron valve seats, molds, keyways, bearing seating. Renewing drawing tools. Correction of machining errors, etc.	~240 HV30 Good resistance to shocks and oxidation while hot. Machinable with cutting tool.

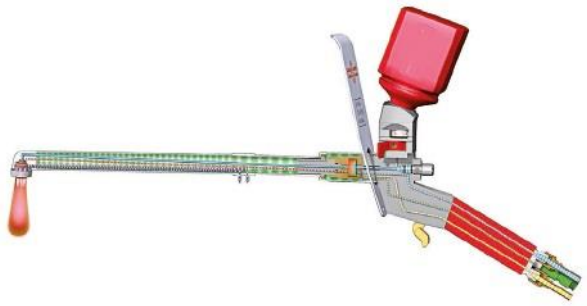
Advantages

Metallurgical bonding with no dilution
A: Deposit , B: Diffusion zone, C: Base metal

Thicker coatings capabilities

Homogeneous and pore free coatings

Advantages



Internal Lance is the solution where access is a problem.

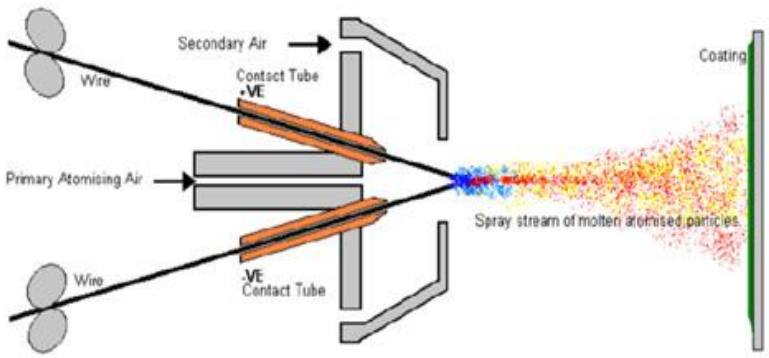
Portable equipment

Techniques Are Used

- Thermal flam Spray.
- **Arc Spray.**
- Plasma Transferred Arc.
- High Velocity Oxygen Fuel (HVOF).

Arc Spray

Involves two consumable metal wires that are fed into an arc gun. When the wires meet, an electric arc melts the material, and compressed air sprays the molten material onto the surface.



Product Type	Applications	Properties
Alloy Fe-Cr-Ti-Si-Mn	Cement cooler plates, boiler water wall protection, pulp production digesters, steam turbine casings, cracking installations, high temperature cyclone, fume extractors etc.	Hardness ~860 HV0.3 Self bonding alloy with enhanced surface wear resistance properties to combat erosion, thermal shock up to 650°C.
Alloy Fe-Cr-Al-Mo	Corrosion and erosion resistant protective coatings in boiler equipment up to 900°C.	Hardness ~260 HV0.3 Self bonding alloy with enhanced surface wear resistance properties to combat corrosion, erosion up to 900°C and oxidation.
Alloy Fe-Cr-Mn-C	Alternative to 13%Cr-steel. Hard chrome replacement on hydraulic pistons. Wear resistant layers for rollers in paper machines, bearing- and sealing seats.	Hardness ~640 HV0.3 Self bonding alloy with enhanced surface wear resistance properties to combat metal-to-metal friction, corrosion and oxidation.
Alloy Fe-Ni-Cr-Si-Mn	Worn general engineering components, undersize external or internal diameters, bearing seats and faces, housings, shrink or force fit areas, flat surfaces etc. Hot gas corrosion protective coatings in heat exchangers, process piping, etc.	Hardness ~230 HV0.3 Self bonding alloy for thick or thin coatings with good corrosion resistance. Easy machinabillity, like machining solid mild steel.
Alloy Fe-Cr-B-Si-Mn-C	Exhaust fans, pump components, coal-fired boilers, super-heaters, economiser waterwalls, boiler tubes, boiler installations, lamella seals and «Füller» cooler plates in cement works etc.	Hardness ~965 HV0.3 Self bonding alloy with enhanced surface wear resistance properties to slurry erosion, corrosion and low stress abrasion. Withstands service environment up to 925°C.

Applications of arc sprayed coatings

- Large structures, e.g. bridges, lamp posts and offshore structures, which are given corrosion protecting zinc and aluminum coatings.

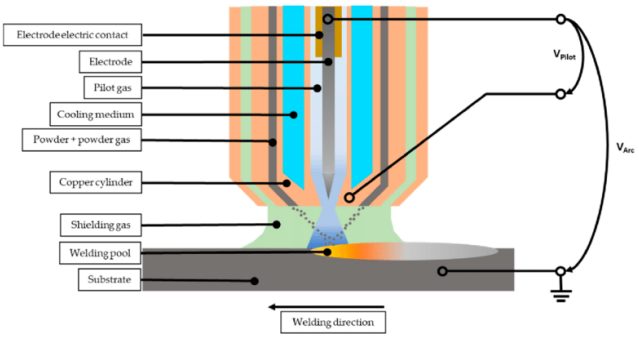
- Rebuilding of machines components (journals, bearings, shafts, exhaust systems).

Techniques Are Used

- Thermal flam Spray.
- Arc Spray.
- **Plasma Transferred Arc PTA.**
- High Velocity Oxygen Fuel (HVOF).

Plasma Transferred Arc PTA.

- Plasma is focused while forced through the heat resistant anode, causing a considerable increase of the arc density, energy and temperature.
- The filler alloy in powder form is conveyed into the plasma arc column where a shielding gas protects the weld pool from the atmosphere.



Applications of Plasma Transferred Arc PTA.

Techniques Are Used

- Thermal flam Spray.
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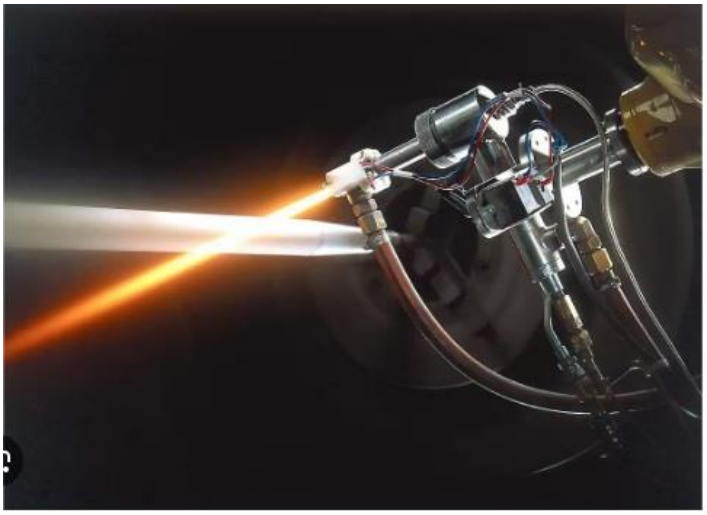
- **High Velocity Oxygen Fuel (HVOF).**



High Velocity Oxygen Fuel (HVOF).

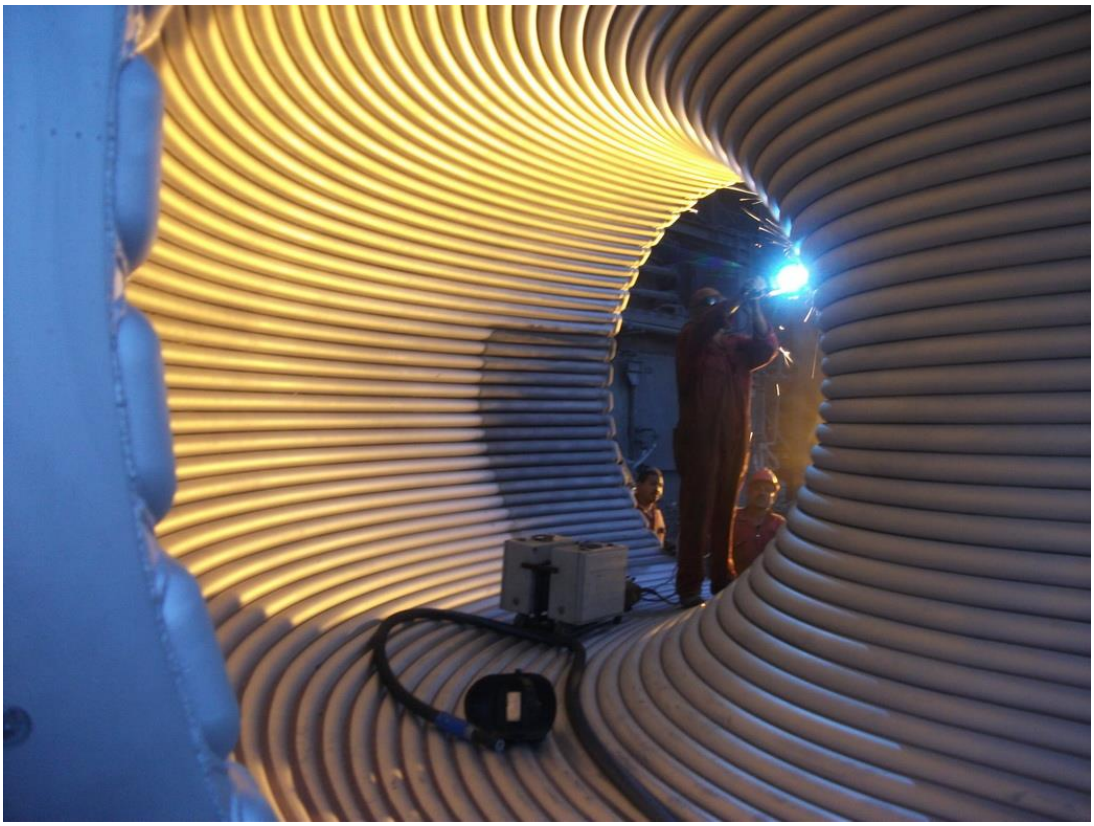
- Uses a high-speed flame to melt the coating material and a supersonic nozzle to spray it onto the substrate. HVOF coatings are extremely dense and strong, making them ideal for applications requiring high wear resistance.
- HVOF can produce coatings with very low porosity (less than 1%), and thicknesses that can range from 20 microns to several millimeters

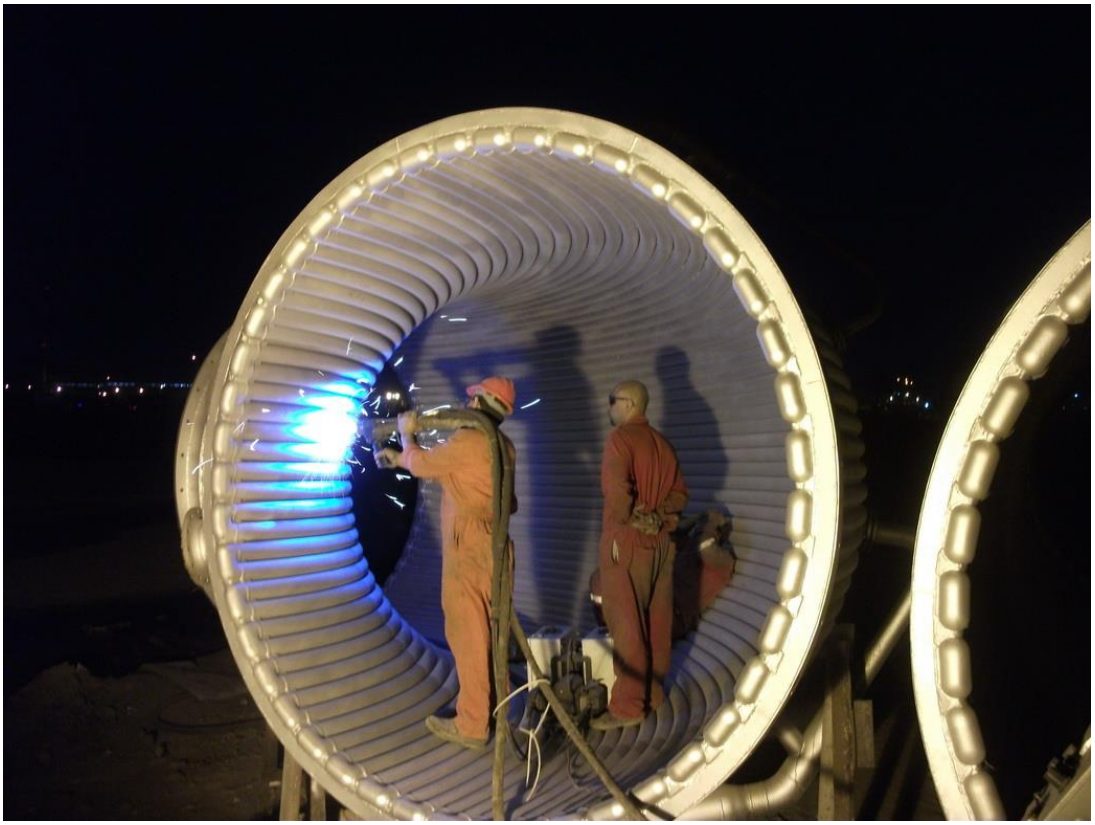
Case Study

Protection coating for Cooling Duct of Steel plant


SUPREME
GARNET
GRADE
12-25
28-40
30-60
20-60
80
NET WT : 25 KGS.
PRODUCT OF INDUSTRIAL MINERAL CO.,
INDIA ISO 9001 : 2008

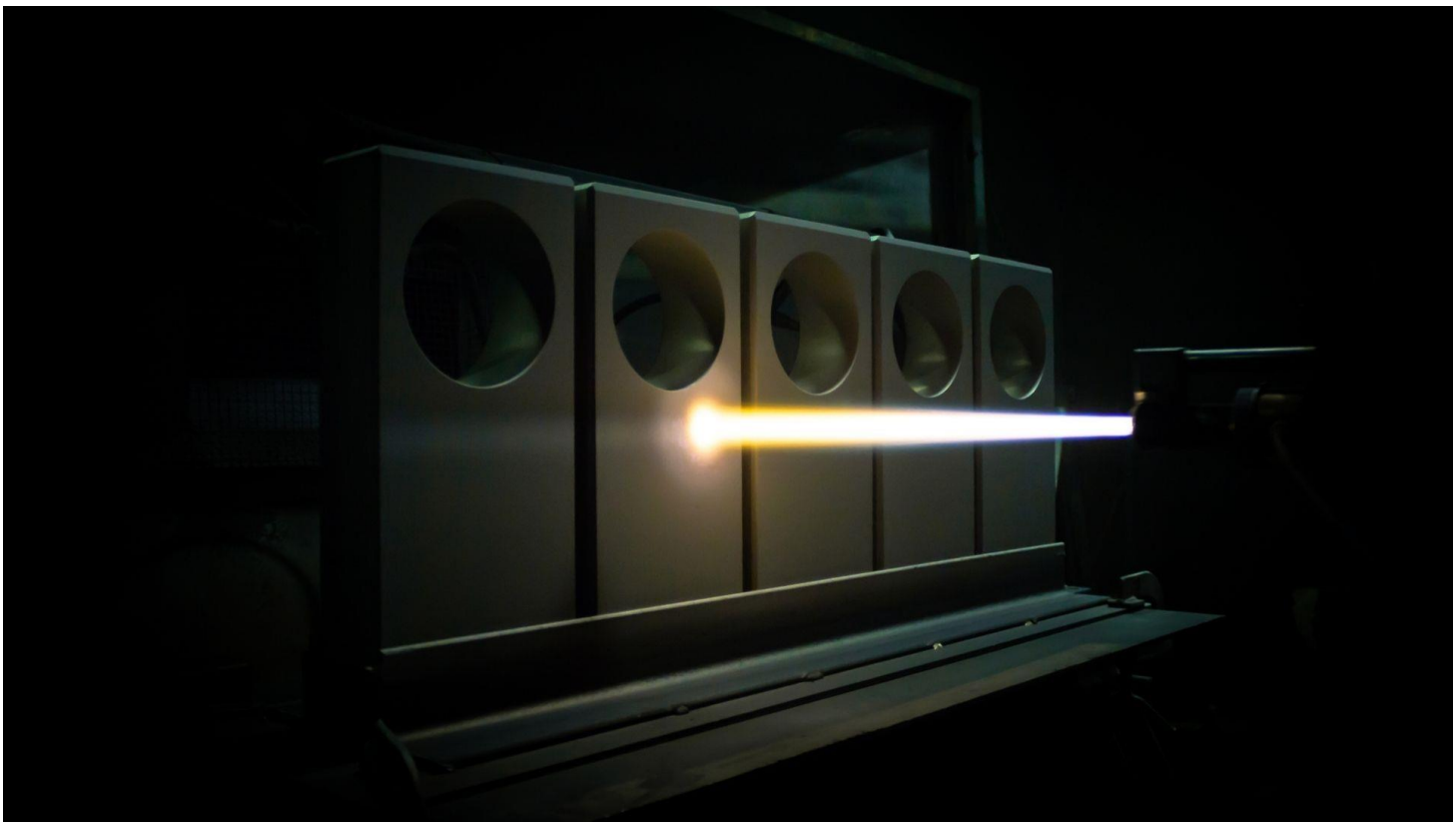
EuTronic® Arc 595 **206118** Arc 595 1.6mm 15kg	Alloy Fe-Cr-B-Si-Mn-C	Exhaust fans, pump components, coal-fired boilers, super-heaters, economiser waterwalls, boiler tubes, boiler installations, lamella seals and «Füller» cooler plates in cement works etc.	Hardness ~965 HV0.3 Self bonding alloy with enhanced surface wear resistance properties to slurry erosion, corrosion and low stress abrasion. Withstands service environment up to 925°C.

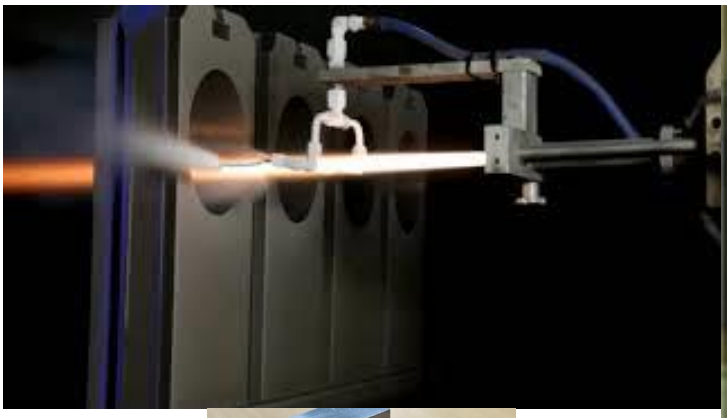




Positive Feedback from the Client After 3 times of original life time

HVOF coating for Gate Valve





DRILLING STABILIZERS

With Powder Welded Tungsten Carbide Inserts

Base Metal:

The base metal used in this is a AISI 4140 or 4145 and attention should be drawn to the procedure for pre heating, as well as maintaining the inter-pass temperature between 250-300^{0}C

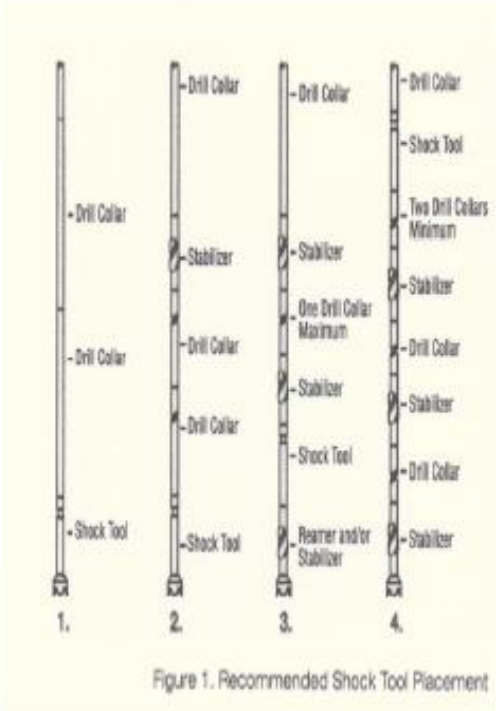


Figure 1. Recommended Shock Tool Placement

1. Carry out pre check on sizes, angles cast numbers and serial numbers as laid out on job card and drawing.

   If previously coated remove all previous coating and then grind clean and sound and carry out NDT.

   Then pre heat to 250°C using a bore heater or electric furnace with thermocouples allows the heat to soak depending on size of stabilizer.

2. Once the tool is at temperature of 250°C set it up in the welding bay with fitted with electro thermal bore heaters, insert the bore heater into the stabilizer and attach thermocouples to monitor the temperature. Additional heat can be supplied by oxy acetylene torch if required; temperature should be kept between 250°C and 300°C.

   The blades should be lightly sanded ensure that this is done lightly so that no abrasive bonding material is smeared on the surface. And ensure no sharp edges remain then pre spray powder PE8980 or LT 8726 covering the whole blade, this first layer can then be fused using a multi orifice torch, then pre spray again.

4. Then arrange the inserts in a brick pattern on masking tape with spacing as laid out in the drawings, normally a 3mm brazing rod works as a good spacer the coated side should be left clear and uncoated side attached to masking tape. Normally you should work in 100mm lengths at a time.

5. Close up of brick pattern laid out on masking tape, inserts can vary in size depending on specifications given in drawing. Or type of stabilizer working environment etc.

6. The 100mm section is then inverted onto the blade of the stabilizer with the powder coated blade and powder coated inserts in contact. It is gently pressed in place and left to allow the heat from the blade to soak through the insert.

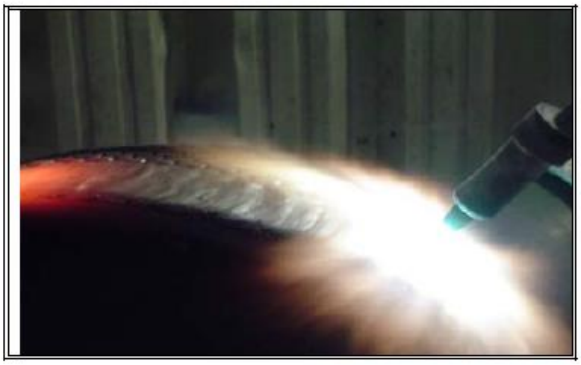
7. Once the heat soaks through the inserts will show brown on masking tape and it can then be gently peeled off. Leaving inserts in brick formation.

8. The inserts are then coated in position with a pre spray of powder to keep them in place, care should be taken not to get too close with the Eutalloy SuperJet S Kooltip torch and move them during this stage. If any inserts move or come out a new insert can be put in place with tweezers and then gently tapped so it holds, then coat over it. This technique is used on leading edges or areas where it is difficult to use the standard method.

9. A close up of the pre sprayed inserts as you can see they are completely coated and this will ensure they do not move when we start to fill in the next stage.

10. The powder between the blade and the inserts is then fused and as it fuses more powder is added to fill between the inserts. It is very important that the inserts are fully bonded before adding filling as this could cause failure in service if full bonding has not been achieved

11. A close up of the filling operation, most operators prefer to work in strips of approximately 50mm when filling and in a circular motion as this prevents the inserts from overheating, particularly along the edges where extra care should be taken



12. Finished blade with all the inserts fully bonded and covered. On completion of all the blades wrap in a heat resistant thermal blanket or cover with vermiculite and allow to cool slowly.

13. When the Stabilizer has reached ambient temperature it can then be ground to size using a cylindrical grinding machine with a suitable stone.

Any Questions?

Contact me