

Syringe Pump Factory Acceptance Testing Review

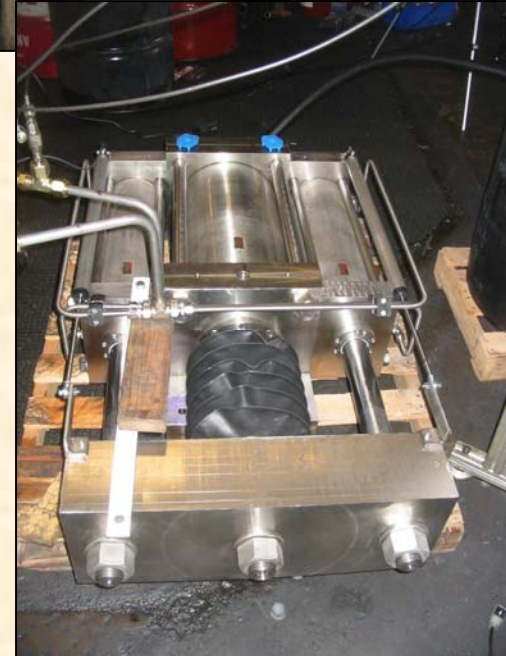
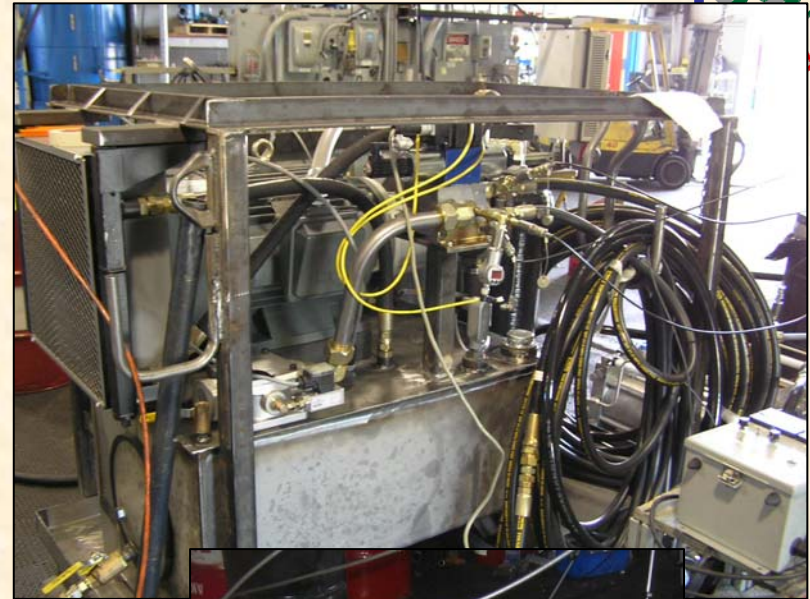
V.B. Graves

**MERIT VRVS Meeting
April 5, 2006**

Acceptance Testing of Syringe Pump Completed

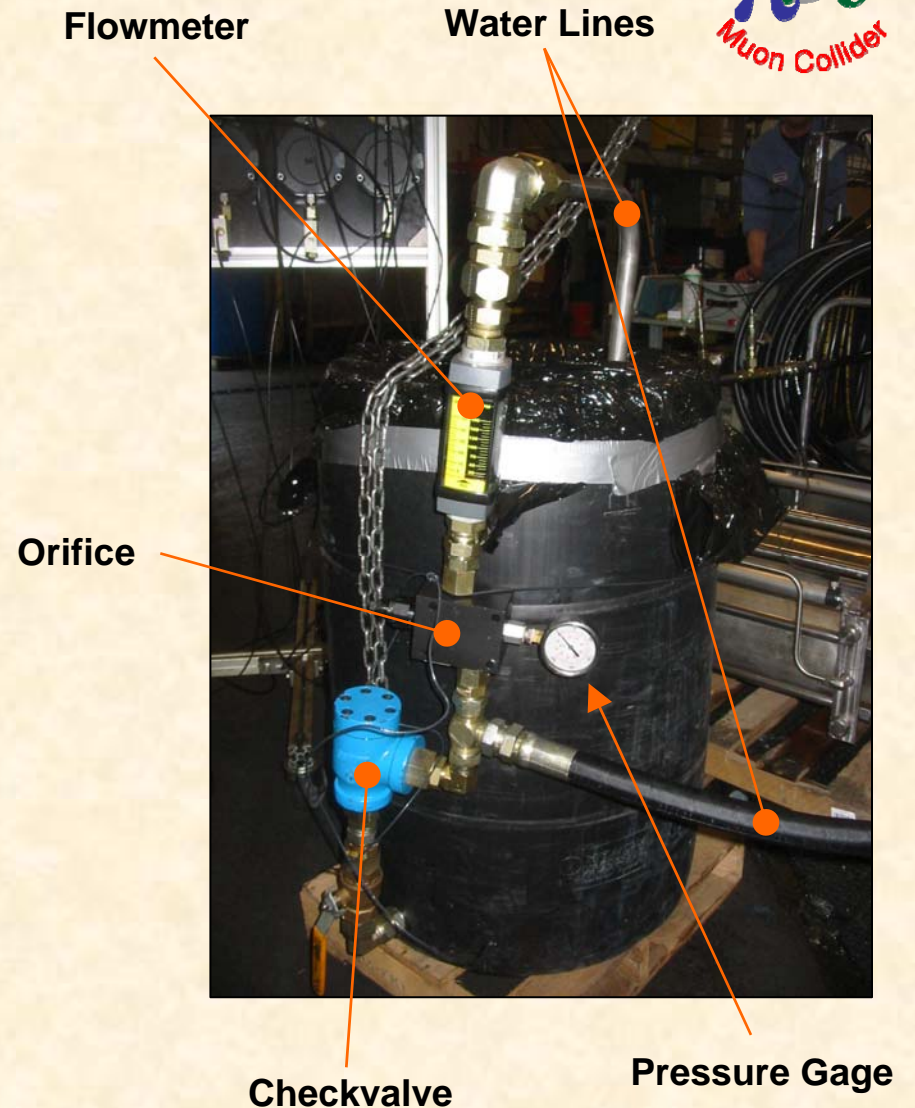


- **Factory acceptance testing of syringe pump completed March 30 at Airline Hydraulics Corp (AHC) Bensalem, PA facility**
- **Test plan consisted of demonstrating**
 - Manual syringe control with on-board controls
 - Remote control using mockup hardware (no Labview)
 - Proper sensor feedback (cylinder position, hydraulic pressure, hydraulic pump protection system)
 - Nominal piston velocity with prototypic backpressure resistance
 - 100-cycle "infant mortality" test



Testing Setup

- System tested using water as Hg substitute
- Backpressure simulated using adjustable orifice
 - Pressure gage provided adjustment feedback
- Flowmeter measured consistency of discharge (and piston velocity)
- Water drawn from bottom of barrel through checkvalve, discharged through orifice & flowmeter to top of barrel



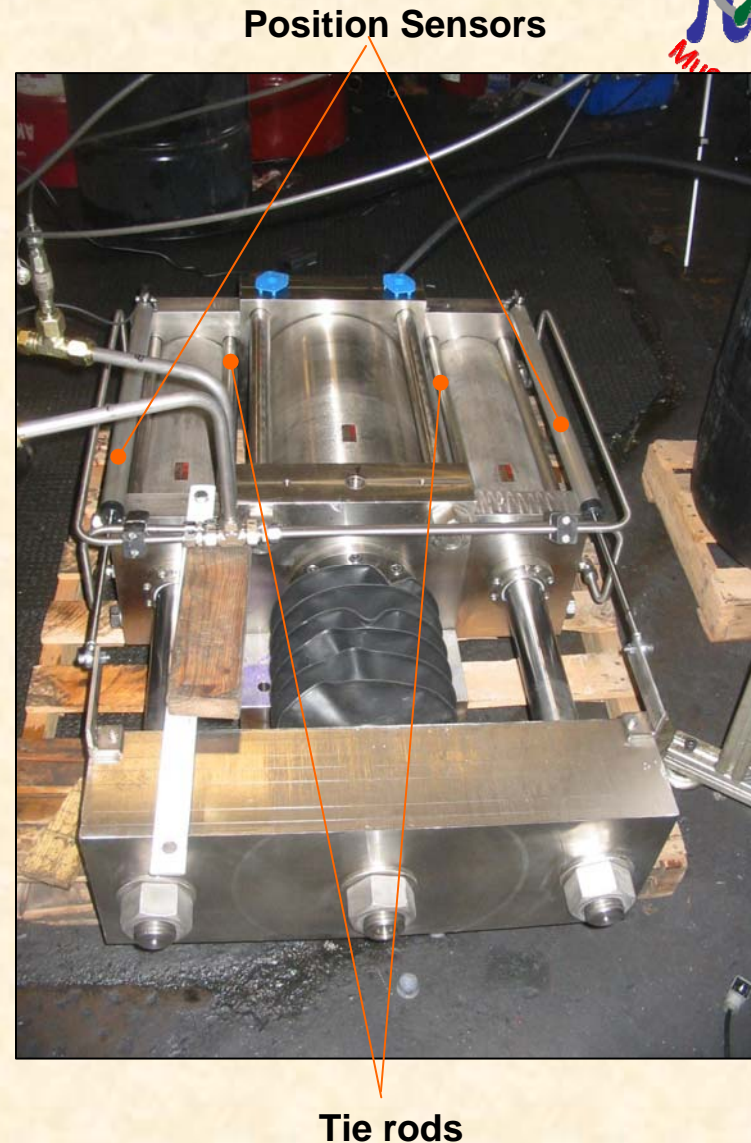


Performance Results

- **Syringe operation very smooth & controllable**
- **Demonstrated ability to pump against design backpressure of 1500 psi**
- **Problem noted: output flow varied with changing backpressure (simulated different field conditions)**
 - **AHC assumed backpressure depended only on downstream piping & nozzle and would be constant**
 - **Solution: AHC will add pressure compensator to flow control valve**

Materials Problem Noted

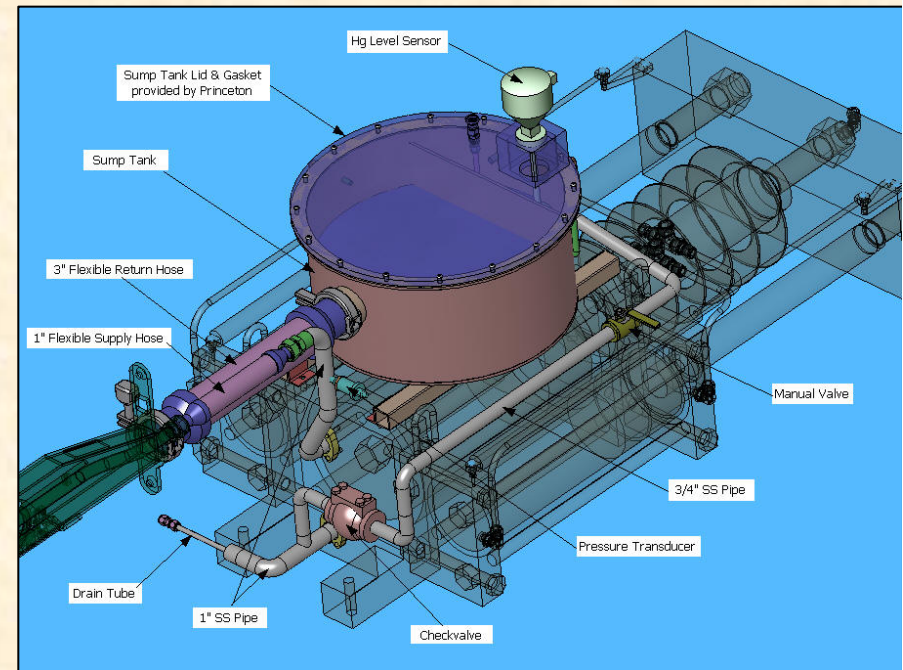
- All cylinder surfaces tested with small magnet
- Drive cylinder tie rods (8X 1" dia, 26" long) were found to be magnetic
 - Cylinder manufacturer (Hanna) used SS 17-4PH because of tension loads exceeded strength of SS316
- Solution: Nitronic50 tie rods will be substituted by Hanna at no-cost, replaced at AHC one-at-a-time to eliminate need for system disassembly by Hanna



Follow-on Work

- **Testing resulted in "punch list" of items for completion**
 - **Extend signal wiring to terminal strip accessible by Labview control system**
 - **Perform lift test of pump system, obtain weight**
 - **Add pressure compensator module & retest**
 - **Disassemble system and paint frame**
 - **Etc**

- **New scope added to AHC contract to provide sump tank and associated piping**
 - **Materials being ordered**
 - **Estimated completion mid-May**





Conclusions

- **Syringe pump system operation successful**
 - Cylinders very controllable
 - No fluid leaks observed
 - All system protection devices successfully demonstrated
- **Anticipate no major issues controlling system remotely**
 - Labview system development continuing
- **Delivery of completed system expected mid-May**