CVO Metal Seated Valve Trim and Coatings Application Guide

With the changes in seating technologies and cross pollination of technologies between the various ball valve products manufactured at CVO, this guide has been created to assist you in specifying products, technologies and coatings for metal seated valve applications.

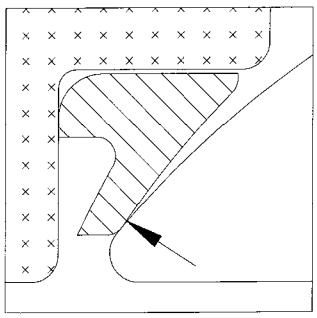
- **Metal Seated ball valve products**
  - Noble Alloy
  - McCanna
  - Worcester Controls
- **Coatings**
  - Hardide
  - HVOF/Plasma spray
  - Tantaline

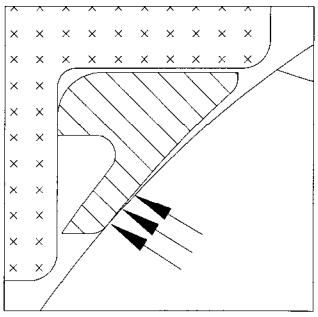
Noble Alloy Valves

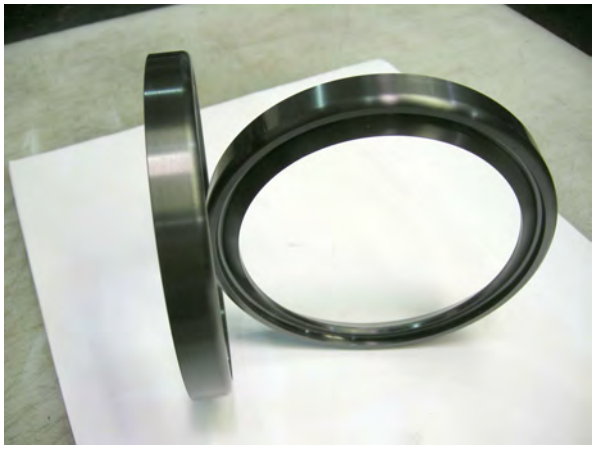
The Noble line offers metal seating in all sizes and pressure classes. The features of the Noble seat are:

- **2 designs** – Conical design and 2pc Slurry design

Conical Design







- No lapping or matched sets – Seat flexes to maintain seal, no springs or seals used.
- Seats made from identical or near identical material as the valve body
- Diffusion hardening processes or Nobleizing® surface hardening used
- Good for high temperature, corrosive and non slurry applications
- All sizes and pressure classes
- Leakage rates per MSS-SP-61 – Performance equals between class V and class VI

2Pc Slurry Design

- 2pc design with separate seat ring nested in a seat carrier. Seat ring has broad face scraper design for slurry applications
- No lapping or matched sets – Carrier has spring machined in to energize the seat. No seals used.
- Seats made from identical or near identical material as the valve body
- Diffusion hardening processes or Nobleizing® surface hardening used as well as spray coatings which requiring lapping
- Available in 3” FP and larger valves, all pressure classes
- Leakage rates per MSS-SP-61 – Performance equals between class V and class VI

FLOWSERVE
McCANNA/MARPAC Valves

The McCanna line used a solid metal seat design which is lapped to the ball forming a matched set.

- These seats are offered in coated and specialty alloy options.
- Must be sold as a lapped matched set
- Are not bubble tight. Refer to Noble when higher leakage rates are required (class V or better)
- No seals or springs are used to seal or energize these seats.

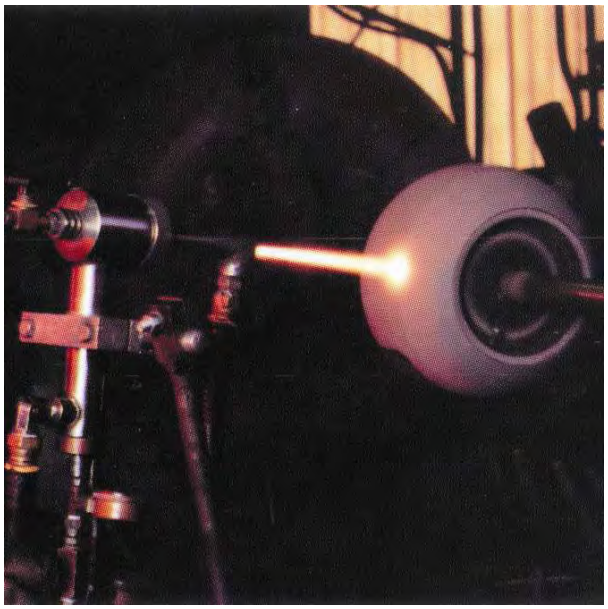
Coatings

Coatings are now the standard metal seated option for the McCanna top entry valve. These offer a cost and performance advantage over Stellite® etc. The coatings offered include:

- **Hardide®**
  - The Hardide® coating offers improved wear resistance in slurries and other metal seats applications over Stellite® at reduced cost. The coating Is a tungsten coating with dispersed nano particles of carbide.
  - Binder free tungsten – sizes ½" to 4" ANSI 150-1500. Cryogenic to 800°F maximum temperature. This is the standard coating offered to it's max temperature and size limitations. For larger valves or higher temperature, we default to the below process or Stellite®.
  - Leakage rates per MSS-SP-61 – Performance equals between class IV and class V
  - Maximum temperature of 800F

- **Thermal spray coatings**

Spray coatings offer a wide variety of coating options at substantially reduced cost and improved performance in larger size valves over Stellite®

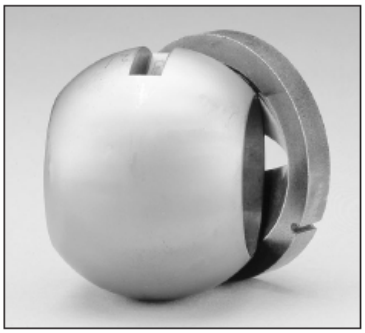


- Chrome Carbide is the standard coating offered for the McCanna top entry valve.
- Sizes 2” to 20” ANSI 150-1500. Cryogenic to maximum 1500°F. Chrome Carbide will be the default coating offered.
- Be sure to inform customer service of the application, pressure and temperature to insure the correct coating is selected. (Many coatings options are available with this process including Nickel Tungsten Carbide, TaCrO2, Titanium Dioxide and others, depending on the service requirements.)
- **No special ordering codes are required when ordering metal seated McCANNA valves. The standard Hardide coating is the default trim. *You will need to inform your Customer Service representative of the operating conditions for the application, to insure the correct coating is supplied* or if there are special corrosive, erosive or temperature conditions which may dictate a different coating or requiring Stellite®.**
- **Stellite® and Waukesha options are still available on request.**
- **For valves ½” to 1.5” with applications over 800F, Stellite must be specified.**

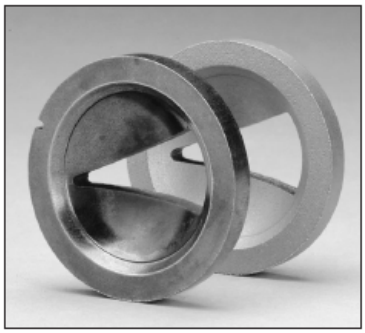
- **Specialty Alloy Metal seats**

  - **Stellite** – Stellite is an old standard offering for the McCanna top entry. It is a cobalt based alloy that has unique toughness properties that prevent it from galling when rubbed together as in a metal seated valve ball and seat.
    - Offered in the entire size and pressure class range.
    - Default offering where coatings cannot be used
  - **Waukesha 88** Is a nickel based alloy that has 4% Bismuth in it to prevent galling.
    - Offered in the entire size and pressure class range.
    - Default offering where coatings or Stellite® cannot be used.

The Worcester Controls line utilizes a different metal seated technology than most ball valve products. The Metal “A” and Metal “G” seats utilize a sintered 316SS (some other materials like Hastelloy C are available) design that is then impregnated with PTFE or Graphite. They are available as round port or CPT style shown below. These require an ENC coated ball in lieu of a standard ball.



316 sintered metal seats are impregnated with TFE or graphite to provide positive shut-off and eliminate galling when contacting the hard coated ball.



Characterized Seats with Metal A TFE impregnation or Metal G graphite impregnation in sizes 1/4" - 4".

- **Metal “A” Alpha seat**
  - Sintered design impregnated with PTFE
  - Suitable for -20°F to 600°F at 1000 psi; 316L metal matrix, filled with TFE
  - This material combines the strength and abrasion resistance of metal with the lubricity of TFE. The seat is grey in color, has a seal groove in the back face, and is noticeably heavier than plastic seats.
  - Utilizes a seat back seal which requires a specific direction of assembly
  - Limited in some services due to temperature, PTFE and the seat back seal design

- **Metal “G” Gamma seat**
  - Sintered design impregnated with Graphite
  - Suitable for -20°F to 1000°F at 1000 psi; 316L metal matrix, filled with Graphite
  - Increased temperature capability (1000°F), by substituting graphite for TFE as the lubricant. Gamma is successful on hot abrasive services.
  - Utilizes a seat back seal which requires a specific direction of assembly

- **Noble Alloy Conical design**
  We have adapted the Noble design to Worcester products including flanges and 3pc valves to 6” RP and FP.

Coatings Application Guide

There are many coatings and surface modification processes, that Flowserve can utilize and some very special coatings and processes we have partnered with, to increase the product performance envelope.

Nobleizing and Surface modification technologies

Due to the Noble conical seat's flexible design, we typically cannot use surface coatings. Coatings to be effective must be hard and their hardness makes them brittle. This means if you flex them, they will crack.

Nobleizing (in House for reactive metals)

- Process performed at CVO for hardening zirconium, titanium, tantalum and other reactive/refractory metals.
- These are the only metals we do this on. Ferrous and nickel alloys cannot be surfaced hardened with this process.

Boron diffusion (Boriding/Noble B)

- Diffusion process where boron is forced into the metal surface at high temperature where it combines with the metal or metal alloy, forming borides.
    - High hardness 1400 knoop (70Rc is 900 knoop)
    - Very thin surface hardening - .001" to .002"
    - No temperature limitations
    - Cannot be used in nitric acid
    - Used on all metals except reactive/refractory metals
    - Vendor that does this process id Material Development Corporation in MA

QPQ Nitride/Noble Q

- This process is the Kolene process, a salt bath nitriding process
    - Diffusion process where nitrogen is forced into the metal surface at high temperature where it combines with the metal or metal alloy, forming nitrides.
    - Maximum 800F temperature limit
    - Produces a surface hardness of 70Rc
    - Used on CS and stainless alloys only.
    - Vendor is Houston Unlimited in Chappell Hill Texas

Thermal Spray Coatings

High Velocity Oxy Fuel (HVOF) systems were developed in order to produce coatings with superior bond strength, higher density and higher hardness than other spray processes. Using **HVOF**, an oxygen-fuel mixture is continuously fed under pressure into a combustion chamber where gases are ignited and channeled into a nozzle. Material is introduced axially or radially into the combustion stream and accelerated onto the substrate at velocities up to 7000 feet per second.

Thermal Spray — Plasma

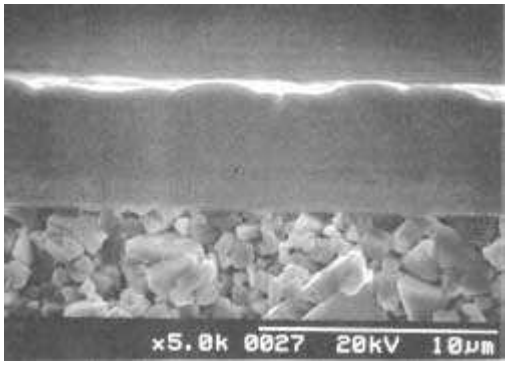
In this process, inert gases or gas is passed through an electric arc formed between the cylindrical copper anode and the centrally aligned tungsten-tipped cathode. As the gas passes through the arc, it disassociates the molecules and ionizes the atoms, thereby forming a plasma jet. Plasma systems allow the use of materials with extremely high melting points, making them ideal for the application of MCrAlY's and ceramics such as chromium, zirconium and aluminum oxides.

Hardide

Flowserve has worked with the Hardide company to introduce their coating into the McCanna top entry line. We are also testing it in the Worcester line.

This is a binder free form or Tungsten with carbide produced by a CVP Chemical Vapor Deposition process.

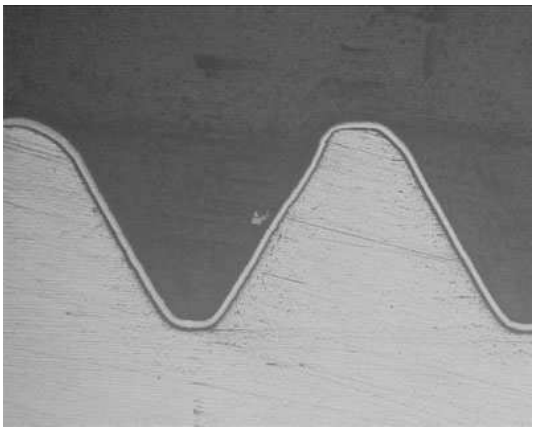
Hardide is unique as it is binder-free therefore eliminating the problem of particle pull-out and offering excellent wear and corrosion resistance.



The photograph shows Hardide Tungsten Carbide (top layer) which has been coated onto a traditional Tungsten Carbide (lower layer). After etching, the individual particles of the traditional Tungsten Carbide layer can easily be seen. By comparison, the Hardide layer is homogeneous and pore-free. The very top layer displays the smooth nodular surface texture unique to Hardide.

Low friction/anti-galling

The coating has a low coefficient of friction and eliminates galling when operating against itself.



A micro-photograph of a cross-section of 50-microns thick Hardide-T coating on thread.

Tantaline®

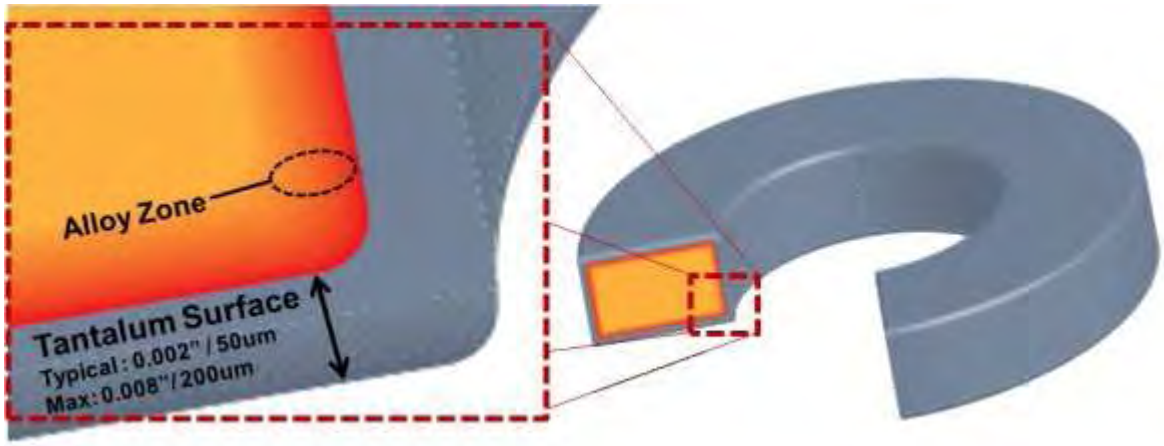
Flowserve CVO has joined with the Tantaline® company to offer our products coated with tantalum using their Tantaline® process. Tantalum is a highly corrosion resistant metal in the same family as zirconium and titanium, but very expensive.

What is Tantaline?

Tantaline products consist of a core substrate (typically stainless steel) which is treated in our process to create an extremely rugged, uniform, inert and corrosion resistant tantalum surface. Through the Tantaline process, tantalum atoms are actually grown into the substrate creating an inseparable surface alloy.

Further processing creates a surface 50 microns thick (0.002") with all of the characteristics and properties of pure tantalum metal. The process being geometry independent, both internal and external surfaces of complex parts such as valves, fittings, process equipment and instrumentation are possible to treat.

The result is parts could be produced with the superb corrosion resistance of tantalum, the availability of stainless steels at prices competitive to specialty alloys like titanium, nickel alloys (Hastelloy C276, C22, B2) and zirconium.



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