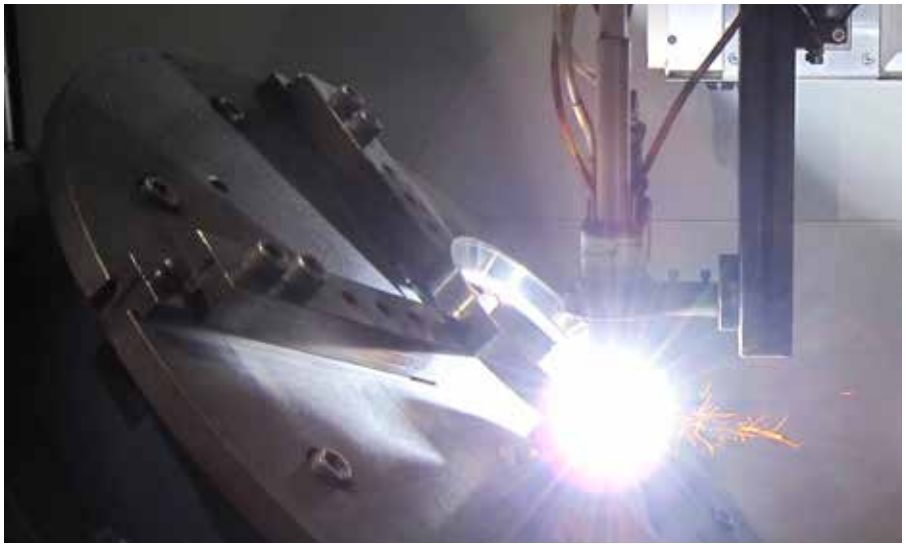
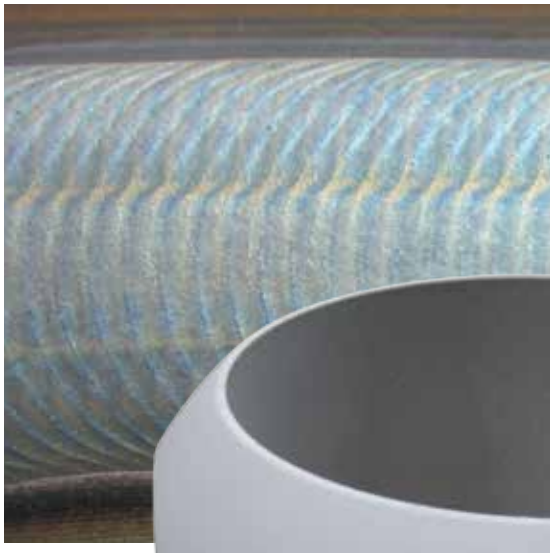
Neles

Coating materials for metal-seated ball valves

metso
Expect results

Ensuring tight shut-off and extreme reliability in service





Coating materials for metal-seated ball valves

Metso's Neles metal seated ball valves offer superior performance and long lasting tightness over a broad range of services in numerous industries. Every application presents unique challenges that must be considered when determining the most suitable valve. Many choices are straightforward such as size, pressure class, and body material, but one of the most critical decisions is often the least understood and is sometimes overlooked. Proper selection of trim coating materials is essential to ensure that a valve is configured to meet the demands of the application.

The importance of trim coatings

Metal seated ball valves achieve sealing by metal to metal contact between the ball and seat. When "soft" metals of similar hardness slide against each other under even moderate pressure, galling occurs.

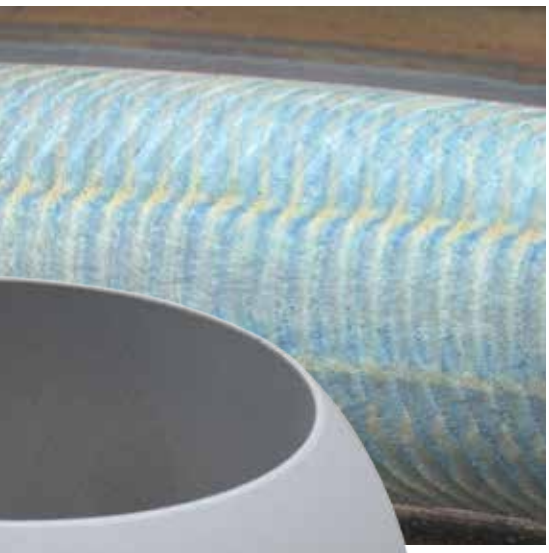
Microscopic protrusions on the seating surfaces catch on each other, resulting in surface friction, heat buildup and plastic deformation. Typically the damage gets worse as the valve cycles until it becomes inoperable due to seizure. If no coatings are applied to the trim, galling will be visible almost as soon as the valve is cycled on the test bench. Once installed in service, the various effects of difficult media would increase wear rate exponentially.

Properly selected coatings reduce the friction between the ball and seats allowing for smooth sliding operation over many numerous cycles, minimizing damage and wear due to galling, abrasion, erosion, particle impact, cavitation and thermal swings. Reducing friction in the trim lowers the valve's operating torque which has several advantages. Lower valve torque allows a smaller actuator to be used which is more economical, results in smaller envelope dimensions of the assembly, improves signal response in control service and simplifies selection of accessories to meet cycle speed targets and other special requirements.

Selection of trim coatings

Valve body, ball and seat materials are selected based on factors such as pressure, temperature and chemical compatibility. These criteria must also be considered when choosing trim coatings. Improper selection can cause almost instant failure of the valve upon startup. It is also important to note that properly selected trim coatings cannot make up for unsuitable base materials.

Most coatings are porous to some degree and do not isolate the base material against the effects of corrosive media. Base material and coating must both be selected to meet the demands of the application.



Coating materials

Overview of coatings, overlays, and surface treatments

Hard Chromium (HCr)

Hard Chromium is the standard coating for most Metso valves and is suited to a wide range of applications in liquids and gases at moderate temperatures and pressures. Corrosion resistance of HCr is generally comparable with stainless steels. HCr is not compliant with strong acids like hydrochloric acid (HCl), hydrofluoric acid (HF) or sulfuric acid (H2SO4), and it should not be used with seawater, wet chlorine or other media with high chloride content.

Nickel Boron (NiBo)

Nickel Boron performs very well in high temperature and high pressure applications. It is resistant to damage from erosion, cavitation and thermal shocks. NiBo is ideal coating for steam service, catalyst handling, slurry services and coal gasification. NiBo has limited corrosion resistance and is not recommended for use with acids and wet chlorine. NiBo coating is available on austenic stainless steels like CF8M (316 SS) balls up to 24" size.

Tungsten Carbide (WC-Co)

Tungsten Carbide is very resistant to wear from high cycle operations and erosion from abrasive catalysts, muds, slurries and powders. It is ideal for cryogenic applications, oxygen service and non-lubricative dry gas services. WC-Co is not suitable for use in corrosive services and condensates such as water, but generally performs well in hydrocarbon gases and liquids.

Coating materials properties

Coating	Description	Application process	Suitable substrates
HCr	Hard Chromium	Electroplated	Stainless steels, nickel base alloys
NiBo	Nickel Boron	Spray & Fuse	CF8M, AISI 316 stainless steel
WC-Co	Tungsten Carbide	HVOF	Stainless steels, nickel base alloys
CrC	Chromium Carbide	HVOF	Stainless steels, nickel base alloys
Cobalt Based Alloy		PTA/Laser	Stainless steels, nickel base alloys
Boride Thermal Diffusion process			
Nitriding Thermal Diffusion process			

Recommended services to use carbide coatings

- High pressure and temperature services when Hard Chrome is not useful
- Abrasive and solids handling services
- High cycles services
- Quick valve operation
- When base material and size limitation do not allow use Sprayed and fused type coatings
- Limited use in HP steam and HP water in isolation service. Use Nibo and other Sprayed and fused type coatings instead

Recommended services to use sprayed & fused NiBo coating

- Medium and high pressure steam
- Boiler feed water service
- High pressure water or condensate
- Abrasive services like
  - Coal gasification
  - Catalyst handling
- Hydrocarbon gases and liquids
  - High cycle / Thermal cycles

Chromium Carbide (CrC)

Chromium Carbide is well suited to very high temperature gas or liquid applications and has excellent resistance to wear, erosion and corrosive media. It performs well in sour (H2S) hydrocarbon gas, high chloride waters, coal liquefaction, catalyst handling and geothermal brine. Low Friction version CrC-LF is applied to seat surfaces to improve sliding performance.

Cobalt Based Alloy

Metso utilizes multiple coating materials classified as cobalt based hard facings often referred as Stellites® (Deloro Stellite). Examples include Alloy 50Nb, Alloy 6 and Alloy 12. Specific materials in this class are applied based on their individual properties and suitability for use on different types of parts such as seats, plugs, shafts and bearings.

Boride thermal diffusion process

Boride is a proces in which boron is diffused into the surface of the base material and can be applied to many ferrous, nickel and cobalt alloys and carbides. Wear and erosion resistance is greatly increased while corrosion resistance is retained or improved. It is well suited to high temperature and abrasive applications and services with demanding material requirements and corrosion concerns. There is no adhesive division point between the surface boride and substrate, resulting in excellent resistance to impact and thermal shocks.

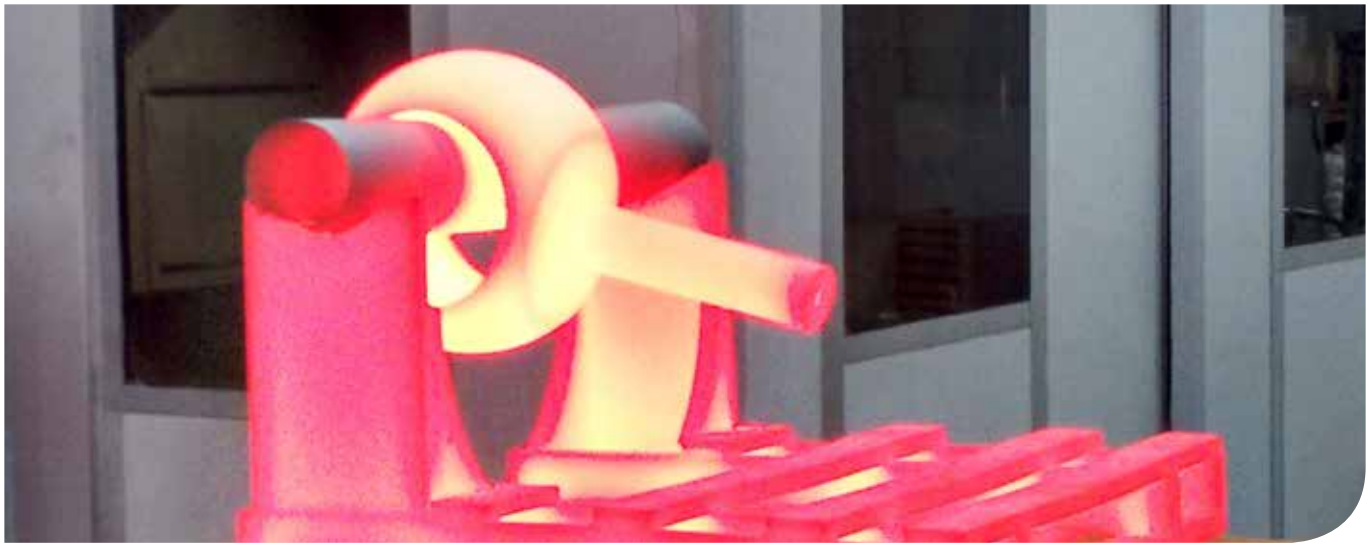
Nitriding Thermal Diffusion Process

Nitriding is a process in which nitrogen atoms are diffused into the surface of ferrous metals like carbon steels or martensitic stainless steels. The nitrogen atoms attach to the chromium, iron, and other alloying elements, which then form hard nitride compounds. The hard nitrided surface is useful in extending the life of a valve bearing surfaces in high temperature and abrasive applications.

Recommended applications

Ball	Temperature range, °C	Corrosion resistance	Erosion resistance	Liquid media	Dry gas
HCr	-50 to +450	Good	Good	Yes	No
NiBo	-200 to +600	Good	Very good	Yes	Yes
WC-Co	-200 to +450	Moderate	Excellent	No	Yes
CrC	-200 to +600*	Very good	Very good	Yes	Yes

* For higher temperatures, please consult factory.



Coating materials

Coating application processes

Electroplating
Coatings are applied in a bath containing chromic acid and sulfates or fluorides as catalysts. This process is used for our standard Hard Chromium plating.

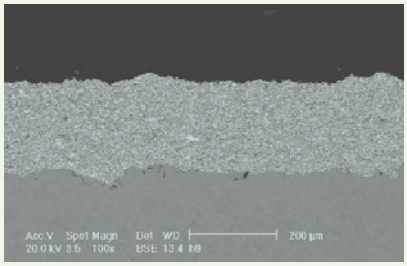
S&F: Thermal Spray and Fuse.
These coatings are fused in a furnace or by flame. The size of the part to be coated is limited by the capacity of the furnace. Nickel Boron coating is applied with this method and is available on balls up to 24" size.

HVOF: High velocity thermal spraying.
Extremely wear resistant carbide based coatings are applied as a powder combined with a high velocity jet of combustible gases.

Thermal diffusion
An element is diffused into the material surface to create a dense reaction zone with increased surface hardness and resistance to wear and impact. Corrosion resistance depends on the properties of the base metal.

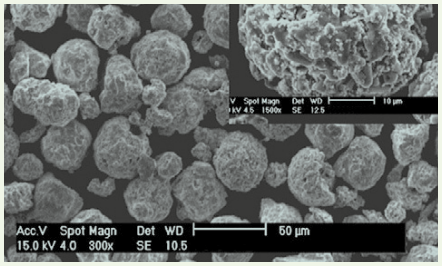
Plasma Transfer Arc (PTA)
The coating is welded to the substrate using a powder consumable. Plasma arc is generated between electrode and workpiece. PTA cladding produces metallurgically bonded fully dense coatings with a low dilution to the base material. This process is typically used to apply cobalt based alloys for internal parts of valves.

Laser cladding
The powder coating material is carried by an inert gas through a powder nozzle into the melt pool. The energy needed is generated by a laser beam. Laser cladding produces metallurgically bonded fully dense coatings with a minimal dilution to the base material. Laser cladding process is typically used to apply cobalt based alloys.

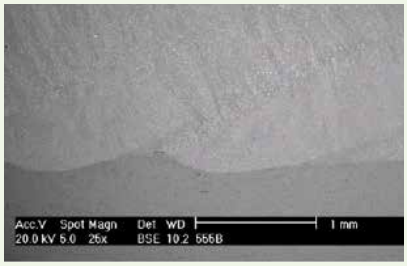


HVOF carbide coating structure

Courtesy of University of Tampere, Finland.



HVOF carbide coating powder



Cobalt based weld overlay (PTA)

Metso Flow Control Inc.
Vanha Porvoontie 229, P.O.Box 304, FI-01301 VANTAA, Finland, tel. +358 20 483 150, fax + 358 20 483 151, www.metso.com/valves