Cleaning

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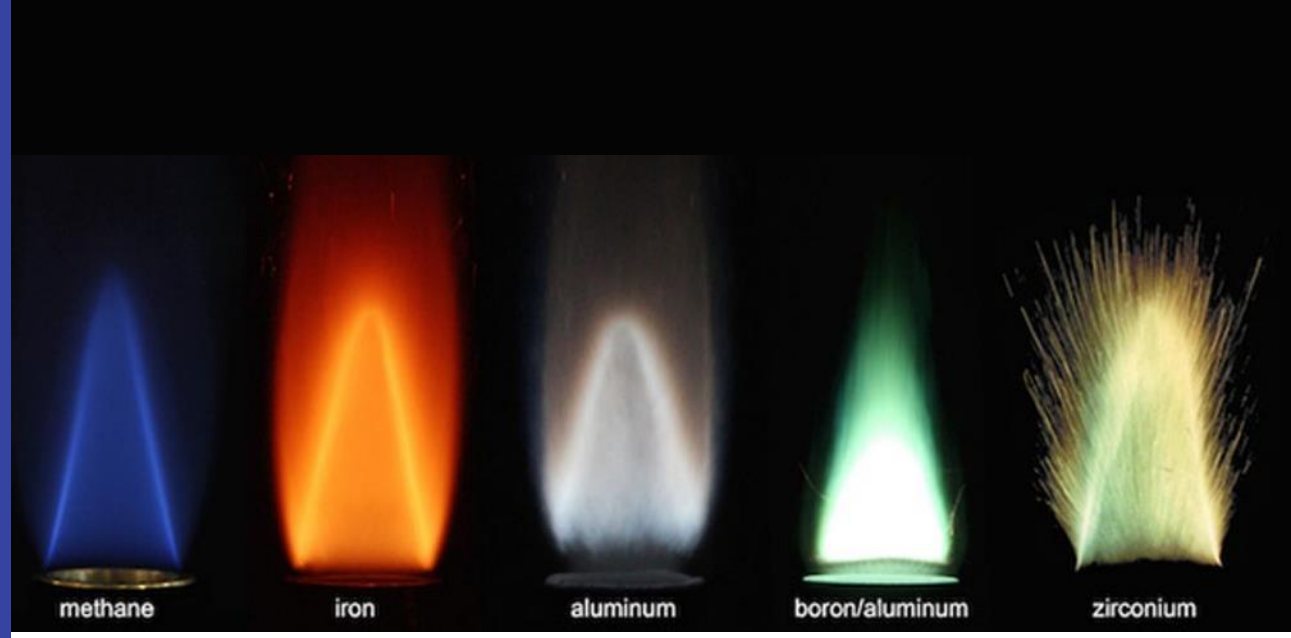
ACADEMIC-INDUSTRY LIQUID ROCKET SYMPOSIUM **2023**

Why Clean



Alternative Fuels Laboratory/Mcgill University

- Trace fuels and materials can burn in a high oxygen environment
  - Lubricants from machining and grease in valves can detonate
- Impurities can alter propellant characteristics

- Foreign Object Debris (FOD) can:
  - Compromise sealing surfaces, such as in regulators and valves
  - Plug injector orifices
  - Create internal ignitions
- Moisture can freeze valves

What to Clean

- Propellant tanks
- Feed lines and hoses
- Valves and fittings
- Ground Support Equipment
- Propellant handling equipment
- New components
- Tools and Caps and Plugs

What You Really Don’t Want To Have To Clean

- Convoluted Hoses

When to Clean

- Before assembling propellant subsystems and ground support
- After water flow testing components for cryogenic service
- Before using tools and caps on the oxidizer and fuel subsystems
- After machining and deburring parts
- After a flammable liquid spill
- After a flight
- After a test campaign
- After a hot fire test, without purge
- After kerosene exposure
- After pulling out of long-term storage

How to Clean

Other brands are available

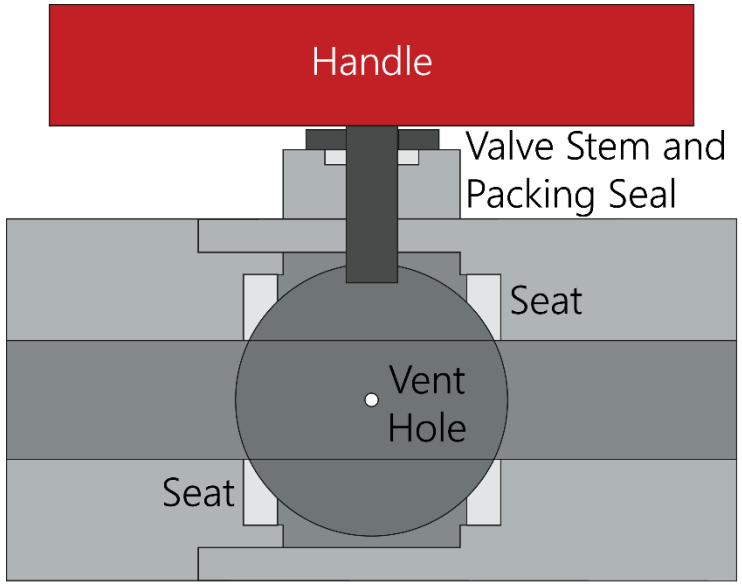
- Make sure components are compatible with cleaning fluids
- Isopropyl Alcohol is a common solvent
- Use brushes that will not scratch surfaces, like nylon
- Use clean towels and cleaning tools
- Make sure components are dry

- Avoid melting or warping plastics and elastomers with drying process
- Purge systems with inert dry gas like nitrogen
- Cap and Plug all open ports
- Absorb kerosene spills with kitty litter
- Use ultrasonic cleaner for small orifices

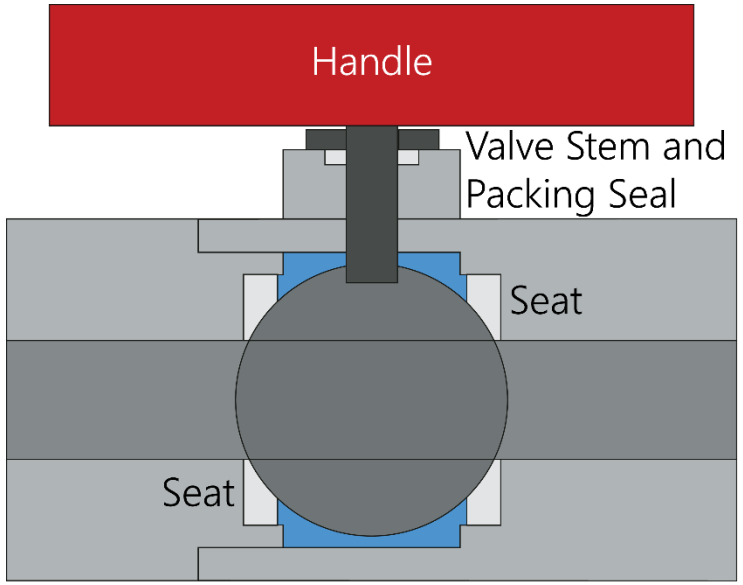
Preparing Ball Valves for Cryogenic Use

- Oil or grease can be captured behind the ball during the manufacturing process
  - Residual oils or grease can detonate with oxygen exposure
- Water can get trapped in valve cavities
  - Water can freeze the valve in place
- Cryogens can get trapped inside the valve after turning
  - Entrapped cryogens will boil into gas
  - Overpressure can blow out seals

Ball Valve Modification

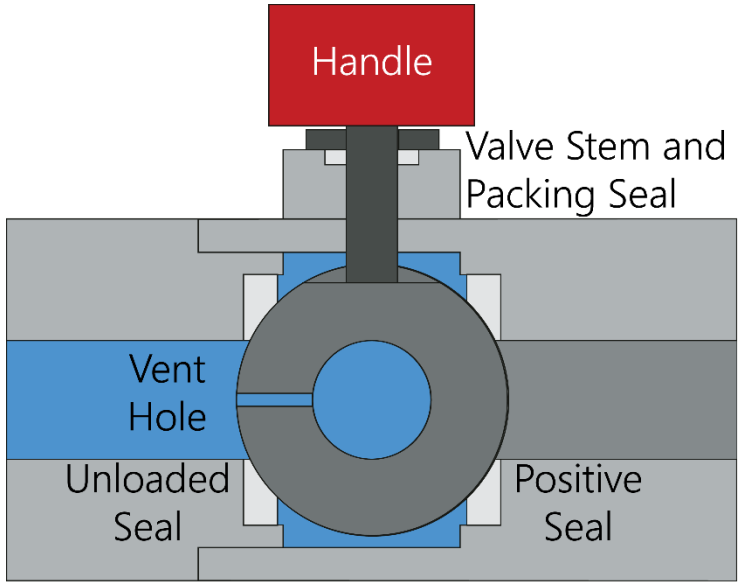


Modified Valve

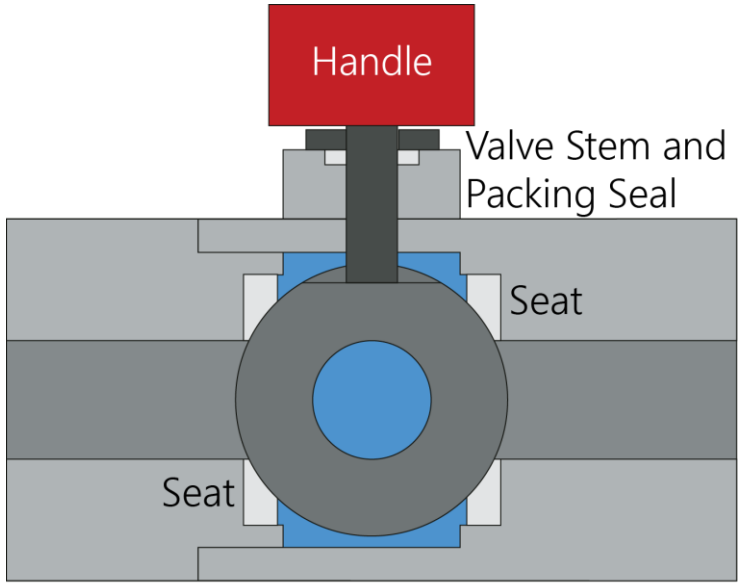


Trapped Propellant

Ball Valve Modification



Modified Valve Closed State



Trapped Propellant

Demonstration: Tubes and Fittings

1. Preclean visible residue normally
2. Wash with simple green solution
3. Use soft brushes and pipe cleaners
4. Rinse with deionized/distilled water
5. Rinse with isopropyl alcohol to remove water
6. Dry in oven or nitrogen or over time in air to remove alcohol
   - If it no longer smells of alcohol, they are dry.
7. Place cleaned parts and tools in a clean bag
8. Plug or tape open lines and ports with clean caps and/or tape

Demonstration: Preparing a Ball Valve

1. Disassemble ball valve
   - Use care to avoid deforming threads
2. Drill vent hole in ball
   - Allows release of fluid trapped behind the ball
3. Clean components for oxygen service and dry to remove moisture
4. Reassemble valve
5. Repack valve stem with PTFE
6. Place in a clean bag until installed