Proof Testing with Water

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ACADEMIC-INDUSTRY LIQUID ROCKET SYMPOSIUM **2023**

Derek Honkawa's Background

- B.S. Civil Engineering, California Polytechnic University, Pomona
- M.S. Aerospace Engineering, California State University, Long Beach
- California Pyrotechnic Operator, 3rd Class
- Engineering Consultant, Derek Honkawa Rocketry
- Rocket Educator and Advocate
- 6 years amateur liquid rocketry
- 4 years Range Safety Officer, Videographer, Friends of Amateur Rocketry
- Former Propulsion Lead, CSULB Beach Launch Team

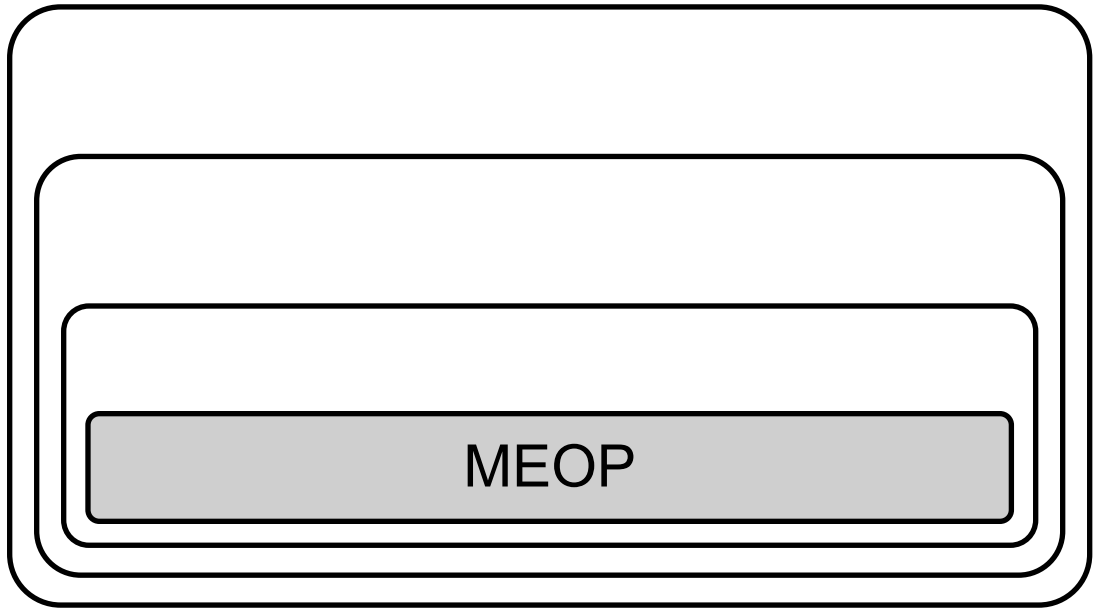
The importance of Proof Pressure Tests

- Pressure vessels may only be handled within a safe operating range
  - Cryo entrapment may cause a significant rise in pressure
  - Regulators can lock up and pressurize uncontrollably

A vessel's actual proof pressure may not match its design characteristics:

- Low weld efficiency or annealing
- Pinhole leaks or cracks
- T6 aluminum loses temper when heated
- Metal fatigue or damage
- Not designed or manufactured correctly

Terminology



- Burst Pressure = Tank Rupture
- Proof Pressure = MEOP x (1.5)
- Relief Pressure = MEOP x (1.25)
- Leak Check Pressure = MEOP x (0.25)
- Maximum Expected Operating Pressure (MEOP) = Maximum Tank Pressure
- Hydrostatic: With water, not actively pumped, and without air pockets

Tanks To Pressure Test

- Experimental Tanks

  (Not ASME or DOT certified)

  - Before use
  - When damaged or cycled many times

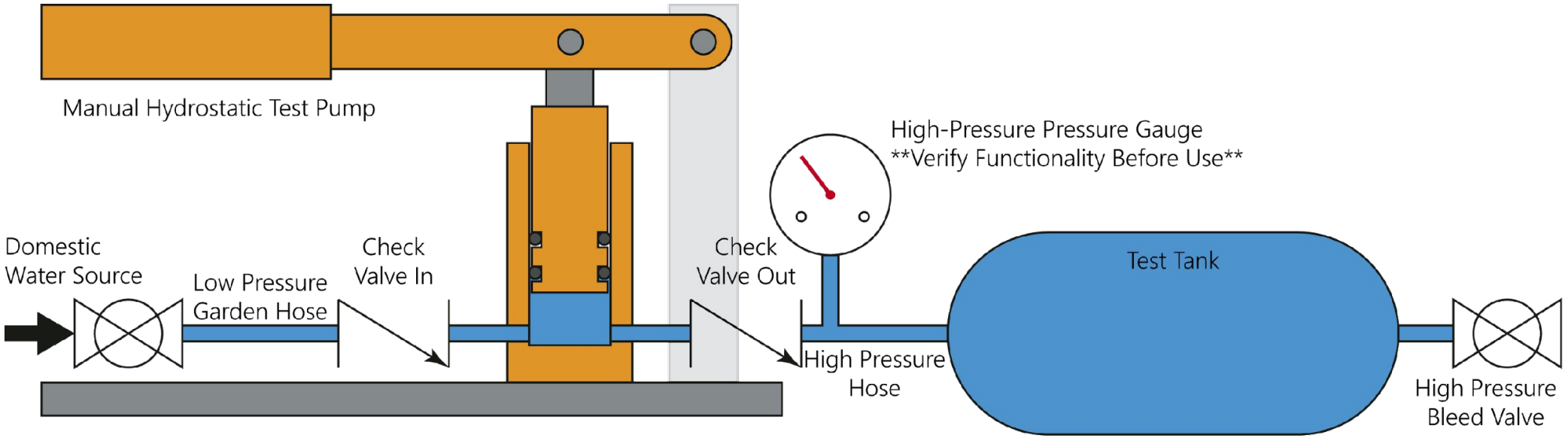
- Commercial Tanks

  (ASME or DOT certified)

  - With unknown manufacture
  - With unknown pressure rating
  - With unknown condition
  - When used above its pressure rating
  - When damaged or modified

Proof Pressure Test Setup

- Perform test in area with good drainage or evaporation
- Can be perform either indoors or outdoors
- Keep electronics and power cords out of wetted area
- Fill tank to entirety with water
- Shake out air pockets and bubbles



Proof Pressure Test Setup

1. Turn on domestic water source
   - Fill tank with bleed valve open upwards
2. Bleed air from test tank
   - Air should stop coming out of the bleed valve and close the bleed valve
3. Cycle pressure three times
4. Turn off domestic water source, Disconnect, Drain, clean, and dry

Pressure Cycle Process

1. Pump up water pressure slowly
   - Pressure should rise with each pump. If not, tank is ballooning, has a leak, or the gauge is not functioning correctly.
2. Stop and hold pressure for 1-minute
3. Relieve pressure with bleed valve, repeat