



Improving Valve Reliability Selection of Severe Service Ball Valves

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About Your Presenters



- **Serge Trudel**
 - Vice President America Sales, Bray International, Houston, Texas
 - President, Rite Global Operations
 - 33 Years in the valve industry, mostly in Senior Sales and Operations Management

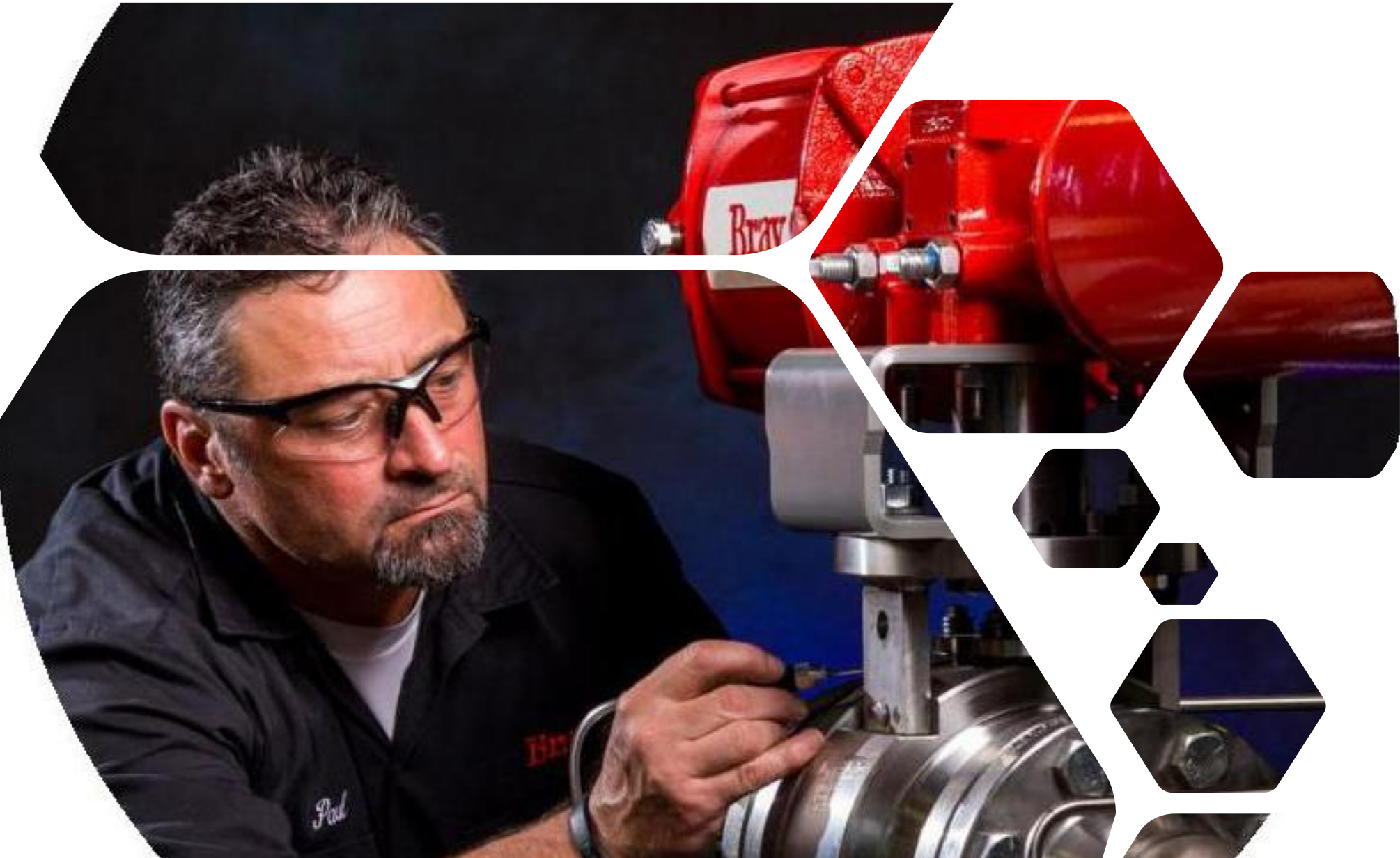


- **William (Bill) Henwood**
 - Vice-President of Sales, Bray Flow-Tek, Inc., Houston, TX
 - 25 Years in Senior Executive positions within the nuclear and severe service valve industry
 - 42 Years total experience in the flow-control business



- **Stan Allen, PE**
 - Engineering Fellow, Bray International Inc., Houston, TX
 - 42 Years in the Valve Industry - R & D, Design Engineering, Applications Engineering, Test Lab Management, and Technical Services Roles
 - Participant in standards development for API, MSS, NACE and ASTM

Our passion: **Solving your flow control problems**



Identifying the Valve Application and Service Conditions

- Identifying the valve application and service conditions is the first and most important step in the selection of the correct valve
- Methods of Identifying Factors and Conditions for Optimal Valve Selection:
 - Check Lists
 - ISA Data Sheet (ISA 75.14) – used for control but also used for critical isolation valves
 - For the most critical valves for safety and performance consider using FMEA – Failure Mode and Effects Analysis, an analytical approach identifying potential failure modes and resulting effects.
 - During FMEA, evaluate for:
 - Integrity of pressure containment
 - Integrity of shutoff or control
 - Functionality (reliability and ease of operation)
 - Operational safety
 - Serviceability

“Severe Service” – FMEA for Addressing Endurance

Example Process Requirements:

- Bi-directional zero leakage after 1 million cycles on 12-inch Class 300 High Performance Butterfly Valves
- Design, including FMEA process, resulted in seat, bearing, stem, spacer and stem packing reviews.
 - **Media: dry air**
 - Stroke time: 1-3 seconds
 - Conditions: pressured, under load – simulating actual process
 - Low (50 psig) and high-pressure (350 psig) tests at each 100K cycles
 - **Successful validation included Accelerated Life Testing**
1 million+ cycles on a standard 12-inch Class 300

Actuator was validated in parallel



Identifying the Valve Application and Service Conditions

- ✓ Application (isolation, control, EBV, blowdown, etc.)
- ✓ Fluid properties
- ✓ Fluid composition (water, slurry, catalyst, natural gas, hydrogen, crude oil, sour multi-phase, entrained sand, etc.)
- ✓ Fluid viscosity
- ✓ Fluid density
- ✓ Fluid state (gas, liquid, solids, superheated steam, 2-phase, 3-phase)
- ✓ Lethal / toxicity / carcinogenicity / radioactivity factors
- ✓ Corrosion mechanisms (acidity, alkalinity, galvanic, crevice, stress corrosion cracking, hydrogen embrittlement, etc.)
- ✓ Compatible materials of construction
- ✓ Pressure (minimum, normal, maximum)
- ✓ Pressure differential across valve (minimum, normal, maximum)
- ✓ Vacuum conditions
- ✓ Direction(s) of high pressure
- ✓ Pressure drop constraints (impact on piping and valve sizing)
- ✓ Impact on process performance

Identifying the Valve Application and Service Conditions

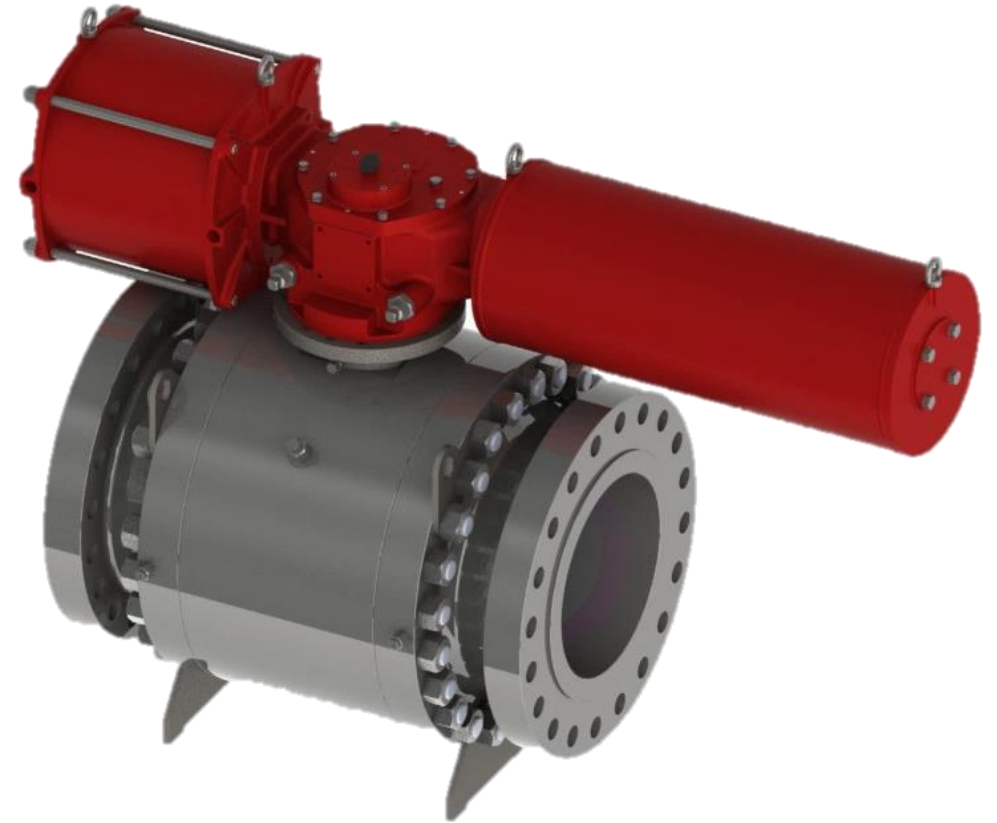
- ✓ Cavitation and flashing concerns
- ✓ Temperature (minimum, normal, maximum)
- ✓ Potential for thermal shock
- ✓ Cryogenic considerations
- ✓ Temperature cyclic conditions
- ✓ Flow rate (minimum, normal, maximum)
- ✓ Direction(s) of flow
- ✓ Potential for water hammer
- ✓ Potential for fluid erosion
- ✓ Solids - abrasive/erosive particulates (density, size, hardness, velocity)
- ✓ Polymerization, coking, scaling or fluid solidifying conditions
- ✓ Availability/acceptability of external utilities or clean process media for valve purging
- ✓ Settling or non-settling slurries to keep solids in suspension
- ✓ Upset conditions (pressure and/or temperature excursion, reverse flow, chemical reactions, etc.)
- ✓ External environmental / site conditions (humidity, saltspray, seismic, vibration, etc.)
- ✓ External forces (subsea, external loading, deflection in buried service)
- ✓ Valve attributes (NPS, end connections, etc.)
- ✓ Piping and flange materials

Identifying the Valve Application and Service Conditions

- ✓ Safety Instrumented System (SIS) Requirements - (SIL ratings)
- ✓ Partial stroke testing (remote or local)
- ✓ Expected service life (both number of cycles and time duration)
- ✓ Required operating speed ranges (open & closed)
- ✓ Required shutoff performance -ANSI/FCI 70-2 Class IV, V, VI
- ✓ API 598 (multiple acceptable leakage criteria depending on resilient or metal seats; includes “no visible leakage”)
- ✓ ISO 5208 (four levels of allowable closure test leakage)
- ✓ Allowable external leakage or fugitive emissions performance
- ✓ Operational maintenance opportunity
- ✓ Actuation & accessories
- ✓ Type (pneumatic, hydraulic, electric, electrohydraulic, etc.)
- ✓ Power variables (range of air supply, voltage range and phase)
- ✓ Accessories required (limit switches, positioner, solenoids, etc.)
- ✓ Failure position(s) (loss of power, loss of supply fluid)
- ✓ Enclosure ratings
- ✓ Ability of specified actuation/accessories to meet desired operating speeds
- ✓ Required safety factors for actuator sizing
- ✓ Frequency of operation

Identifying the Valve Application and Service Conditions

- ✓ Valve cleaning
- ✓ Preparatory, such as oxygen or chlorine cleaning
- ✓ In situ, such as pigging, steam or acid cleaning
- ✓ Special startup considerations (weld slag in piping, high pressure testing)
- ✓ Plant design considerations
- ✓ Ergonomics (rim pull, noise, physical size)
- ✓ Weight for structural loads
- ✓ Orientation restrictions
- ✓ Overall envelope dimensions (or 3D models) for interference detection
- ✓ Code, standard, and legal compliance requirements (PED, OSHA, EPA, etc.)



Specification and Communication of Requirements

- Documentation Required in RFQ or PO

- Project Specifications
- General Specifications
- Valve Data Sheets
- Service Conditions
- Referenced Documents

- Challenges

- Completeness of Specs
- Lost in Handoff
- Lost in Translation
- Revision Level Confusion
- Miss-interpretation
- Conflicts in Specifications

| Valve Data Sheet | | | | | | | | | | Tag No. | | |
|------------------------------------|---|-----------------|---|---|---------------|---|---|-------------------|----|--------------|---------------|--|
| | | | | | | | | | | Application: | | |
| | | | | | | | | | | Quantity: | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| Customer: | | Distributor: | | | End User: | | | End User Contact: | | | Project Name: | |
| Distributor Contact: | | Phone No.: | | | Email: | | | End User Contact: | | | Email: | |
| Conditions: | | Design | | | Minimum | | | Normal | | | Maximum | |
| Flow Rate: | | Shut Off | | | Units | | | Units | | | Units | |
| Inlet Pressure (P1): | | Units | | | Units | | | Units | | | Units | |
| Outlet Pressure (P2): | | Units | | | Units | | | Units | | | Units | |
| Diff. Pressure (ΔP): | | Units | | | Units | | | Units | | | Units | |
| Temperature: | | Units | | | Units | | | Units | | | Units | |
| Vapour Pressure (Pv): | | Units | | | Units | | | Units | | | Units | |
| Critical Pressure (Pc): | | Units | | | Units | | | Units | | | Units | |
| Absolute Viscosity: | | Units | | | Units | | | Units | | | Units | |
| Specific Gravity (G): | | Units | | | Units | | | Units | | | Units | |
| Specific Heat Ratio: | | Units | | | Units | | | Units | | | Units | |
| Comp. Factor Z: | | Units | | | Units | | | Units | | | Units | |
| Molecular Weight: | | Units | | | Units | | | Units | | | Units | |
| Density: | | Units | | | Units | | | Units | | | Units | |
| Required (Cv / Kv): | | Units | | | Units | | | Units | | | Units | |
| Allowable Noise (dBA): | | Units | | | Units | | | Units | | | Units | |
| Fluid Type: | | Liquid | | | Gas | | | Steam | | | Slurry | |
| Fluid Name: | | Size | | | Pipe Schedule | | | Units | | | Units | |
| Inlet: | | STD | | | Imperial | | | Metric | | | Units | |
| Outlet: | | STD | | | Imperial | | | Metric | | | Units | |
| Pipe Material: | | Min | | | Max | | | Units | | | Units | |
| Design Temp: | | Units | | | Units | | | Units | | | Units | |
| Design Pressure: | | Units | | | Units | | | Units | | | Units | |
| Environmental Conditions: | | Units | | | Units | | | Units | | | Units | |
| Manufacturer/Part Number: | | Units | | | Units | | | Units | | | Units | |
| Valve Type: | | Units | | | Units | | | Units | | | Units | |
| Valve NPS Size / Bore: | | Units | | | Units | | | Units | | | Units | |
| End Connection (In/Out): | | Units | | | Units | | | Units | | | Units | |
| Pressure Class/Rating: | | Units | | | Units | | | Units | | | Units | |
| Body Material: | | Units | | | Units | | | Units | | | Units | |
| Ball Material: | | Units | | | Units | | | Units | | | Units | |
| Stem Material: | | Units | | | Units | | | Units | | | Units | |
| Seat Material: | | Units | | | Units | | | Units | | | Units | |
| Valve Packing Material: | | Units | | | Units | | | Units | | | Units | |
| Fire Safe: | | Units | | | Units | | | Units | | | Units | |
| Torque (Break Run End): | | Units | | | Units | | | Units | | | Units | |
| Bonnet Type: | | Units | | | Units | | | Units | | | Units | |
| Face to Face / End to End: | | Units | | | Units | | | Units | | | Units | |
| Sealing Direction: | | Units | | | Units | | | Units | | | Units | |
| Flow Characteristic: | | Units | | | Units | | | Units | | | Units | |
| Hydrostatic Shell Test: | | Units | | | Units | | | Units | | | Units | |
| Leakage Class: | | Units | | | Units | | | Units | | | Units | |
| Area Classification: | | Units | | | Units | | | Units | | | Units | |
| Pos. Material Identification: | | Units | | | Units | | | Units | | | Units | |
| Mat. Traceability Reports: | | Units | | | Units | | | Units | | | Units | |
| Stroke Speed Test: | | Units | | | Units | | | Units | | | Units | |
| General or Oxygen Cleaning: | | Units | | | Units | | | Units | | | Units | |
| Required Certificates: | | Units | | | Units | | | Units | | | Units | |
| NDE: | | Units | | | Units | | | Units | | | Units | |
| Special Testing: | | Units | | | Units | | | Units | | | Units | |
| Stainless Tag: | | Units | | | Units | | | Units | | | Units | |
| Manufacturer/Part Number: | | Units | | | Units | | | Units | | | Units | |
| Voltage & Phase: | | Units | | | Units | | | Units | | | Units | |
| Modulating or On/Off: | | Units | | | Units | | | Units | | | Units | |
| Communication Protocol: | | Units | | | Units | | | Units | | | Units | |
| Input Signal: | | Units | | | Units | | | Units | | | Units | |
| Feedback Signal: | | Units | | | Units | | | Units | | | Units | |
| Auxiliary Switches: | | Units | | | Units | | | Units | | | Units | |
| Condensation Heater: | | Units | | | Units | | | Units | | | Units | |
| Torque Switches: | | Units | | | Units | | | Units | | | Units | |
| Manual Override: | | Units | | | Units | | | Units | | | Units | |
| Fail Position: | | Units | | | Units | | | Units | | | Units | |
| Actuator Output Torque: | | Units | | | Units | | | Units | | | Units | |
| Required Safety Factor: | | Units | | | Units | | | Units | | | Units | |
| Actuator Speed: | | Units | | | Units | | | Units | | | Units | |
| Act. Temperature Limitation: | | Units | | | Units | | | Units | | | Units | |
| Duty Cycle: | | Units | | | Units | | | Units | | | Units | |
| Manufacturer/Part Number: | | Units | | | Units | | | Units | | | Units | |
| Type (Mechanical/Proximity / Qty): | | Units | | | Units | | | Units | | | Units | |
| Switch Rating: | | Units | | | Units | | | Units | | | Units | |
| Electrical Connection: | | Units | | | Units | | | Units | | | Units | |
| Material of Construction: | | Units | | | Units | | | Units | | | Units | |
| Indicator Type/Color: | | Units | | | Units | | | Units | | | Units | |
| Area Classification: | | Units | | | Units | | | Units | | | Units | |
| Volume Booster: | | Units | | | Units | | | Units | | | Units | |
| Air Set Filter Regulator: | | Units | | | Units | | | Units | | | Units | |
| Regulator Set Pressure: | | Units | | | Units | | | Units | | | Units | |
| Tubing Material of Construction: | | Units | | | Units | | | Units | | | Units | |
| Tubing Size and Thickness: | | Units | | | Units | | | Units | | | Units | |
| Rev. # | | Revision Reason | | | Date | | | By | | | Chk'd | |

Specification and Communication of Requirements

**Valve Need by
End User**

EPC

Fabricator

“Inspector”

**Valve-Actuator Integrator or
Distributor**

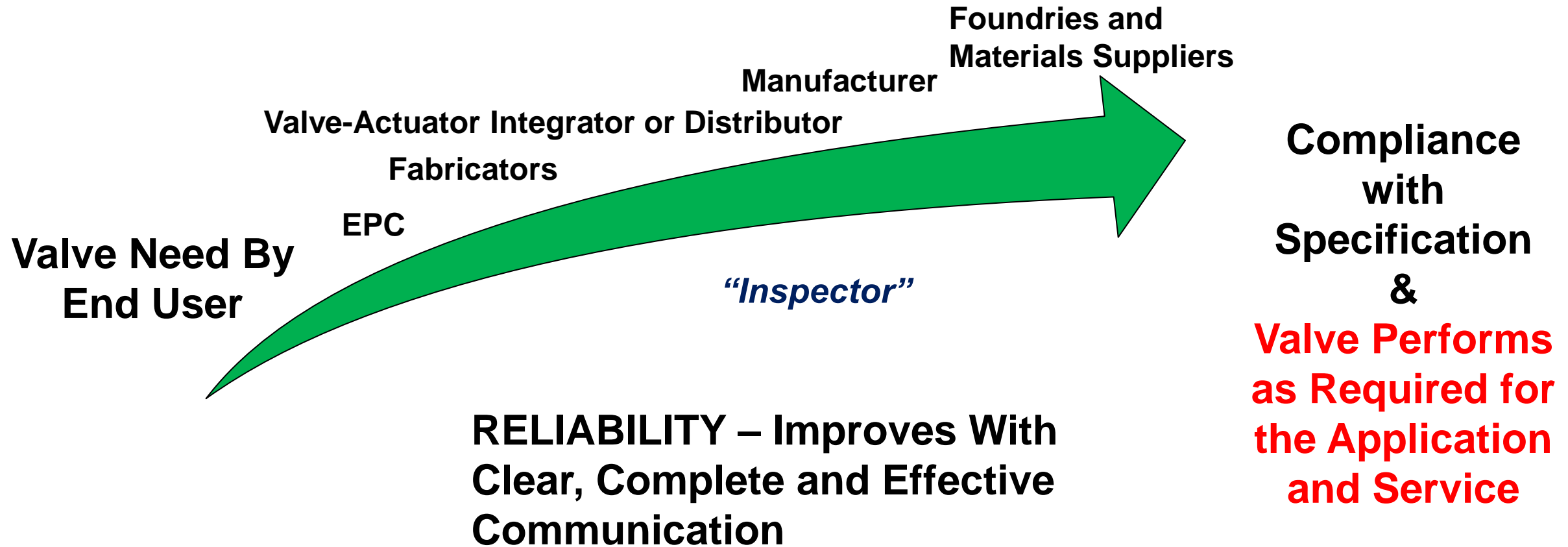
Manufacturer

**Foundries and
Materials Suppliers**

**RELIABILITY – Potentially
Suffers at Each Handoff**

**Goal: Compliance
with Specification**

Specification and Communication of Requirements



Specification and Communication of Requirements

- Recommendations for reliable specifications and communication of requirements
 - Paint the full picture, but focus on defining safety and performance reliability requirements
 - Use and pay attention to revision levels on documents
 - Apply or reference ASTM, EN, API, ISO, MSS and other specifications wherever possible
 - Use data sheets for critical valves; do not be timid about using “notes”
 - Use bullet point specifications – particularly on material requirements (rather than narratives)
 - Review quotations and order acknowledgements – do not assume requirements are understood
 - Review and acknowledge deviations or clarifications

| Item | Specification | Section | Requirement | D, C | Deviation or Clarification | Alternative Proposal | Reason | Disposition |
|------|---------------|---------|-------------|------|----------------------------|----------------------|--------|-------------|
| | | | | | | | | |
| | | | | | | | | |

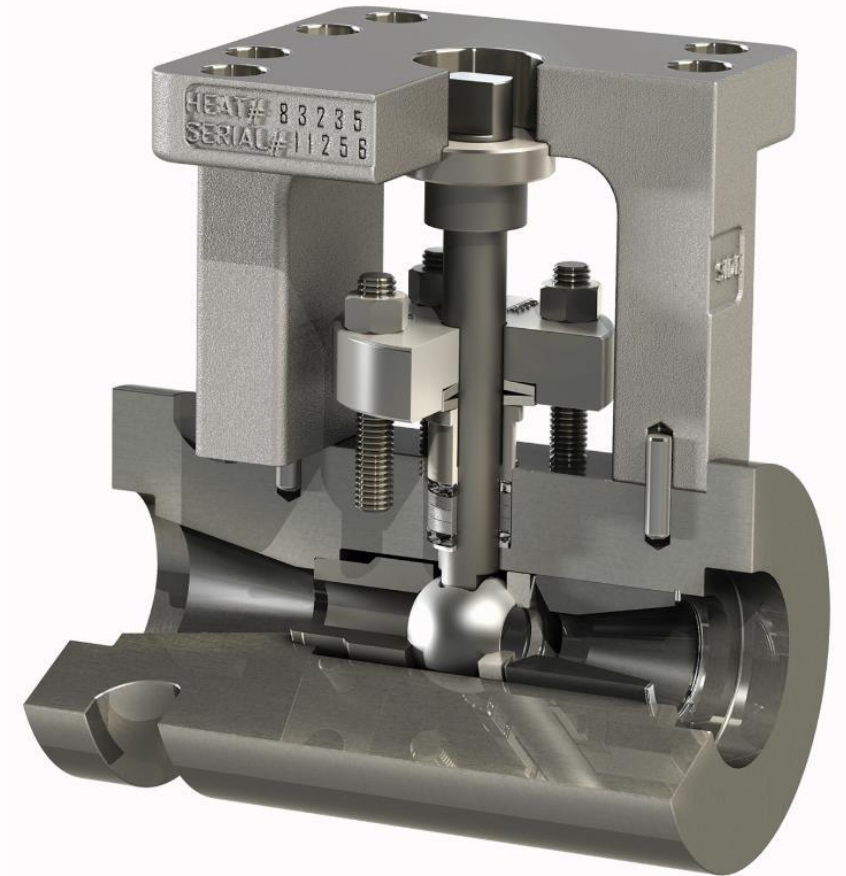
- Review Meeting - Skype, WebEx, etc.
- Ultimately you are responsible - “Own it!”

Severe Service Ball Valves Defined

- Valve manufacturers - “severe service” describes challenging conditions relative to the risk of the valve not functioning as designed
- Valve users - “severe service” is one in which conventional valves do not perform the required function in their specific conditions and for the time required
- Both are correct – slightly different perspectives
- The challenge is selecting the right valve, features, materials, and other parameters to isolate flow when the conditions of operation include challenging factors like
 - **Entrained solids**
 - **Corrosion**
 - **High pressure**
 - **High temperature**

What Factors Make a Valve “Severe Service”? Other Factors.

- Applications having 2 of these factors.
- Other factors that can put a standard valve into severe service category.
 - High flow rate
 - High fluid viscosity
 - High number of cycles
 - Toxic or lethal nature of fluids
 - Required shutoff performance - tighter than normal, particularly after high cycle



Basic Operation of a Severe Service Ball Valve



Process and Application Factors

- One of the biggest contributors to end users making the decision to switch to a severe service ball valve is the following:
- Not anticipating potential changes to variables that arise following startup or after a major process change.
 - Change of catalyst type
 - Increase of temperature
 - Increase in flow
 - Change in fluid chemistry and resultant corrosion

But What Factors Require the MOST Focus?

- High temperature
- Entrained solids
- High pressure
- Corrosion



Due to increased operating torque, automated valves also require special focus. Actuator selection and sizing are critical. Consider On-Demand Correction Factor (ODCF).

Temperature

- Conventional resilient seated ball valve: 450°F (232°C)
- Conventional triple offset butterfly valve: 842°F (450°C)
- Severe service ball valves may be used in excess of 1500°F (816°C)
- Selecting a valve for a given temperature is only the first step
- Materials rapidly expand and contract and dimensions change, which can cause issues such as
 - increased operating torques
 - thermal binding (lock-up)
 - coating failure
 - loss of required compression or sealing tolerances
- Tensile and yield strength degrade with high temperature; often different materials are required to provide required strength for some components
- Temperature cyclic services such as
 - molecular sieve
 - catalyst regeneration
 - steam turbine drains
- Consider creep rate and toughness at high temperature (ASTM A182 Grade F91)



- Manufacturers Design Tools:
 - FEA with thermal expansion analysis
 - Thermal simulation software
 - Thermal testing
 - Accelerated Life Testing

Pressure

- As pressure increases, the process sealing surfaces in valves often experience higher and higher contact stresses and torques
- Floating ball valve seats are line pressure energized and the stress and torque increase directly with an increase in pressure
- High pressure when, especially when combined with high temperature, solids, and/or corrosion, require high metal-seat technology.
- Most resilient materials have combined and interrelated challenges with compressive strength, abrasion resistance, and even chemical compatibility
- In some services PEEK and graphite (and sometimes combined with metal) for seating surfaces
- Full metal seats – either metal alloys or coatings - provide substantial durability in extreme conditions, but still must be effectively designed to distribute high stresses and provide tight sealing to prevent internal, and in some cases, external leakage
- Obtaining tight shutoff with metal seats requires experience with a variety of precision machining, grinding, and lapping techniques

Solids

- Primary reason severe service ball valves are required:
 - Sand
 - Slurries
 - Catalyst carryover
 - Coke buildup
 - Asphaltenes
 - Sediments
 - Other solids
- Fluid velocities, pressures, temperatures, and the combined effect of corrosion often require the use of metal or ceramic components
- These factors are evaluated to determine the correct base metallurgy and the metallurgy of coatings, overlays or liners that may be used to protect seats, seals, and, in some cases, body wall
- Failure to determine and specify the correct materials and valve design can lead to catastrophic failure of valve trim and pressure boundary due to erosive wear



Corrosion

- A challenge for the end user, engineering companies, and valve manufacturers alike is to identify the correct materials for a set of service fluids and conditions
- The most common corrosion concerns are stress corrosion cracking, pitting, and galvanic corrosion.
- NACE publications and standards, such as MR0103 and MR0175 for stress corrosion cracking (SSC), and NACE Corrosion Data Survey for metals are often used to select appropriate materials in several different industries
- Overlooked considerations are:
 - Failure of components due to the combined effects of stress and corrosion
 - Combined effects of erosion and corrosion
 - Impact of material selection on adhesive wear (galling).
- Various approaches are used to address corrosion including selecting appropriate corrosion resistant base materials, isolating components, protective coatings, and cladding/inlay/overlay processes.



Where are Severe Service Valves Used? What Industries?

- **Oil refining**
- **Gas processing**
- **Oil and gas production**
- **Petrochemical & chemical**
- Power
- Mining
- Food and beverage processing
- Aerospace
- Pulp and paper



Across these industries, the driver for using severe service valves is the severity of one or more process factors and the operational reliability and/or safety risks involved in failure of the valve to perform under the conditions.

Petrochemical-Chemical Applications

- Reactors
- Distilling
- Synthesizing
- Catalyzing
- Dilution
- Concentration
- Polymerization
- Feedstock supply
- Transfer



Refinery Applications

Heavy Vacuum Gas Oil – HVGO & Hydrocracking

- Pump Isolation
- Overhead Vapor Isolation & Control
- Letdown Stations
- Catalyst Handling

Fluid Catalytic Cracking (FCCU)

- Catalyst Handling
- Slurry Isolation & Control
- Regeneration
- Heavy Oil
- Flue Gas
- Cyclone



Distillation
Gasification
Hydro-treating
Alkylation
Lube Oil Treating
Visbreaking

Refinery Applications

Continuous Catalytic Reforming (CCR)

- Catalyst Lockhopper
- Regeneration
- Isolation & Vent

Delayed Coking

- Coke Drum Feed
- Coke Drum Bypass
- Overhead Vapor Line
- Cutting Water Pump
- Steam Stripping



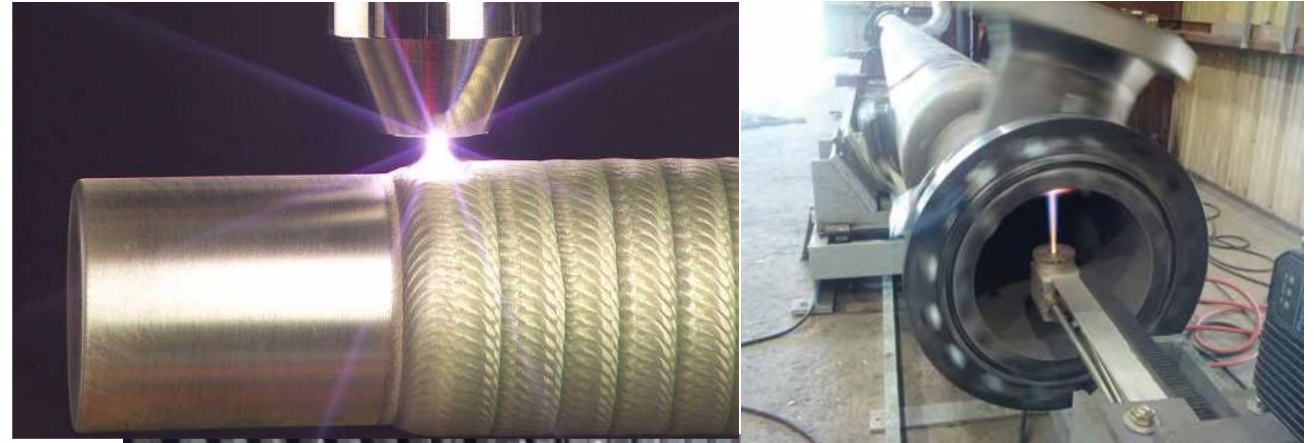
Steam Systems
Crude Storage
Product Blending
Gas Plant (Light Ends)
Furnace Isolation
ESD Valves



**Coating Technologies in
Refining
&
Petrochemical**

Coating Technology Used on SSBV

- **PTA:** Plasma Transfer Arc is a method of automated weld overlay of hard-facing materials such as Alloy 6 and Alloy 21 particularly useful for erosion and high temperature applications $\geq 750^{\circ}\text{F} / 398^{\circ}\text{C}$
- **HVOF:** High Velocity Oxygen Fuel is a method of applying a coating to a ball and seats for better sealing and wear resistance.
- **APS:** Atmospheric Plasma Spray is another method of applying a coating to a ball and seats for better sealing and wear resistance.



REFINING

ACS = Advanced Coating Specification

Sliding/
Galling

Impact
Resistance

Corrosion
Resistance

Erosion
Resistance

Abrasion
Resistance

High
Temperature

Oxidizing
Service

Thermal
Shock

Sulfides/
Sour Fluids

ACS-0001* (CrC-NiCr 75/25)

Chrome Carbide w/ Ni Chrome

Hardness: 66-70 Rockwell C



ACS-0002 (WCCoCr 86/10/4)

Tungsten Carbide w/ Cobalt Chrome

Binder Hardness: 68 Rockwell C Min



ACS-0003 (WCCrCNi 73/20/7)

Tungsten Chrome Carbide w/ Nickel

Binder Hardness: 68 Rockwell C Min



ACS-0004

Chrome Nickel Tungsten Carbide in Ni

Matrix Hardness: 68-70 Rockwell C



ACS-0005

Chrome Nickel Boron Carbide in Ni-Mo

Matrix Hardness: 58-63 Rockwell C



ACS-0006

Chrome Ni Tungsten Carbide Cobalt

Matrix Hardness 56-61 Rockwell C



ACS-0007

Cobalt 21

Hardness 28-40 Rockwell C



ACS-0010

Cobalt 6

Hardness 40-45 Rockwell C



Nylon 6-6-6 Pellets



**ABRASIVE-
EROSIVE**

FCCU Frac Bottoms

**HI-TEMP,
EROSION,
FOULING**



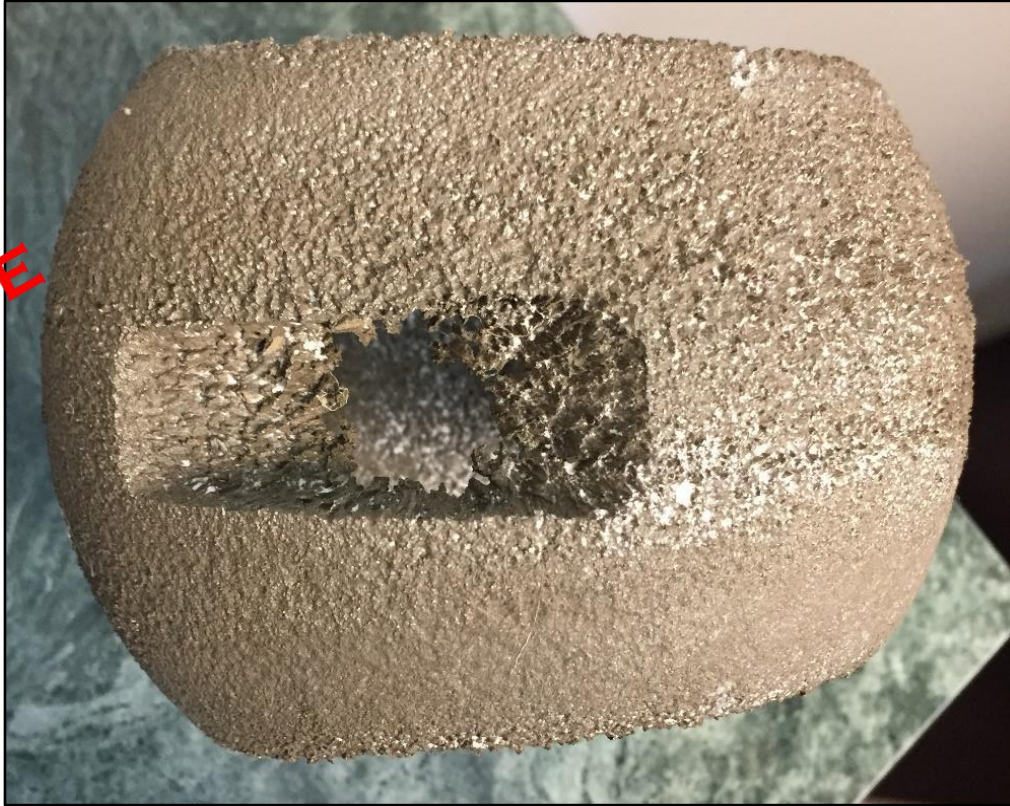
Naphtha Reformer Catalyst

ABRASIVE



Nitric Acid

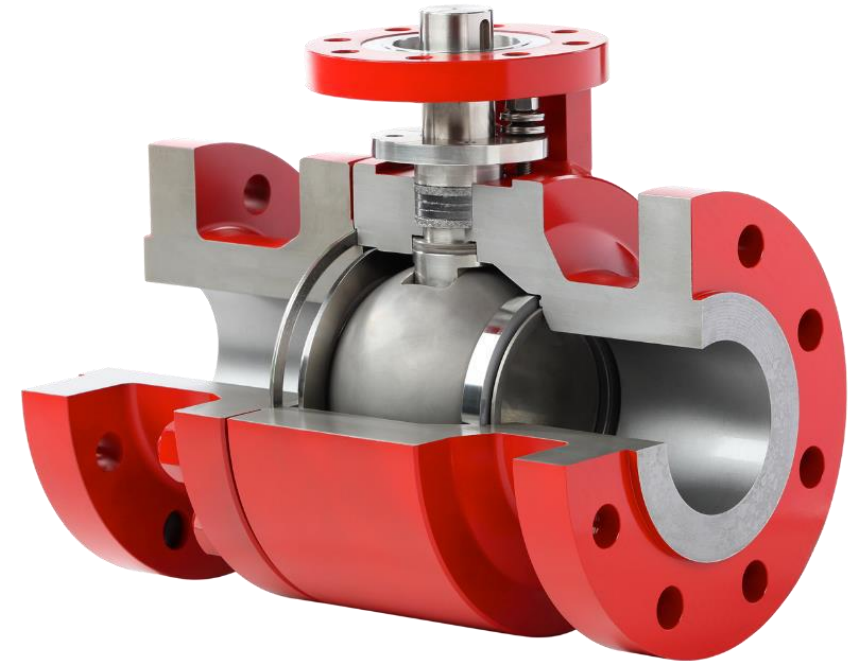
CORROSIVE



Design Factors for Severe Service Valve Selection

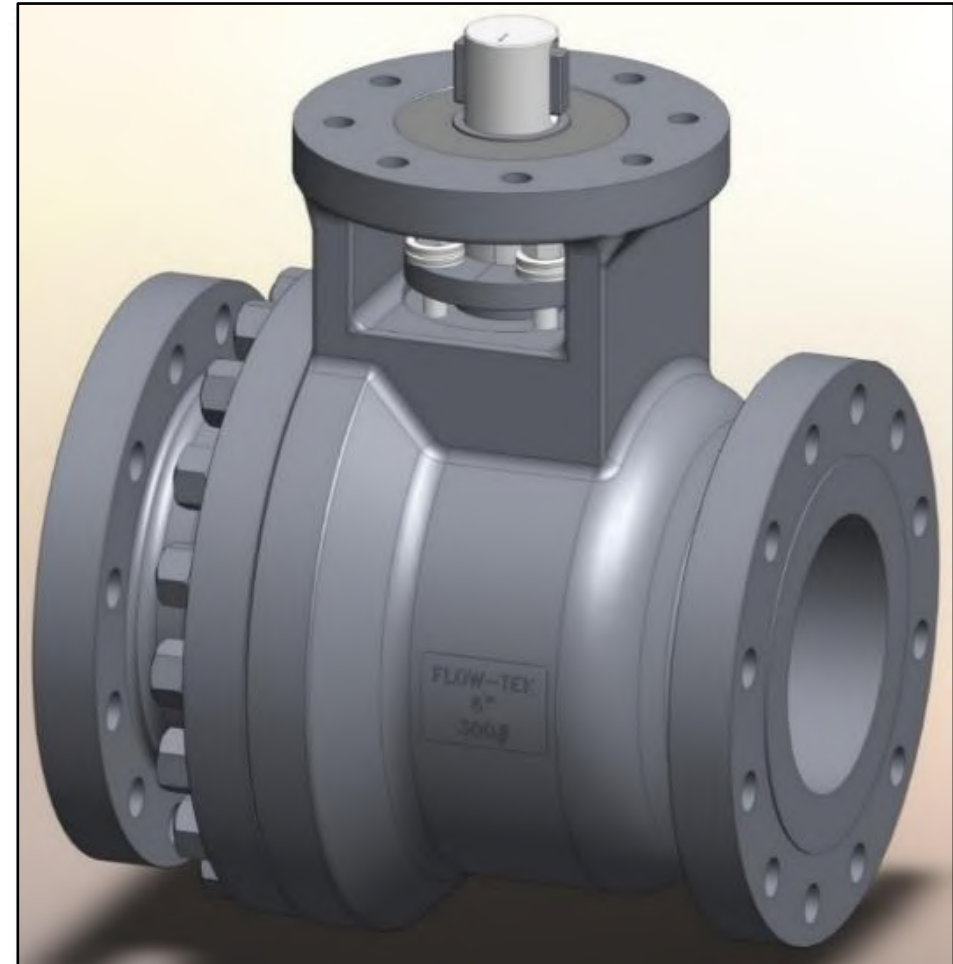
Manufacturers of severe service valves focus on the following aspects of the valve design:

- Isolating the media from the environment through stem packing, gaskets, and bearings
- Isolating the media in the closed position – ball, seat, and springs
- Consider material selection for extreme temperatures, stress analysis for high pressure, and prevention/mitigation of damage associated with the ingress of solids



Design Factors for Severe Service Valve Selection

- Protecting any exposed components in the open position – by design or material selection
- Example, full port severe service ball valves may be designed to inherently provide unobstructed flow in the open position and shield the key sealing areas from the process media
- In certain highly erosive services, end users will often request special bore sizes to match the pipe ID precisely



Design Factors for Severe Service Valve Selection

- Prevent the media from “locking up” the valve
 - By thermal expansion
 - Media accumulation preventing valve operation
- Thermal expansion is addressed through dimensional design, material selection, or combinations of the two (low and/or similar coefficient of thermal expansion)
- Various approaches may be taken with regards to the interaction of solids and the trim
 - Sometimes it may be best to prevent ingress
 - Different media favor different design philosophies
 - Sometimes the mechanical design of the stem drive train must consider higher safety factors to allow the valve to cycle through solids
- Actuator selection and sizing
- Heat shields (extensions) to protect actuator

Design Factors for Severe Service Valve Selection

- Improved resistance to galling and wear
- Coating, weld overlay, and ceramics technology improve resistance to abrasive, erosive, and adhesive wear from the process media
- Certain coatings and overlays may additionally provide corrosion resistance
- Coatings may be applied through APS, VPS, HVOF, spray-and-fused
- Ceramic liners can be effective to mitigate erosive wear within valve bodies and trim components



Design Factors for Severe Service Valve Selection

- Design for repairability means:
 - Minimizing the portions of the valve that experience wear necessitating replacement
 - Ensure that these portions can be economically and reliably replaced or refurbished
- Severe service designs are an investment and may still require regular maintenance due to the severity of the process
- They can also be designed with such cost effectiveness and substantial length of service life that their repair is neither regularly required nor cost effective

ExxonMobil

Flow-Tek M1-R100 4" Full Port Class 150 RF

Application: Fuel Gas*
Internals: 410SS/ 660SS/ 718
Actuator: Bray S98 45E2-14-SR4
Fail: Closed

*Replaced valves that had a tendency to “stick”

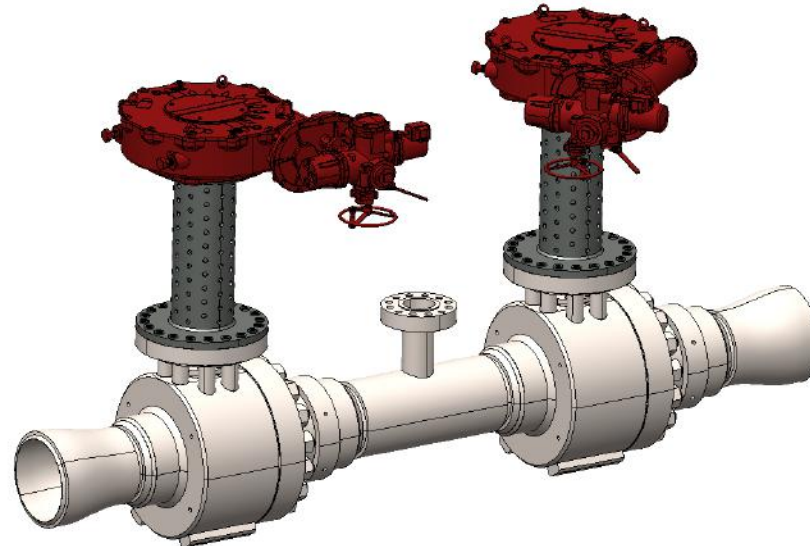
COATING USED:
ACS-0001 HVOF, Chrome Carbide



“Plant 1” Chemical Critical Duty

VALVE: Flow-Tek M1-R100 16” Class 1500 (13.00” BORE)
MEDIA: SUPER HEATED STEAM
PRESSURE: 1230 psi
TEMP: 968°F
TORQUE 1.62M lb-in

COATING USED:
ACS-0001 (HVOF, Chrome Carbide)



“Plant 2” SRW - Orange, Texas

- Application: HP LDPE Autoclaving, Polyethylene Wax Blowdown
- Qty. 3, 1” Class 1500 RTJ A105 with Bray S92 Pneumatic Actuator
- Installed February 2013
- 1 refurbished/reinstalled March 2017, 1 refurbished/reinstalled May 2017, and 1 still in service
- Previous life 1-2 years, now 7+ years

**COATING USED:
ACS-0004 (Chrome Nickel Tungsten
Carbide in Ni Matrix)**



“Plant 3”- Artesia, New Mexico

- UOP CCR Platformer
- Lockhopper Isolation with H₂, N₂, and Catalyst
- Qty. 16, Flow-Tek M1 3” Class 300 RF 316H
- With Bray 316 SS S92 Pneumatic Actuator
- 1025F, 350 psig
- Approximately 95,000 cycles performed
- Previous valve life of 4-6 months, now 5 years

COATING USED:

ACS-0005 (Chrome Nickel Boron Carbide) Ball

ACS-0001 (Chrome Carbide) Seats



“Plant 4” - Ardmore, Oklahoma

- UOP CCR Platformer
- Lift Gas (Reactor Top) with Catalyst
- 800 F @ 70 psig
- Qty. 1, 3” 600 Class RF A105/410 w/Bray Pneumatic
- Shipped 4Q14, Installed 1Q15, Still in Service (over 5 years)

**COATING USED:
ACS-0001 (Chrome Carbide)**



“Plant 5” Tulsa, Oklahoma

- Application: FCC Fractionator Bottoms Isolation
- Flow-Tek M1-R200
- Qty. 3, 6” Class 300 RTJ Grade F9/410/HVOF CrC
- Qty. 4, 8” Class 300 RTJ Grade F9/410/HVOF CrC
- Original order – Sept 2017
- Follow up order – July 2018, Installed Q1 2019

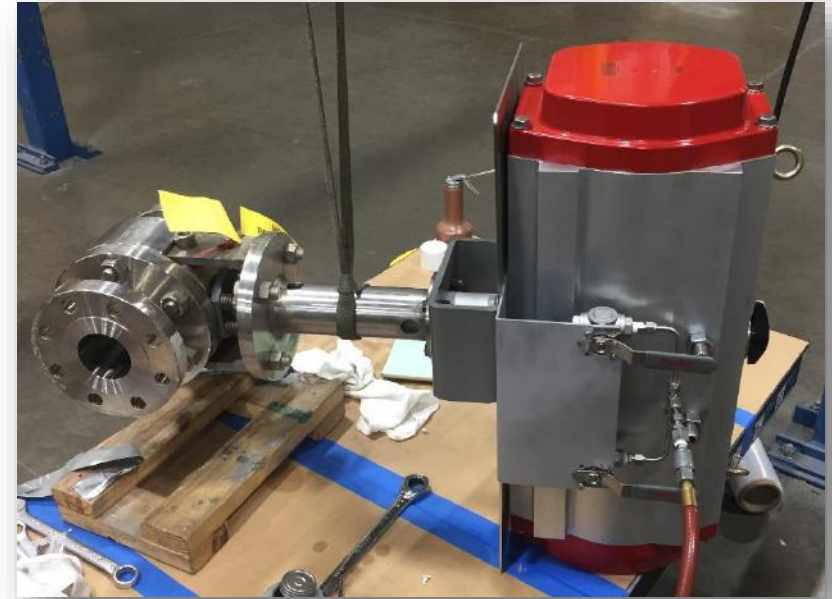
**COATING USED:
ACS-0001 (Chrome Carbide)**



“Plant 6”, Sunray, TX

- FCC
- Catalyst Withdrawal
- 4 x 3” Class 300 RF Automated and Gear Operated
- 347H with Incoloy 800H trim with Spray and Fused Chrome Carbide
- 1300 F @ 25 psig
- Clean Air Purges & Heat Shield (extension)

**COATING USED:
ACS-0004 (Chrome Nickel Tungsten Carbide in Ni Matrix)**



“Plant 7”, Roxana, Illinois

- S Zorb - Catalytic Sulfur Removal
- Al_2O_3 & Ni/ZnO catalyst in N_2/H_2 gas
- Qty. 1, 4” Class 600 M1-R100 RF F316/410/HVOF CrC with Gear Operator
- Qty 3, 1” Class 1500 SW M4 F22 with Lever
- Installed May 2015, still in service

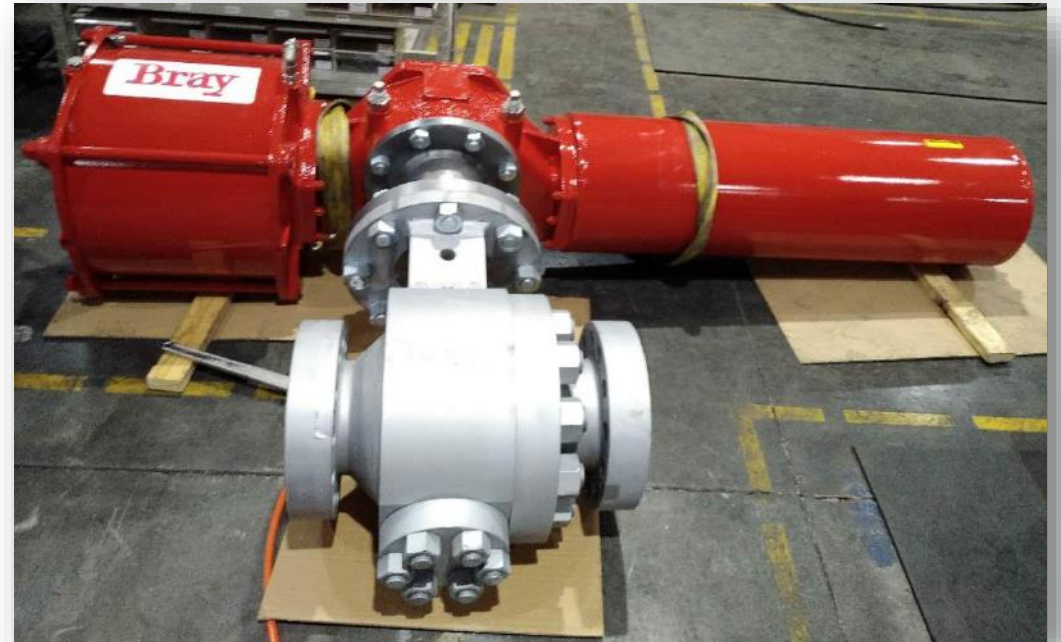
**COATING USED:
ACS-0001 (HVOF, Chrome Carbide)**



“Plant 8”, China

Coal Hydrogasification to Methanol & Stable Light Hydrocarbons, Ordos City, Inner Mongolia, China

- Syngas, Steam, H₂, N₂, and coal powder services
- 58 valves,
- ½”-12”, Class300-1500
- Up to 932 F
- F316, F304, F22, A105
- Gas tested for bidirectional zero leakage



COATING USED:
ACS-0002 (Tungsten Carbide with Cobalt Chrome Binder)

“Plant 10”, Point Comfort, TX

- Ethylene Dichloride
- DC Vinyl Chloride Monomer
- Qty. 8, ½” Class 600 RF M5 F22 Lever
- Qty. 1, ¾” Class 600 RF M5 F22 Lever
- Shipped 4Q14 (6 Years Ago)

COATING USED:

ACS-0001 (HVOF, Chrome Carbide)

ACS-0004 (Chrome Nickel Tungsten Carbide in Ni Matrix)



“Plant 11” Gas Plant, BC, Canada

- Natural gas de-sanding (40% sand)
- 2” Class 600 RF M1-R100 A350 LF2 Body/End, 17-4PH Ball, Seats, Stem
- Automated with Bray S92 Actuators

**COATING USED:
ACS-0002 (Tungsten Carbide with Cobalt Chrome Binder)**



“Plant 12” Mississauga, ON, CAN

- UOP Hydrocarbon Platform
- Qty. 2, 1” Class 300 RF A105/Inconel 718 with Bray S93 Pneumatic Actuator
- Shipped 4Q14, Installed 1Q15, Still in Service
- Approx. 8,000 cycles per year in catalyst service
- Over 30,000 cycles total to date and counting
- Helium leak tested @ 200 psig to less than 0.01 cfm



**COATING USED:
ACS-0004 (Chrome Nickel Tungsten Carbide in Ni Matrix)**

“Plant 13” Texas City

- **S19L Segmented Ball Valve**
- **FCC Frac Bottoms Slurry**
- **3” Class 600 RF**
- **WCB/316/17-4PH**
- **WC-Co Liner & WC HVOF**
- **Prior valves 4-6 Month life**
- **New valve has already exceeded prior life with no signs of failure – ROI less than 1 year**

COATING USED:

Conformal Cladding Tungsten Carbide



“Plant 14” Refinery, Russia

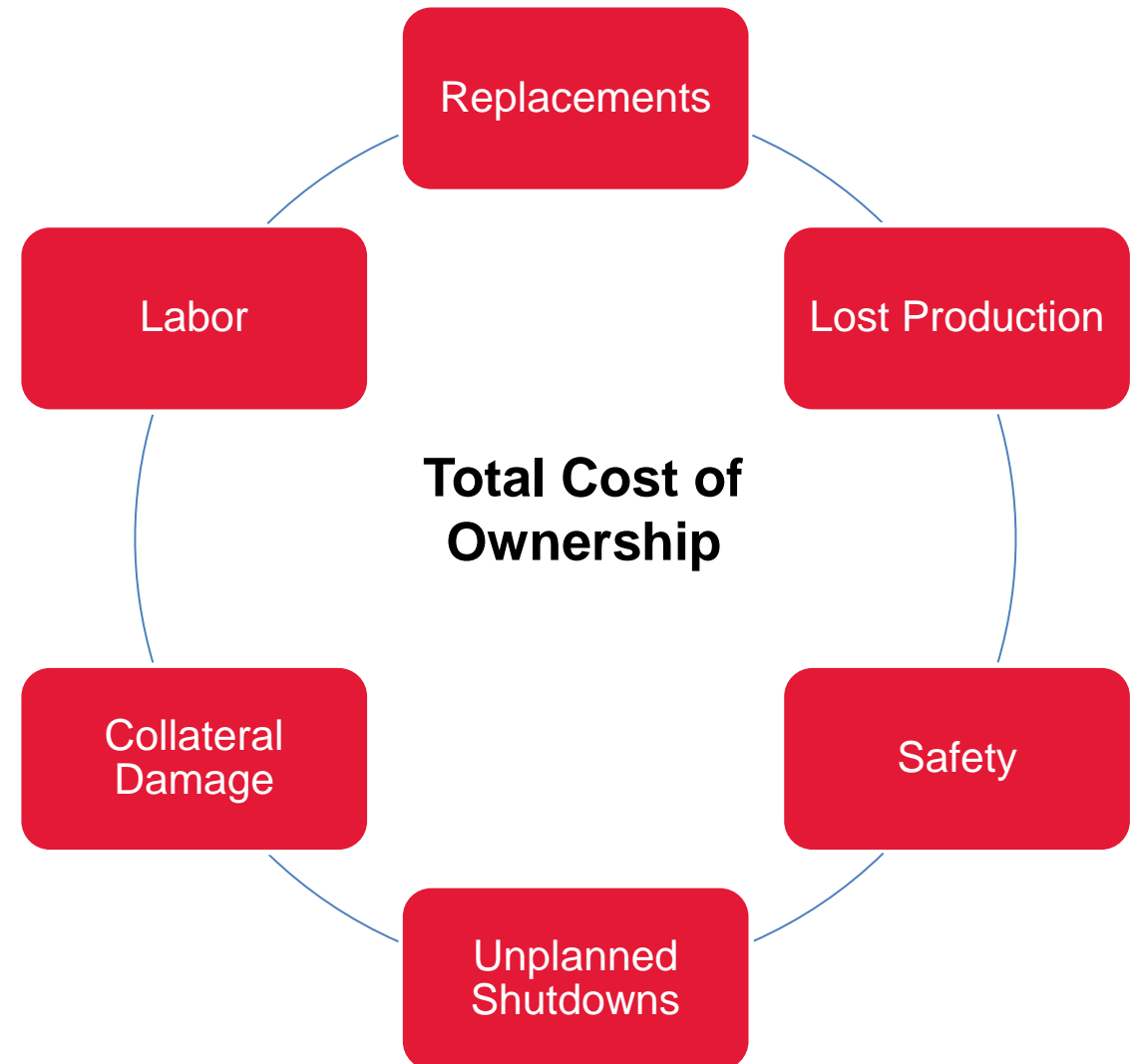
- **S19C Segmented Ball Valve**
- **UOP CCR Naptha Platformer**
- **2” Class 600 RF CF8M/316/17-4PH/HVOF Tungsten Carbide**
- **Gap between seat and segment for shutoff on spherical catalyst & prevention of catalyst crushing - 1 of 2 Approved Manufacturers**
- **Replaceable Seat Insert**

**COATING USED:
ACS-0002 (Tungsten Carbide with Cobalt Chrome Binder)**



Total Cost of Ownership

- Avoid making choices based on only on initial capital cost
- Apply **Total Cost of Ownership** that the plant owner will experience
- Added costs of incorrect selection include:
 - Replacement valves
 - Labor costs
 - Collateral equipment damage
 - Lost production
 - Cost of unplanned shutdowns
 - Safety of personnel, facilities and community

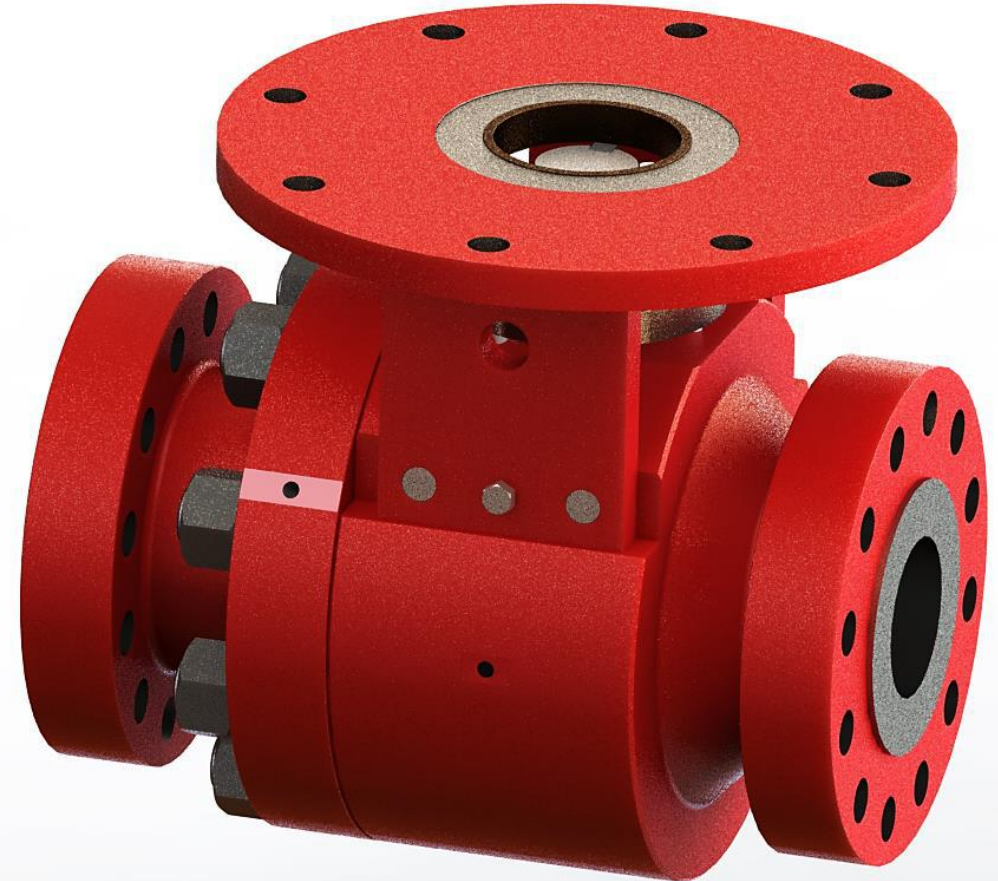


Conclusion

Selection of severe service valves requires a collaboration by:

- End user
- Specifier
- Manufacturer

To properly identify and evaluate all service and application factors to select the correct valve



Contact Your Presenters



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**Improving Valve Reliability
Selection of Severe Service Ball Valves**

**Thank You!
Questions?**