



Water Hydraulics, Inc.

# *WATER – The Next Generation of ‘Green’ Hydraulics*

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- History of Water Hydraulics
- Water versus Oil Hydraulics
- Current Water Hydraulic Applications
- Design of Water Hydraulic Components
- Fluid Considerations
- Maintenance Considerations
- Limitations
- Cost Considerations



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# History





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# Why Water Hydraulics?

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1

*Water hydraulics can accomplish the same work as traditional systems, without worrying about the environmental impacts associated with oil based systems.*

2

*Water hydraulics is a very efficient way to transmit fluid power; water is incompressible with no energy loss attributable to fluid compression.*

3

*Water hydraulics is naturally fire resistant; please note that advertised 'fire resistant fluid' can ignite when atomized under pressure. The key is that water is truly 'Non Flammable'.*

4

*Water hydraulics can be used even in below freezing applications; environmentally safe additives can significantly lower the freezing point.*

5

*Water hydraulics is proven technology and is being used extensively throughout many industries today such as steel, aluminum, mining, medical, food processing...and the list continues to grow.*

$$E^3 = E_{\text{conomical}} \times E_{\text{co-Friendly}} \times E_{\text{fficient}}$$



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# Applications today are Headed Towards Water



## *Water Is Used in Many Applications Today*

<b>Industry</b>	<b>Reason For Alternative Fluid</b>
Steel Industry	Fire Retardant
Aluminum Industry	End Product Contamination
Forging Sector	Incompressibility of H <sub>2</sub> O
Mining Industry	Fire/Explosion
Food Industry	Contamination
Oil and Gas Industry	Cost/Environmental
Marine Industry	Environmental

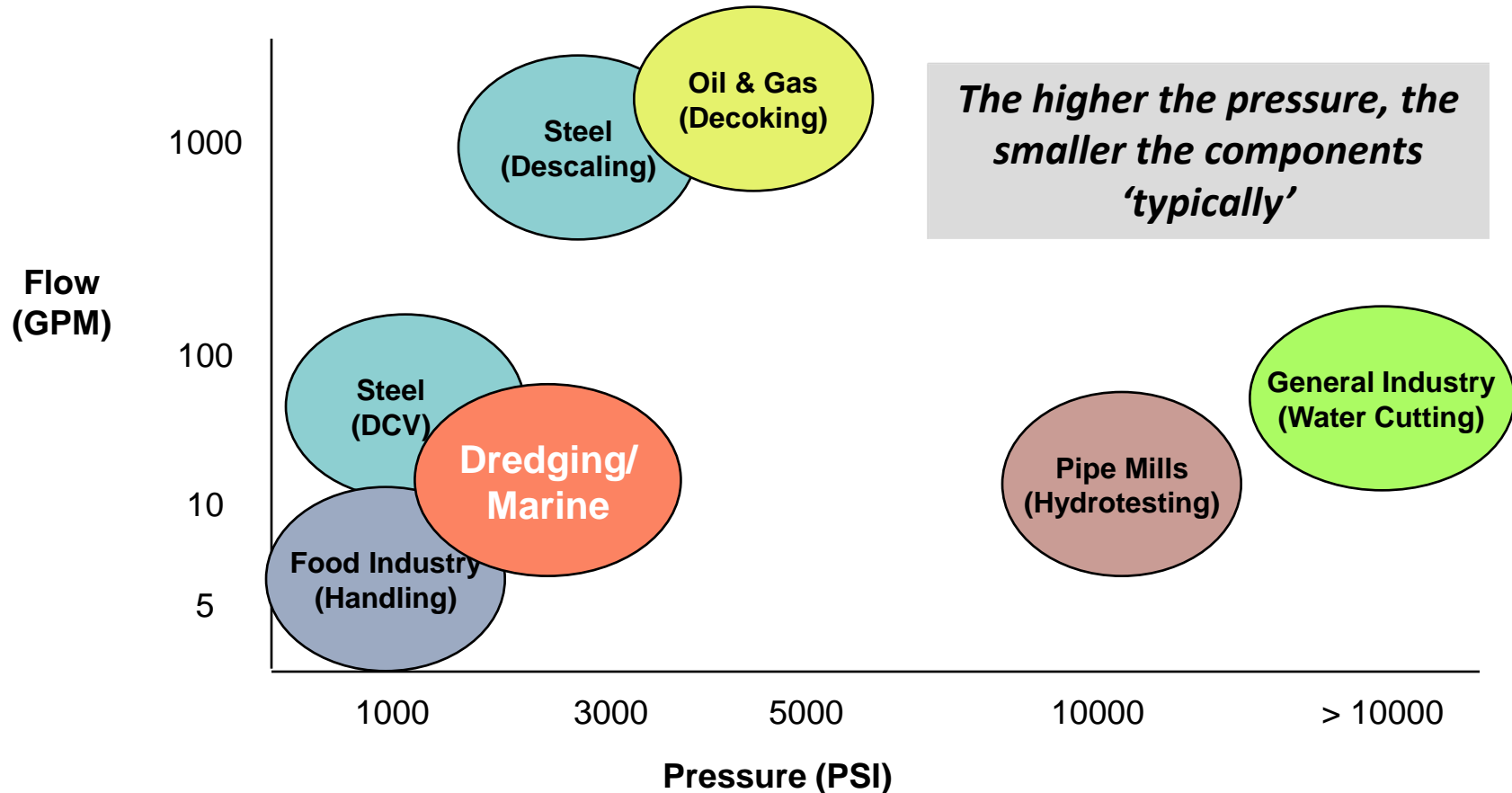


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# Range of Water Systems



From low to high pressure; low to high flow





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# Technical Considerations

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## Technological Factors Contributing To The Re-emergence Of Water As The Pressure Medium

- Advancement In Highly Corrosion Resistant Materials Such As Lower Cost Stainless Steels.
- Precision Machining That Can Produce Very Fine Tolerances To Reduce Leakage.
- Lubrication Free Materials.
- Additives To Reduce Microbial Growth.
- Environmentally Safe Anti-freeze.

Zero Leakage – Environmentally Friendly – Higher Efficiency – Lower Total Cost of Ownership



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# Technical Considerations

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## Disadvantages of Water

- Lubricity
- Velocity
- Freezing

Zero Leakage – Environmentally Friendly – Higher Efficiency – Lower Total Cost of Ownership





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# Marine Applications



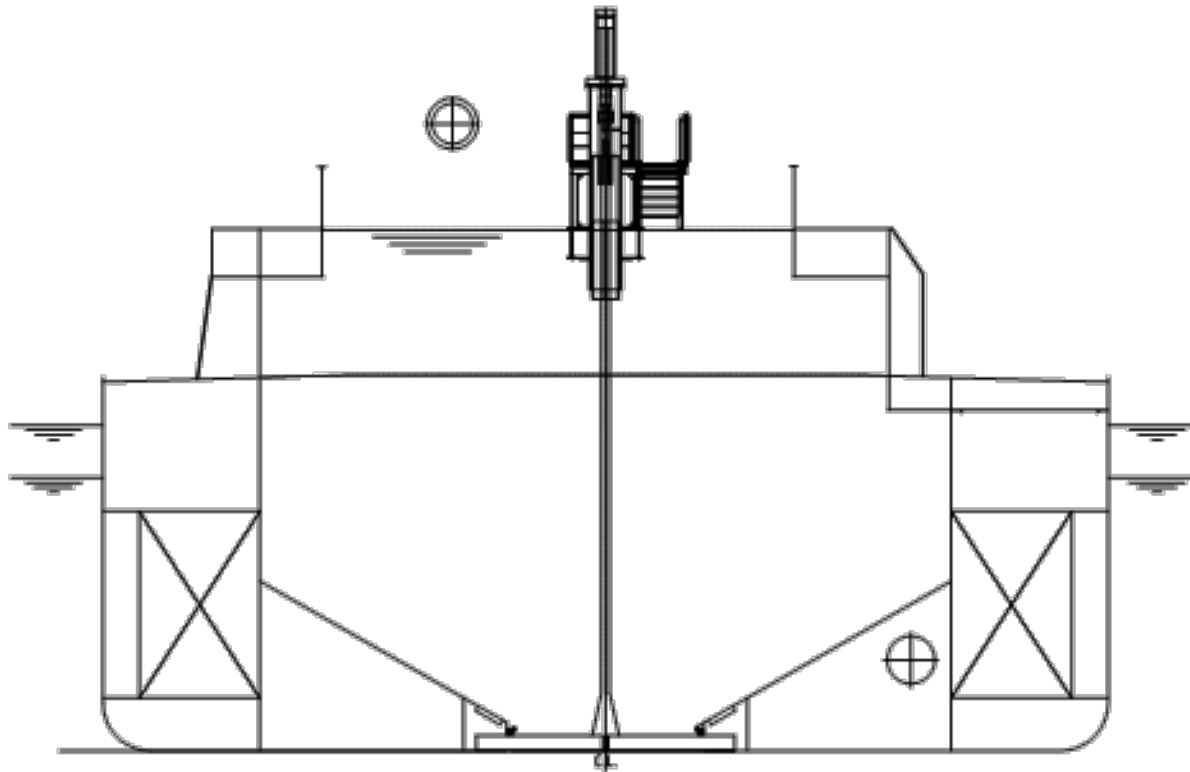
- **Hopper Dredging**

- Hopper Door Operators
- Dredging & Jetting Valves
- Dragarm Davits
- Draghead Visors
- Swell Compensator
- Vacuum Relief Valves
- Overflow Weir Cylinders
- Hopper Distribution
- Bow Coupling Control
- Split-Hull Open/Close



# Marine Applications

- **Hopper Dredging**
  - Hopper Door Operators





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# Marine Applications

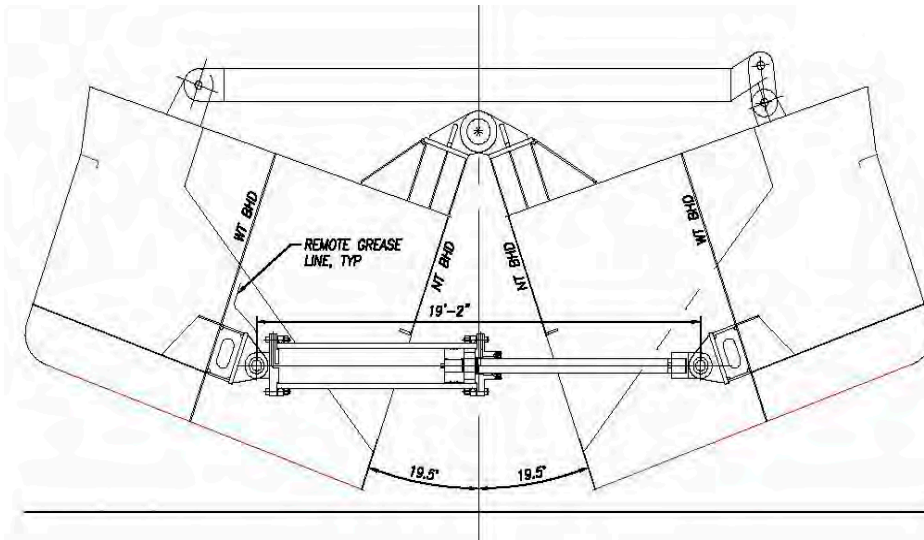


- **Hopper Dredging**
  - Dragarm Davits
  - Swell Compensator



# Marine Applications

- Hopper Dredging
  - Split-Hull Open/Close





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# Marine Applications



- **Pipeline Dredging**

- Dredging & Jetting Valves
- Vacuum Relief Valves
- Spud Hoists

- Spud Carriage
- Beach Nourishment Distribution Valves





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# Marine Applications



- **Other Marine Applications**
  - Steering Systems
  - Valve Operators
  - Jib and Boom Cranes
  - Towboat Elevating Pilot Houses
  - Fish Conveyors
  - Fishing & Research Vessel A-Frames
- Navigation
- Water Control Structures

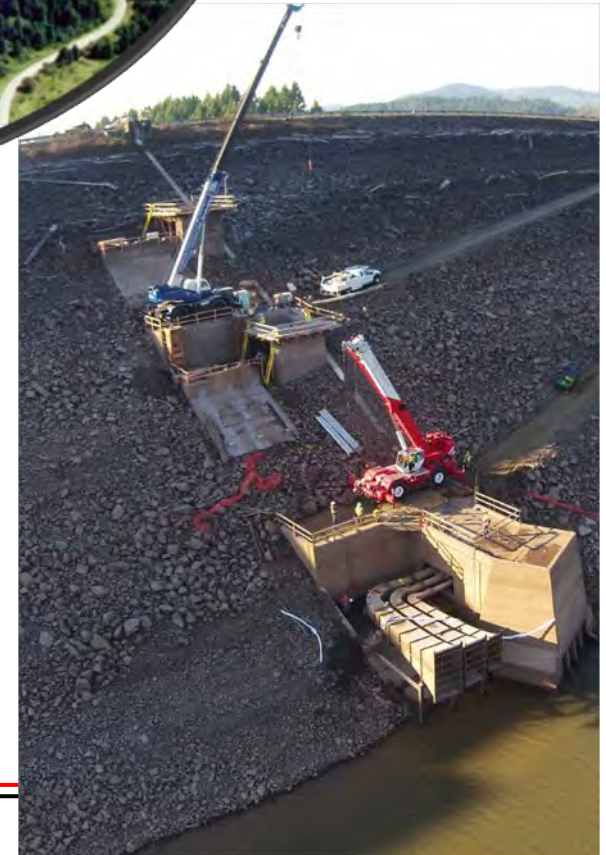




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## Fall Creek Reservoir Fall Creek, Oregon





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# Design

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## Design of Water Hydraulic Components

- Valves
- Controls
- Pumps
- Actuators

Zero Leakage – Environmentally Friendly – Higher Efficiency – Lower Total Cost of Ownership





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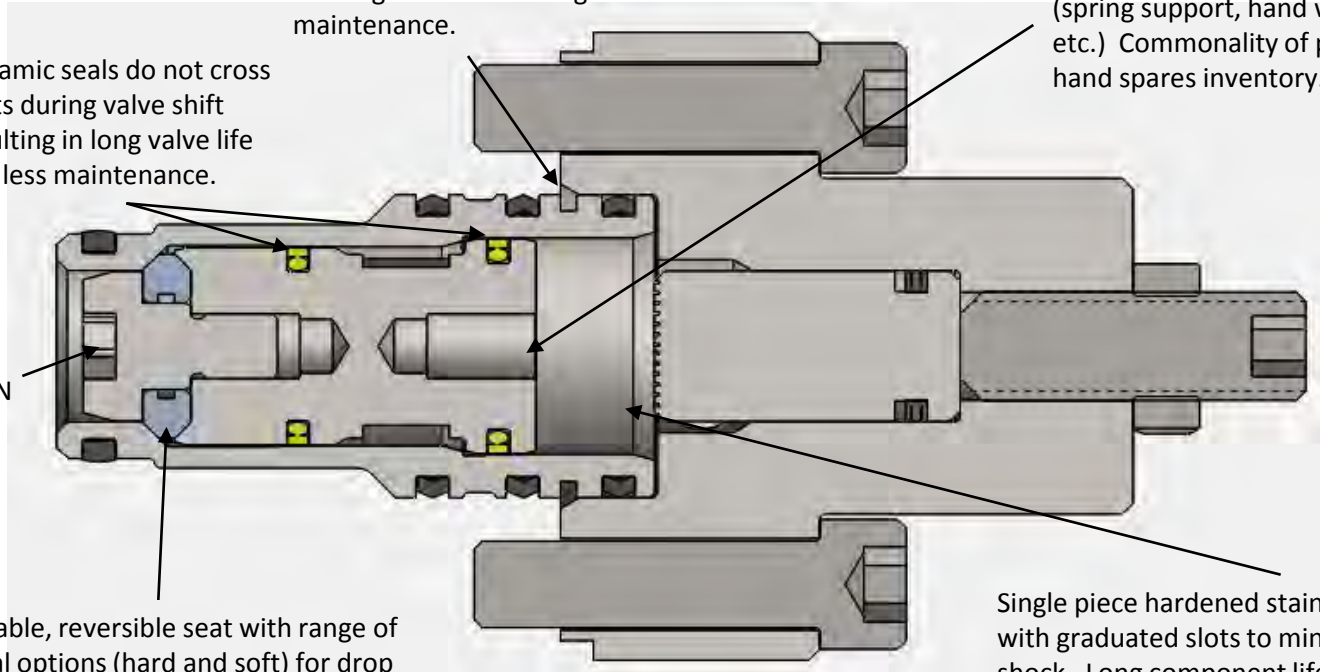
# VALVES - CARTRIDGE FEATURES



Dynamic seals do not cross ports during valve shift resulting in long valve life and less maintenance.

Slot for fast and easy cartridge removal during maintenance.

Threaded hole to support special functions (spring support, hand wheel installation, etc.) Commonality of parts reduces on hand spares inventory.



Hex socket for fast, easy removal and torquing. DIN 80 and up use multiple torque screws.

Removable, reversible seat with range of material options (hard and soft) for drop tight sealing – double seal life reducing maintenance costs.

Single piece hardened stainless steel sleeve with graduated slots to minimize hydraulic shock. Long component life and less downtime and system maintenance.





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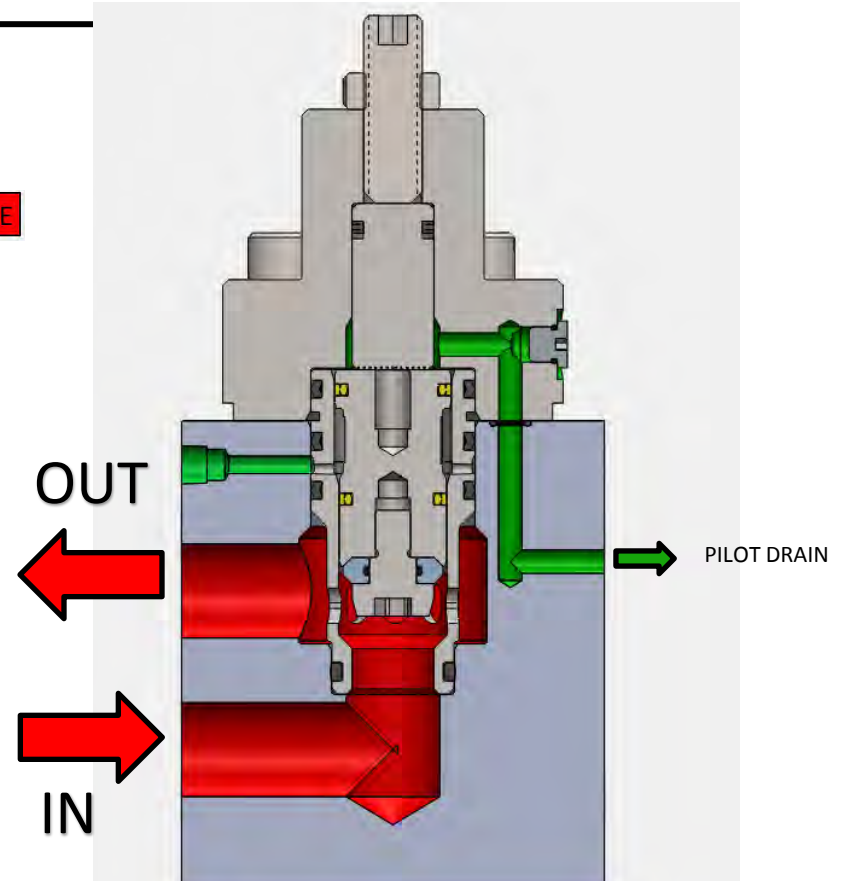
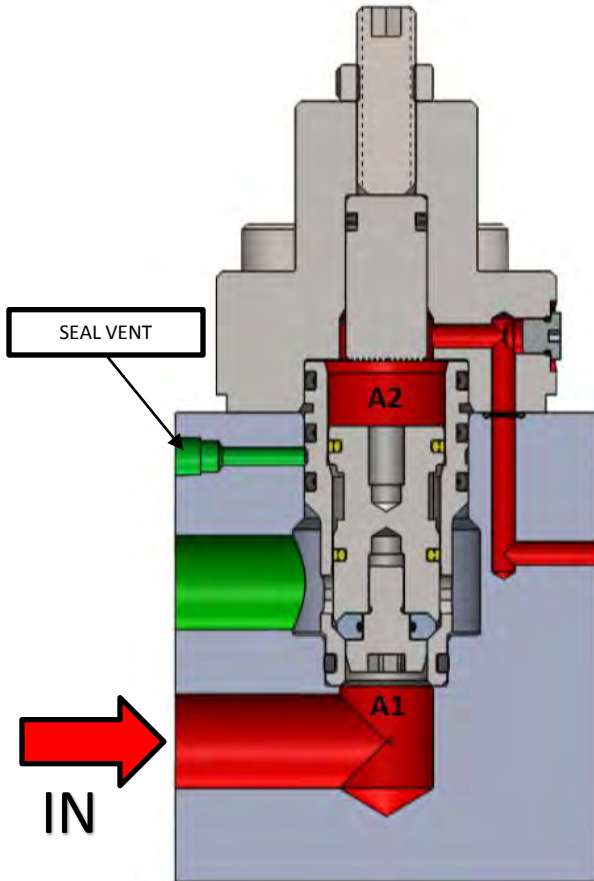
# VALVES - CARTRIDGE FEATURES



CLOSED POSITION

OPEN POSITION

SYSTEM PRESSURE



- Area 2 > Area 1
- System pressure is applied to top of poppet to close valve.
  - Pressure acting on larger area, (A2), closes the valve.

- System pressure is vented out of top of poppet.
- Pressure acting on bottom of poppet, A1, opens the valve.



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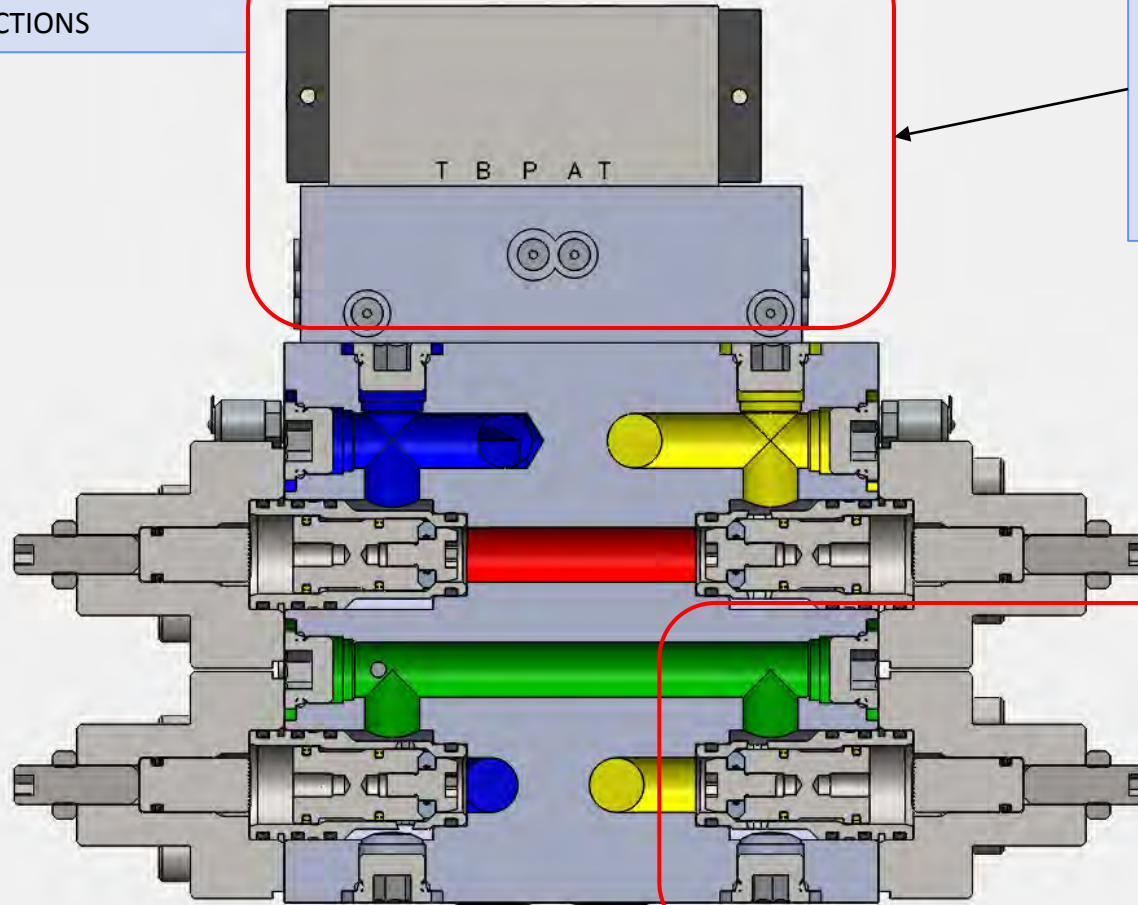
# CONTROLS - CARTRIDGE STYLE DIRECTIONAL CONTROL VALVES



- IDEAL FOR WATER SYSTEMS
- ZERO INTERNAL LEAKAGE
- FLEXIBLE ACTIONS

## PILOT SECTION:

- CONTROLS OPENING AND CLOSING OF CARTRIDGES IN CORRECT SEQUENCE.
- MANY VARIATIONS AVAILABLE FROM SOLENOID OPERATED TO LEVER OPERATED.



4 COMMON IDENTICAL CARTRIDGES

4 WAY VALVE



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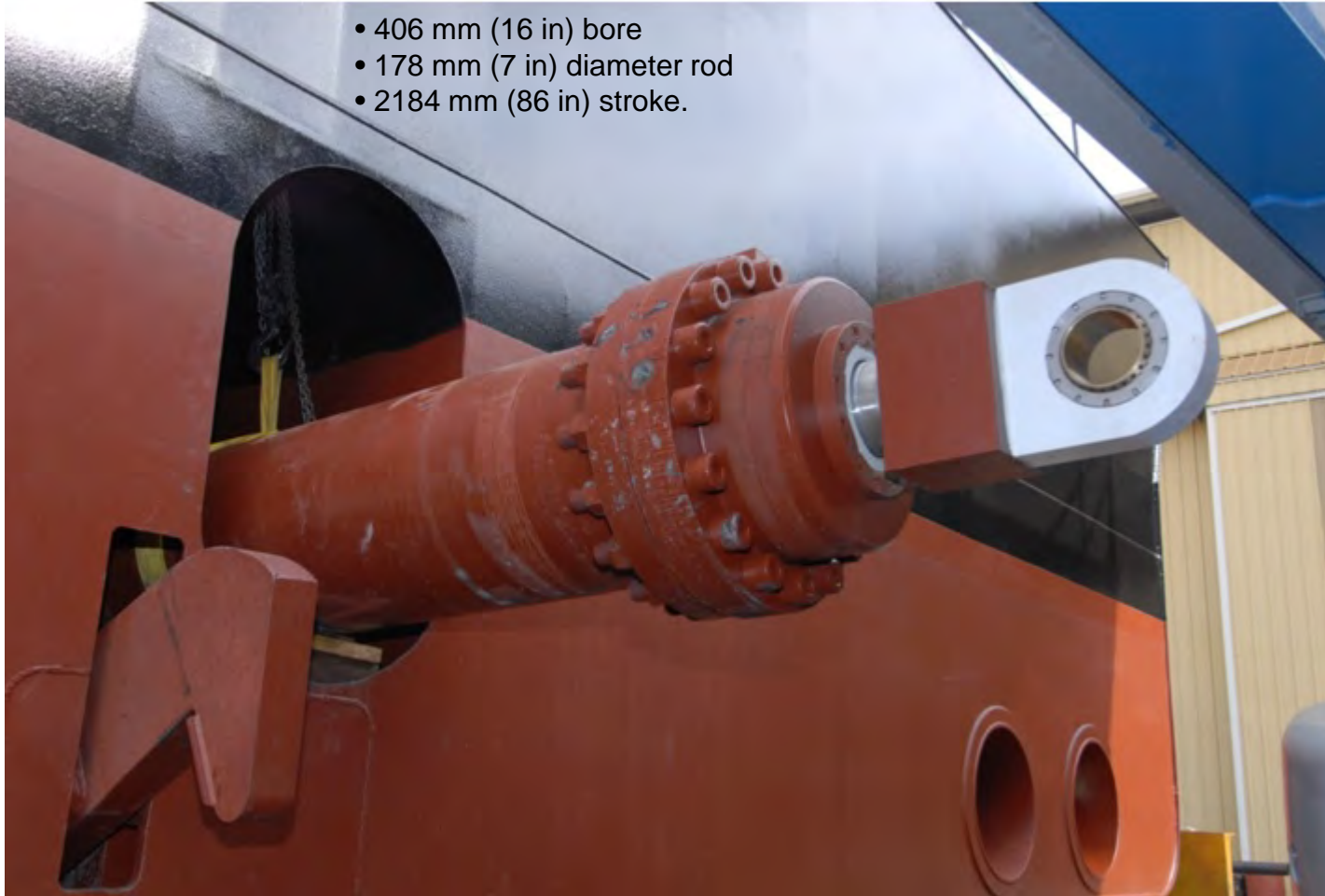
# Pumps





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# Actuators



- 406 mm (16 in) bore
- 178 mm (7 in) diameter rod
- 2184 mm (86 in) stroke.



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# Fluid Considerations

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- Media is 'Tap Water'
- Cleanliness – Some reasonable level of cleanliness (100 microns or better)
- Additives
  - Corrosion Control – Synthetic additives bond to the internals of the system and prohibit or slow corrosion
  - Algae Control – Algaecides mix with the fluid and prevent growth of biologics which can degrade system performance
  - Lubricity Assistance – Other additives are design to add lubricity to the fluid making it slippery and enhancing life of components
  - Freezing Control - Additives such as Propylene glycol (FDA approved food additive) lower the freezing temperature of the water

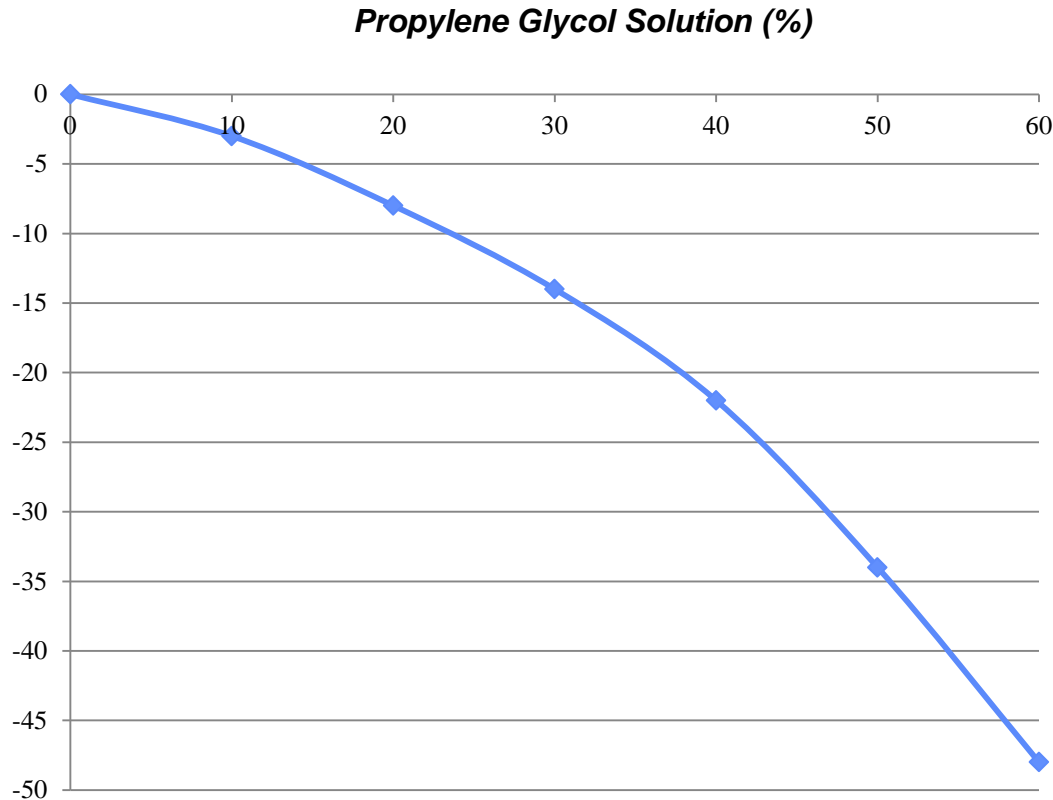


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# Freeze Prevention



## Increasing Propylene Glycol % of Solution Lowers Freezing Point



*Note: Increasing Propylene Solution level also acts to raise the boiling point from 100 deg C with no additive to 107 deg C with 60% additive. However fluid temperatures should be well below this point, preferably less than 65 deg C at all times.*

◆ Freezing Point (Deg C)



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# Maintenance Considerations Water vs Oil Hydraulics



	Oil Hydraulics	Water Hydraulics
<b>Pumps</b>	Typically non-repairable; wear out due to metal-metal contact and breakdown of fluid over time	Typically rebuildable/repairable; tighter tolerances during manufacture, high end materials of construction
<b>Valves</b>	Typically non repairable and replace with new	Tend to use packed configurations with limited metal on metal contact; typically can be repacked and re-used
<b>Fluid Conditioning</b>	Focus is on oil quality and cleanliness; fluid breakdown with time, heat, water content	Focus is on water quality and cleanliness; bacterial contamination, cleanliness, freeze point
<b>Cylinders</b>	Cylinder maintenance differences are negligible between water and oil systems. Typically side load on rod tends wear thorough plating, ruins seals; not a function of fluid	





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# Limitations of Water Hydraulics

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## Considerations

- Limited Component Supply Options
- Limited Servo Control Options for Precision Applications
- Limited Rotary Actuators – Large rotary actuator currently not available

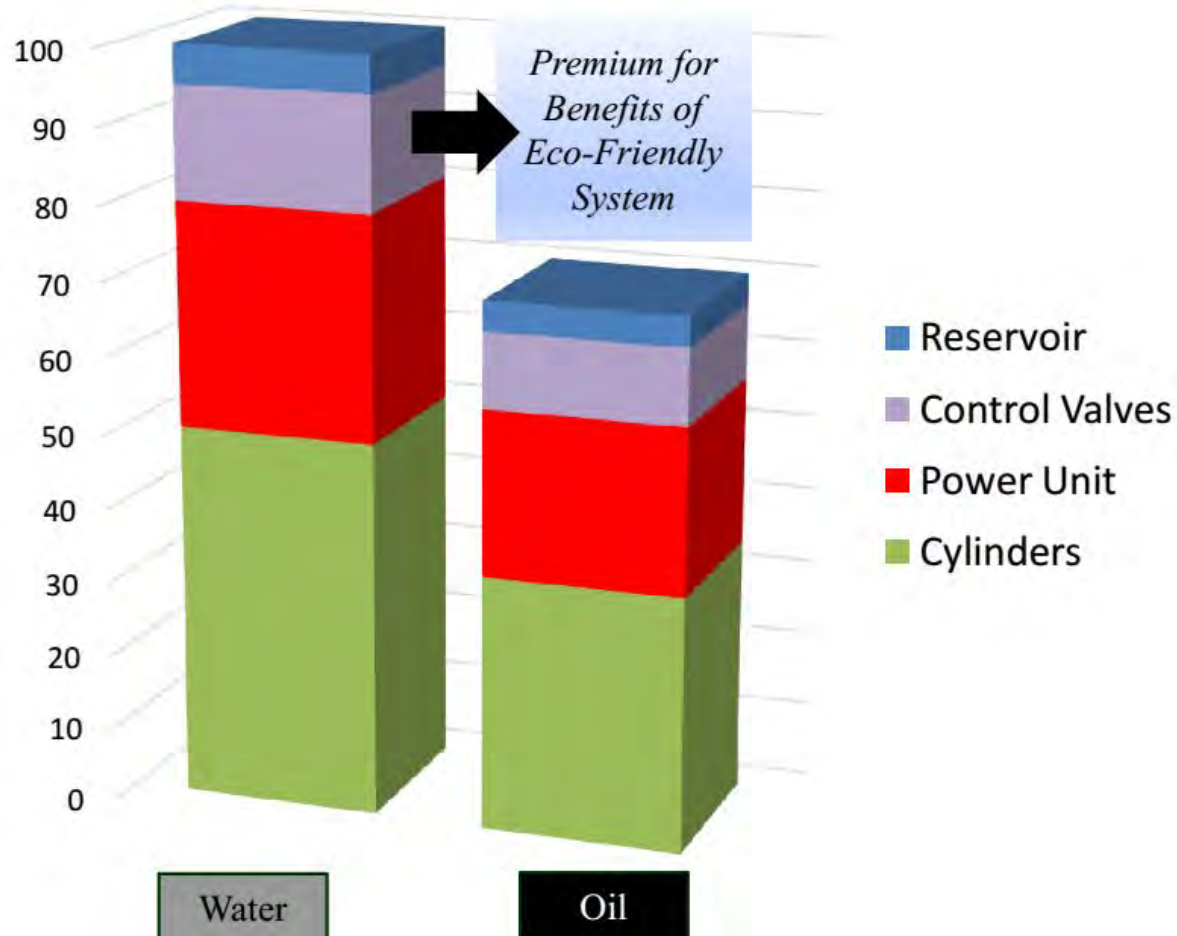


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# Initial Cost

## Water Hydraulics vs Oil Hydraulics





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# ***Fluid Cost***

## ***Water Hydraulics vs Oil Hydraulics***



Description	Tank Volume	EAL Cost	WH Cost
Reservoir	1325 L/350 Gal	\$13,300	\$350
Storage Tank	7570 L/2000 Gal	\$76,000	\$0
Fluid Makeup		\$38/Gal \$10/L	\$.26/L \$1/Gal
Fluid Contamination	350 Gal	\$13,300	\$350

### Notes:

- Water Hydraulics is filled directly from potable water system.
- No clean up cost or fines associated with Water Hydraulics.
- No storage, handling, or disposal costs for Water Hydraulics.

# CONCLUSION

- It Cost \$0 To Ask, “Can the Same Function Be Done With Water?”
- No Research Or Development Costs Associated With A Water Alternative
- Dredge MURDEN Chief Engineer David Cribbs said, “The system I doubted the most is ironically my most reliable.”



First Water Hydraulic System on a  
US Coast Guard Certified Dredge



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# DISCUSSIONS/QUESTIONS

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