Fermilab

Particle Physics Division

# Mechanical Department Engineering Note

Number: MD-ENG- 199 Date: August 18, 2009

Project: COUPP, E-961

Project Internal Reference:

Title: **E-961, Piping Engineering Note**

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Reviewer(s): Tug Arkan, TD/SRF Development

Key Words: Piping, safety, COUPP, 5031

Abstract/Summary:
This is a formal piping engineering note per FESHM 5031.1 written for E-961 the COUPP 60 kg bubble chamber piping system.

Applicable Codes:
Fermilab Environmental, Safety, and Health Manual chapter 5031.1, Piping Systems
ASME B31.3

# FESHM 5031.1 PIPING ENGINEERING NOTE FORM

Piping System Title: COUPP, E-961 Bubble Chamber System

## Statements of Compliance

Piping system conforms to FESHM 5031.1, installation ***is not*** exceptional: Yes / No

Piping system conforms to FESHM 5031.1, has been designed, fabricated, inspected, and tested using sound engineering principles: Yes / No

Reviewer's Signature: *Tug Arkan, TD/SRF Development* Date: *Aug. 13, 2009*

D/S Head's Signature: *Mike Lindgren, PPD Head* Date: *Aug. 13, 2009*

ES&H Director's Signature: not required Date: _____
(if exceptional)

Director's Signature or Designee: not required Date: _____
(if exceptional)

# FESHM 5031.1 PIPING ENGINEERING NOTE

Prepared by: Russell Rucinski Preparation Date: June 2, 2009

Piping System Title: COUPP, E-961 Bubble Chamber System

Lab Location: DZERO Assembly Building Lab Location code: DAB

Purpose of system / System description: Pressurize bubble chamber

Piping System ID Number: Lab-wide numbering system not yet established

Appropriate governing piping code: ASME B31.3

Fluid Service Category (if B31.3): Category-D / Normal / Category-M / High Pressure (circle one)

Fluid Contents: Technical grade Propylene Glycol in pressurization piping
Air in de-gassing piping and air system piping
Water in water system piping

Design Pressure: 500 psig pressurization lines, propylene glycol
450 psig outer pressure vessel, propylene glycol
300 psig some piping on gas side of de-gassing tank
70 psig compressed air piping/tank & diaphragm tank
50 psig filter piping on liquid side of de-gassing tank
30 psig water system pump discharge
15 psig de-gassing tank piping, chiller piping

- See color coded piping flow schematic

Design Temperature: 40 C, water system and components within water tank

Piping Materials: ½", 1 ½" Schedule 40 Stainless steel piping, forged stainless steel fittings and parflex hydraulic hoses for pressurization piping, Stainless steel and brass in de-gassing piping, Stainless steel, Plastic and PVC in water system piping

Drawing Numbers (PID's, weldments, etc.): 9219.000-MD-444682 revision J

Designer/Manufacturer: Fermi National Accelerator Laboratory

Test Pressure: 150% 750 psig hydraulic test for pressurization piping
135 psig pneumatic test for air system piping

Test Fluid: Propylene Glycol for hydraulic test, gas nitrogen for pneumatic test

Test Date: July 2009 - See individual test permits

# FESHM 5031.1 PIPING ENGINEERING NOTE

This piping engineering note covers the process systems associated with operation of the 60 kg COUPP bubble chamber system, experiment number E-961.

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## I. Summary


The piping and components used have allowable pressure ratings or proof pressure ratings that exceed the maximum possible pressure by more than a factor of 1.5. The 'hydraulic' system using propylene glycol as the working fluid has the highest potential pressure of 500 psig. It was pressure tested hydraulically to 750 psig. All piping was pressure tested as required by FESHM 5031.1. All welding was done by Fermilab welders using standard welding practices. A quality factor of 0.8 was in determining piping pressure rating calculations due to lack of specific documentation on welds.


## II. General description

The piping system has four distinct fluid systems.

1. Propylene glycol fluid is used in the hydraulic re-compression piping system.
2. There is a compressed air system.
3. There is a 50/50 glycol/water chiller cooling circuit.
4. There is a heated open bath water tank system.

### 1. <u>Hydraulic compression system</u>

The hydraulic compression piping uses technical grade propylene glycol as the working fluid. The bubble chamber pressure is controlled by changing the pressure of this fluid. A light weight bellows in the expansion volume of the bubble chamber enables the pressure/force of the glycol on the dished head of the expansion volume to react against the water/CF3I bubble chamber fluids.

The maximum pressure of this piping is 500 psig, limited by the relief valve (PSV-34) setting on the discharge of the hydraulic pump. The normal operating pressure of this circuit is in the range of 0 to 30 psig when the bubble chamber is decompressed (superheated state, waiting for bubble nucleation) and 200 psig pressure when the bubble chamber is compressed.

The bubble quenching compression is very fast, on the order of 100 msec. This is accomplished by opening an air valve to a piston assembly which drives a smaller piston in the hydraulic side of the system. Because of the fast motion, there is considerable momentum developed. At the end of the pressurization stroke, the hydraulic side pressure multiplied by the piston area must momentarily exceed the air side pressure multiplied by the piston area to slow down and reverse the piston motion. The system dampens after a few oscillations. The peak pressure has been measured to be about 275 psig during the initial stage of piston motion.

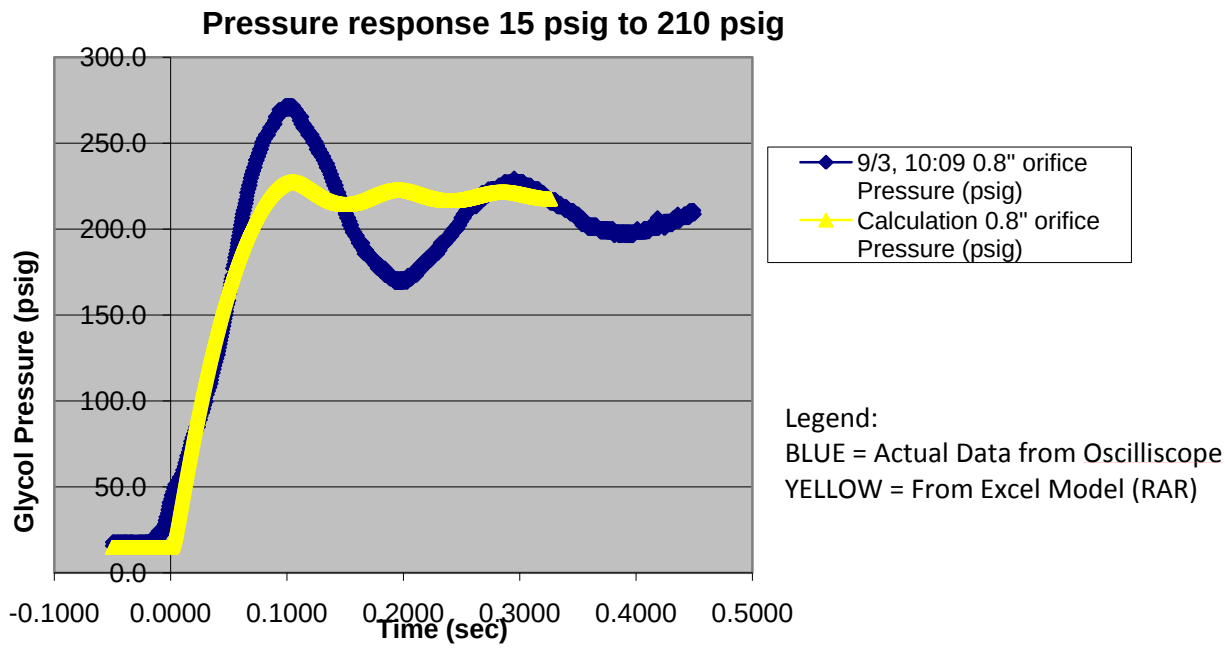


**Figure 1.** Pressure response trace measured with oscilloscope during PAB engineering run.

The function of the hydraulic pump is to supply or remove glycol at a slow rate to compensate for volume changes induced by bulk glycol temperature change. The pump is very small.

**Picture 1.** Oildyne HBS206 pump. Pump head is about 2" on a side.

The maximum pump flow will be 618 cc/min = 0.163 gpm. This is based on the maximum motor speed of 3000 RPM and a 0.206 cc/revolution displacement. This is a very small flow rate which can easily be handled by the relief valves.

2. **Compressed Air System**

The hydraulic recompression system uses house compressed air to force the air side piston which is coupled to a smaller sized piston on the glycol side. House compressed air is typically limited to 120 psig. House air pressure is immediately reduced to 55 psig by Wilkerson pressure reducing regulator, PV-10. The setting of 55 psig is an operational choice that limits the glycol side recompression pressure to 4 (ratio of air cylinder area to glycol cylinder area) multiplied by 55 psig = 220 psig. The maximum design pressure for the air system components is 70 psig which is the set point of PSV-60 (located immediately downstream of PV-10). There are two pressure vessels in the compressed air system. Both are ASME code stamped vessels with formal pressure vessel engineering note documentation reviewed and approved. The air reservoir tank is code stamped for 200 psig. It is FNAL vessel #10109. Normal operating pressure for the air reservoir tank is 55 psig. The air reservoir tank supplies the air cylinder. The other tank is a bladder tank. The air is regulated down to 10 psi by PV62 and pressurizes the bladder side of the tank. Glycol is on the other side. The bladder tank is ASME code stamped for 150 psig. It is FNAL vessel #10110. The bladder tank supplies the hydraulic pump with a modest glycol volume at a steady suction pressure of 10 psig.

3. **Chiller Cooling system**

A commercial NESLAB RTE-740 chiller runs in a closed loop configuration. It supplies cooling or warming 50/50 glycol/water fluid to copper coils that are inside of the outer glycol vessel. The chiller has an internal relief valve to protect the system piping. The pump pressure is a maximum of 7 psig. 3/8" OD plastic polyflow tubing is used to connect the fixed piping of the chiller to a penetration fitting located on lid of the outer vessel. The coil of tubing inside is ½" OD x 0.032" wall copper tubing, 12 turns at a radius of about 9". The copper coil has the potential to see 450 psid maximum external pressure and therefore was analyzed for the case of collapse. The ASME boiler and pressure vessel code (reference sections UG-28 thru UG-30 & figure NFC-6, SB-75 Cu tubing, Section II, part D, Fig. G) was used to determine an allowable external pressure rating of 940 psi.

4. **Heated Open water bath**

The bubble chamber device sits submerged in a circulated, heated water bath. The water bath container is a 4000 gallon, ½" thick polyethylene tank. The polyethylene tank is good for temperatures up to 120 F (49 C). It can be used up to 140 F but would experience permanent creep over time. We intend to use it at 40 C. A commercial spa pump and 5.5kW heater are used to circulate and heat the water. The spa temperature controller (http://www.spaguts.com/Product.aspx?ID=57) has temperature limits that prevent overheating. The water pump has a maximum pressure output of 30 psig. The pump curve is elsewhere in this document. The design pressure of the pump discharge piping was chosen to 50 psig. All components are rated for pressures greater than this.

## III. Valve, Instrument, Equipment, and piping Components list

The valve component list and instrument component list contain manufacturer information and pressure ratings for each component. A "System Maximum Pressure" column is added to allow easy comparison between the rated pressure and the maximum possible. In all cases, the pressure ratings are higher than the system maximum. This is by design. If the rating was less, a different higher rated component was used or the system maximum pressure was limited by means of a relief valve. The valve component and instrument component list are used with the system flow diagram, FNAL drawing number 9219.000-MD-444682. Manufacturer catalog information for each component can be found in section V of this document.

The piping component list lists the various types of piping used for the runs between components. Of interest are the flexible hydraulic lines, fittings, and piping used in the hydraulic recompression system. This is the system with the highest potential maximum pressure of 500 psig. As can be seen in the list, all components have working pressure ratings of greater than 1000 psig. Commercial hydraulic components were used that are rated to much higher pressures. Forged, high pressure, 3000 psig rated elbows and tees were used with welded connections. The use of threaded connections (still rated sufficiently high) was minimized. Piping pressure ratings were determined using formulas from ANSI/ASME Piping code B31.3. A sample of those calculations is included at the bottom of the piping list. The submerged sections of piping are constructed of stainless steel pipe or Parflex plastic hydraulic hose. A pressure test to 750 psig will be/has been done to certify the tightness and safety of the hydraulic piping. See the pressure testing permit at the end of this document.

The equipment list has manufacturer information about the components that don't fall into the category of components or piping. Things like chillers, tanks, pumps are listed. Information about equipment that acts as a pressure source is included in section VI of this document.

| TYPE | Num | Fluid | Description/Location | Manufacturer | Model number | Size | Pressure Rating | Other Info | System Maximum Pressure |
|---|---|---|---|---|---|---|---|---|---|
| PSV | 1 | PG | outer vessel | Kunkle | A79633-1BKP | 1/1/2002 | 500 psig | 400 psi S.P. | 450 psig |
| MV | 2 | PG | Instrumentation line purge | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 500 psig |
| MV | 3 | PG | bellows purge | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 500 psig |
| MV | 5 | PG | outer volume purge | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 6 | PG | recompression | Sharpe | 2-53036-SW | 2 | 1000 psig | Cv=395 | 500 psig |
| MV | 7 | PG | instrument line purge | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 500 psig |
| EV | 8 | A | fast recompression | Mac | 57D-63-611JC-0449 | 1 NPT | 150 psig | Cv =17.4 | 150 psig |
| MV | 9 | A | decompression vent | Deltrol | EFL-10-B | 1/4 | 2000 psig | | 150 psig |
| PV | 10 | A | air pressure regulator | Wilkerson | B12-03-HLRL | 3/8 NPT | 250 psig | 0-200 PSI | 150 psig |
| PSV | 11 | PG | outer vessel | Kunkle | A79633-1BKP | 1/1/2002 | 500 psig | 400 psi S.P. | 450 psig |
| MV | 12 | PG | instrument isolation | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 500 psig |
| PSV | 13 | A | air reservoir | CDI, SF50 | McMaster 48435K82 | 1/2 | 250 psig | 150 psi S.P. | 150 psig |
| PSV | 14 | PG | outer vessel operational relief | Circle Seal | 5159T-4MP-45, spring chg. | 3/4 | 2400 psig | 300 psi S.P. | 300 psig |
| MV | 15 | PG | outer vessel vent | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 450 psig |
| MV | 16 | V | flask interseal evacuation | Swagelok | SS-4BK-VCO | 1/4 | 1000 psig | Cv=0.4 | 15 psig |
| MV | 17 | PG | outer vessel diverter | Apollo | 800 WOG | 3/4 | 800 WOG | | 450 psig |
| MV | 18 | PG | SV-14 isolation | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 450 psig |
| MV | 19 | A | accumulator charging shrader valve | McMaster carr | 6380T76 | 1/2"-20 | 3000 psi | | 500 psig |
| MV | 20 | A | diaphragm tank liquid side high pt bleed | Swagelok | B2HK2 | 1/8 | 1000 psig | | 500 psig |
| PSV | 21 | A | diaphragm tank air | CDI | McMaster 48435K82 | 1/4 NPT | 250 psig | 50 psi S.P. | 150 psig |
| MV | 22 | PG | diaphragm tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 23 | PG | diaphragm tank to pump | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 24 | PG | pump isolation | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 25 | PG | pump isolation | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 26 | PG | pump-degassing chamber | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 27 | PG | volume control system | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 28 | PG | outer vessel bottom fill | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 29 | PG | outer vessel drain | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 450 psig |
| MV | 30 | PG | fluid pump bypass | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 500 psig |
| MV | 31 | PG | high point gas bleed at accumulator | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 500 psig |
| MV | 32 | PG | fluid pump bypass | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 500 psig |
| MV | 33 | PG | high point gas bleed below MV-6 | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| PSV | 34 | PG | pump discharge relief valve | Delta Power | PB-RVA-00-0800 | 1/4 | 3500 psig | 500 psig S.P. | 500 psig |
| PSV | 35 | PG | pump discharge relief valve | Delta Power | PB-RVA-00-0800 | 1/4 | 3500 psig | 90 psig S.P. | 500 psig |

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|---|---|---|---|---|---|---|---|---|---|
| MV | 36 | PG | outer vessel bottom fill | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 37 | PG | diaphragm tank bypass | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 38 | PG | diaphragm tank fill | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 39 | PG | block valve near diaphragm tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 40 | PG | degassing tank bottom drain | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 41 | PG | PG supply drum | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 15 psig |
| MV | 42 | PG | degassing tank level meter | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 15 psig |
| MV | 43 | PG | degassing tank level meter | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 15 psig |
| MV | 44 | V | vacuum pump isolation | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 450 psig |
| MV | 45 | N | dry gas backfill | Sharpe | 1/4-53036-SW | 1/4 | 1000 psig | Cv=20 | 15 psig |
| PSV | 46 | PG | degassing tank | Circle Seal | D559B-4M-20 DN6 | 1/2 | 200 psig | 15 psi S.P. | 15 psig |
| EV | 47 | PG | cartridge, pump discharge | Delta Power | MA-S2E-00-HC-24 | 1/4 | 1500 psig | | 500 psig |
| MV | 48 | PG | vapor line to de-gassing tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 49 | PG | bottom drain de-gassing tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| MV | 50 | PG | pump-degassing chamber | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 500 psig |
| PSV | 51 | PG | flow indicator proctection | Circle Seal | 5159B-4MP-350 | 1/2 | 2400 psig | 300 psi SP | 300 psig |
| RO | 52 | PG | Restricting orifice union, 0.8" dia. | McMaster carr | 45525K598 | 1 1/2" | 3000 psi | | 500 psig |
| MV | 53 | PG | instrument isolation | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 450 psig |
| MV | 55 | PG | high point vapor bleed | Swagelok | B-4HK | 1/4 | 1000 psig | Cv =0.28 | 450 psig |
| MV | 56 | PG | high point vapor bleed | Swagelok | B-4HK | 1/4 | 1000 psig | Cv =0.28 | 450 psig |
| PSV | 57 | PG | Liquid line filter protection | Aquatrol | 130A-50 | 1/4 | 200 psig | 50 psi S.P. | 50 psig |
| F | 58 | PG | Filter, ge-gas tank liquid line | Watts | W10RPH14CWSC | 1/2 | 125 psig | | 50 psig |
| PSV | 60 | air | air tank operational limit | Circle Seal | 5159B-4MP-60 | 1/2 | 2400 psig | | 150 psig |
| MV | 61 | air | air tank drain | Unknown | S34 CW617N | 1/8 | 200 psig | | 150 psig |
| PV | 62 | A | diaphragm tank charging | Wilkerson | B08-01-CK00 | 1/4 | 150 psig | | 150 psig |
| MV | 70 | W | heating/cooling return | Sharpe | 1/2-53036-TE | 1/2 | 1000 psig | Cv=28 | 15 psig |
| MV | 71 | W | heating/cooling return | Sharpe | 1/2-53036-TE | 1/2 | 1000 psig | Cv=28 | 15 psig |
| MV | 72 | PG | Block valve near de-gassing tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 300 psig |
| CV | 73 | Air | Compressed air connection point | Nupro | B-4CP4-1/3 | 1/4 | 3000 psig | 1/3 psi S.P. | 150 psig |
| MV | 75 | PG | Block valve near de-gassing tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 300 psig |
| MV | 76 | PG | Block valve near de-gassing tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 300 psig |
| MV | 77 | PG | Bottom liquid drain at sight glass | Nupro | B4HK-2 | 1/4 | 1000 psig | Cv=0.28 | 15 psig |
| PSV | 78 | PG | Sight glass over-pressure protection | Circle Seal | 5120T-2MP-275 | 1/8 | 2400 psig | 15 psi SP | 15 psig |
| MV | 79 | PG | Block valve near de-gassing tank | Sharpe | 1/2-53036-SW | 1/2 | 1000 psig | Cv=28 | 15 psig |
| MV | 80 | CF3I | PT83 isolation | Carten | MD-250 | 1/4 VCR | 550 psi | 1.5*Op Press | 450 psig |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| MV | 81 | CF3I | purge valve | Swagelok | 6LVV-DPHFR4-8 | 1/4 VCR | 3045 psi | Cv=0.20 | 450 psig |
| MV | 83 | CF3I | Vapor purge line | Carten | MD-250 | 1/4 VCR | 550 psi | 1.5*Op Press | 450 psig |
| MV | 84 | CF3I | Main Bubble Chamber isolation | Carten | HF-1075 | 1" VCR | 550 psi | 1.5*Op Press | 450 psig |
| F | 89 | W | Filter, 5 elements 1 micron x 30" lg | Fulflo | FHSS-530 | n/a | 150 psig | | 30 psig |
| MV | 90 | W | PI-90 manifold block valve | Anderson Greenwood | MM1VSO2-8174 | 1/4 | 3000 psi | | 30 psig |
| MV | 91 | W | Water recirculation, pump suction | Hayward | 2" PVC | 2 | 180 psi | | 15 psig |
| MV | 92 | W | Water recirculation, pump discharge | Hayward | 2" PVC | 2 | 180 psi | | 30 psig |
| MV | 93 | W | Water recirculation, fill/drain | Hayward | 2" PVC | 2 | 180 psi | | 30 psig |
| MV | 94 | W | Water system high point purge | Worcester | 4416NSE RCWP300 | 1 | 300 psi | Cv=32 | 15 psig |
| MV | 95 | W | Water filter housing high point purge | Whitey (Swagelok) | SS-62-TS4 | 1/4 | 2200 psig | | 30 psig |
| MV | 96 | W | Water filter housing tap | Apollo | C11 801 800 WOD | 3/4 | 600 psig | | 30 psig |
| MV | 97 | W | PI-90 manifold block valve | Anderson Greenwood | MM1VSO2-8174 | 1/4 | 3000 psi | | 30 psig |
| MV | 98 | W | PI-90 manifold block valve | Anderson Greenwood | MM1VSO2-8174 | 1/4 | 3000 psi | | 30 psig |
| MV | 99 | W | LI-21 purge valve | Swagelok | SS-4P4T4 | 1/4 | 3000 psig | Cv=0.9 | 15 psig |

| Type | Num | Fluid | Description/Location | Manf | Model | Range | Proof Pressure Rating | System Maximum Pressure |
|---|---|---|---|---|---|---|---|---|
| PI | 1 | PG | outer volume glycol pressure | McMaster | 3845K3 | 600 PSIG | 600 psig | 500 psig |
| PT | 2 | PG | slow response BC pressure | Setra | 2251-0500P-A-C4-11-B1 | 500 PSIA | 650 psig | 500 psig |
| PT | 3 | PG | fast response BC pressure | Noshok | 100-500-2-1-2-1 | 500 PSIG | 875 psig | 500 psig |
| ZT | 4 | | BC bellows position | Unimeasure | JX-PA-3.8-N-1-21S-31N | 3.8 inches | n/a | n/a |
| PT | 5 | PG | Ultra-fast dynamic pressure response | Dytran | 2005V | 50 psi dynamic | 1000 psig | 500 psig |
| ZT | 6 | | piston position | Balluf | BTL5-E10-M0203-Z-S3L | 8 inches | n/a | n/a |
| PIT | 7 | A | recompression air supply | Ashcroft | 20X 1005 HD 02L | 160 PSIG | 240 psig | 150 psig |
| FI | 8 | PG | pump recycle | Kobold | VKM 6103 | 0.05-0.3 GPM | 3600 psig | 500 psig |
| WT | 9 | PG | diaphragm tank weight | Honeywell Sensotec | C2W | 0-100 lb | n/a | |
| WE | 9 | | diaphragm tank weight | Honeywell | #53 | 0/100 lb | n/a | n/a |
| PI | 10 | A | diaphragm tank air pressure | Wilkerson | with regulator | 60 PSIG | 90 psig | 70 psig |
| LI | 11 | PG | degassing chamber | John C Ernst Inc. | 415-05 | 0-16" | 370 psig | 15 psig |
| ZI | 12 | | BC bellows position indicator | none | ruler and pointer | -2.0" to +2.0" | n/a | n/a |
| PT | 14 | | atmospheric pressure | Noshok | 100-30A-2-1-2-1 | 0 to 30 psia | 50 psig | 18 psia |
| LI | 21 | W | water tank level indicator | Dwyer | Magnehelic | 0-20" | 15 psig | 20"H2O |
| MS | 22 | W | camera enclosure water sensor | Dwyer | Series WD2 | digital | n/a | n/a |
| LT | 23 | W | water tank level sensor | Echotouch | LU20-5000 | 0.5'-18' | n/a | n/a |
| TE | 30 | PG | outer volume shell temp | Minco | S101733PD3S80 | | n/a | n/a |
| TT | 30 | PG | outer volume shell temp | Minco | TT176 PD1N | 0-50C | n/a | n/a |
| TE | 31 | PG | outer volume shell temp | Minco | S101733PD3S80 | | n/a | n/a |
| TT | 31 | PG | outer volume shell temp | Minco | TT176 PD1N | 0-50C | n/a | n/a |
| TE | 32 | PG | outer volume shell temp | Minco | S101733PD3S80 | | n/a | n/a |
| TT | 32 | PG | outer volume shell temp | Minco | TT176 PD1N | 0-50C | n/a | n/a |
| TE | 33 | PG | outer volume shell temp | Minco | S101733PD3S80 | | n/a | n/a |
| TT | 33 | PG | outer volume shell temp | Minco | TT176 PD1N | 0-50C | n/a | n/a |
| TE | 34 | W | chiller return temperature | Minco | S17624PDZT36B | | n/a | n/a |
| TE | 35 | W | chiller supply temperature | Minco | S17624PDZT36B | | n/a | n/a |
| PT | 41 | PG | hydraulic pump pressure | Noshok | 100-500-2-1-2-1 | 500 PSIG | 875 psig | 500 psig |
| PT | 43 | PG | hydraulic pump pressure | Noshok | 100-500-2-1-2-1 | 500 PSIG | 875 psig | 500 psig |
| PI | 44 | V | vacuum pump inlet | McMaster | 38465K11 | -30"Hg-0 psig | 15 psig | 15 psig |
| PI | 45 | PG | degassing chamber | Noshok | 500 series | -30"Hg-0 psig | 15 psig | 15 psig |
| FI | 50 | W | chiller return flow | Orange | 2421FG-1-E-2.5-B | 10 GPM | 1500 psig | 15 psig |
| PI | 54 | A | Accumulator charge pressure | US Gage | brass, 2.5" diameter | 0-400 psig | 600 psig | 500 psig |
| FI | 55 | PG | Sight glass de-gassing tank top fill | LDI industries | F155 | visual only | 345 | 300 psig |
| PT | 83 | CF3I | bubble chamber pressure | Noshok | 612-300-2-1-T-20' | 300 PSIG | 875 psig | 450 psig |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TE | 84 | | outer vessel temperature | Minco | S17624PDZT36B | | n/a | n/a |
| TS | 85 | | outer vessel temperature | Minco | CT325 PD 2 C 1-20 | 70C | n/a | n/a |
| TE | 86 | | outer vessel temperature | Minco | S17624PDZT36B | | n/a | n/a |
| TS | 87 | | outer vessel temperature | Minco | CT325 PD 2 C 1-20 | 70C | n/a | n/a |
| PI | 90 | W | Water system pressure | Ashcroft | | -30-0-+100 | 150 psig | 15 psig |

| Item description | Manufacturer/size | Working Description | System Pressure Rating | Maximum Pressure |
|---|---|---|---|---|
| 1 1/2" x 10 feet long fast recompression hose | Gates | 24G-1.5" R2/25N EN853 1300 psig (9.0 MPa) Max WP Flame Resistant USMSHA 2C 11C7NBR/NBR-PVC made in India | 1300 psig | **500 psig** |
| 1/2" hydraulic hoses, 8 feet, 3 feet, 2 feet long | Parker Fluid Products | Parflex hose ass'y , Parker # F540N0606080808C | 2000 psig | **500 psig** |
| Parker adapter fitting, male elbow, 1/2" NPT x flare | Parker Fluid Products | Parker 8-8 CTX-S | 5000 psig | **500 psig** |
| Pipe fittings, 1/2" and 1-1/2" size | Grainger, Sharon Piping | Typical fitting description, Socket Weld Connection, Material of Construction 304 Stainless Steel, Pressure 3000 PSI, Standards Materials Conform To ASTM-A-182, F304, Dimensions Conform To ASME B16.11-1996 | 3000 psig | **500 psig** |
| 1/2" schedule 40, type 304 stainless steel pipe | 0.840" OD x .109" wall thickness | plain pipe, A= 0.0 | 3870 psig | **500 psig** |
| 1/2" schedule 40, type 304 stainless steel pipe | 0.840" OD x .109" wall thickness | NPT threaded pipe; thread depth A=0.05714 inch | 1735 psig | **500 psig** |
| 1-1/2" schedule 80, type 304 stainless steel pipe | 1.90" OD x 0.200" wall thickness | plain pipe, A= 0.0 | 3070 psig | **500 psig** |
| 1-1/2" schedule 80, type 304 stainless steel pipe | 1.90" OD x 0.200" wall thickness | NPT threaded pipe; thread depth A=0.06957 inch | 1940 psig | **500 psig** |
| 1-1/2" schedule 40, type 304 stainless steel pipe * | 1.90" OD x 0.145" wall thickness | plain pipe, A= 0.0 | 2170 psig | **500 psig** |
| 1-1/2" schedule 40, type 304 stainless steel pipe * | 1.90" OD x 0.145" wall thickness | NPT threaded pipe; thread depth A=0.06957 inch | 1095 psig | **500 psig** |

* Only schedule 80 was used for 1-1/2" pipe. Schedule 40 shown for reference if the wrong schedule was used.

| | | | | |
|---|---|---|---|---|
| **ANSI/ASME PIPING B31.3 calculations** | **P =** | 500 | psi | |
| **S** | 16700 | psi | Basic allowable stress | B31.3, table A-1, 304L, conservative since 304 = 20 ksi |
| **E** | 0.8 | | quality factor | table A-1A & A-1B, minimum used |
| **SE =** | 13360 | psi | maximum allowable stress | |
| **y =** | 0.4 | | temperature coefficient | |
| **Do =** | 1.9 | inches | outside diameter of pipe | |
| **t =** | 0.2 | inches | pipe wall thickness | |
| **tm = PDo/(2(SE+Py))** | | | | |
| ***tm* =** | 0.035 | inches | minimum pipe wall thickness | |
| ***A*=** | 0.06957 | inches | thread depth, h | h, B1.20.1 table 2 |
| **P = 2SE(t-A)/(Do-2y(t-A))** | | | | |
| ***P* =** | 1941 | psi | maximum allowable pressure for t | |

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Date: July 28, 2009

**COUPP LIQUID WITHDRAWAL LINE & FILTER**
**Pressure Testing Permit***

**Type of Test**: [X]Hydrostatic [ ] Pneumatic

**Test Pressure** 75 psig **Maximum Allowable Working Pressure** 50 psig

**Items to be Tested**
Particulate filter and piping in the de-gassing tank withdrawal line. See flow diagram FNAL#9219.000-ME-444682 rev. J. 50 psig segment is bounded by MV-40, MV-49, PSV-57.

**Location of Test** DZERO ASS'Y HALL PIT **Date and Time** about July 28, 2009

**Hazards Involved**
Propylene glycol release. Contact with eyes or skin is an irritant. Propylene glycol is slippery if on walking surfaces.

**Safety Precautions Taken**
Wear safety glasses with side shield. Know path to nearest eyewash station in DAB1 Kitchen area. Wear nitrile or rubber or latex gloves. Have plenty of wipes on hand. Have alcohol spray bottles to cut and clean up any spills.

**Special Conditions or Requirements**

Use hydraulic pump operated in the direction of PSV-35 relief valve (90 psig set point).
Must remove or plug PSV-57. Use PT-43 to read achieved pressure.
Must remove air out of the lines before test.

**Qualified Person and Test Coordinator** Russ Rucinski, ID#8351N
**Dept/Date** PPD/MD/DZERO Ops, July 2009

**Division/Section Safety Officer** Eric McHugh, ID#13747N
**Dept/Date** PPD/ES&H 7/28/09

**Results**
Held 77 psig for 20 minutes with no leaks or change in ZT6 position. Good.

**Witness** R. Rucinski, ID#8351N, R. Barger, ID#2316N **Dept/Date** PPD/MD/DZero Ops
(Safety Officer or Designee)

* Must be signed by division/section safety officer prior to conducting test. It is the responsibility of the test coordinator to obtain signatures.

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Date: July 27, 2009

**COUPP HYDRAULIC PRESSURE LINES**
**Pressure Testing Permit***

**Type of Test**: [X]Hydrostatic [ ] Pneumatic

**Test Pressure** 345 psig ** **Maximum Allowable Working Pressure** 300 psig
** Test pressure is limited to 115% based on FI-55 rating = 345 psig

**Items to be Tested**
Pressurization line segment of COUPP. See color coded flow diagram (FNAL#9219.000-ME-444682 rev. J
included in piping engineering note. 300 psig segment is bounded by MV-48, MV-76, MV-75.

**Location of Test** DZERO ASS'Y HALL PIT **Date and Time** about July 28, 2009

**Hazards Involved**
High pressure propylene glycol release. Contact with eyes or skin is an irritant. Propylene glycol is slippery if on walking surfaces.

**Safety Precautions Taken**
Wear safety glasses with side shield. Know path to nearest eyewash station in DAB1 Kitchen area. Wear nitrile or rubber or latex gloves. Have plenty of wipes on hand. Have alcohol spray bottles to cut and clean up any spills.

**Special Conditions or Requirements**
Perform after the main hydraulic lines are tested. Leave MV-19 on accumulator open.
Use hydraulic pump. Must replace PSV-34 with original 500 psig relief for test.
Must remove or plug PSV-51. Use test gage at MV-20 port to read achieved pressure.
Must remove air out of the lines by first evacuating the lines with vacuum pump, then backfill from de-gas tank.

**Qualified Person and Test Coordinator** Russ Rucinski, ID# 8351N
**Dept/Date** PPD/MD/DZERO Ops, July 27, 2009

**Division/Section Safety Officer** Eric McHugh, ID# 13747N
**Dept/Date** PPD/ES&H, 7/28/09

**Results**
Found internal leakage in hydraulic pump discharge relief valve prevented good pressure hold tests. When the pump was valved out, MV-25, MV-30, MV-32, MV-37, MV-38 closed, Hydraulic system held 346 psig for over an hour with no pressure drop seen. No leaks discovered. Pressure test was successful.

**Witness** R. Rucinski, ID#8351, Geoff Savage ID#12318N **Dept/Date** PPD/MD, PPD/DZero
(Safety Officer or Designee)

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Date: July 27, 2009

**COUPP HYDRAULIC PRESSURE LINES**
**Pressure Testing Permit***

**Type of Test**: [X]Hydrostatic [ ] Pneumatic

**Test Pressure** 750 & 550** psig **Maximum Allowable Working Pressure** 500 psig

** Instrumentation manifold is tested to 550 psig (110%) to prevent instrumentation damage. All other piping is tested to 750 psig.

**Items to be Tested**
Pressurization lines of the COUPP. See color coded flow diagram (FNAL#9219.000-ME-444682 rev. J included in piping engineering note. 500 psig lines are bounded by MV-22,MV-49, MV-48, MV-3, MV-12, MV-5, MV-6, MV-28.

**Location of Test** DZERO ASS'Y HALL PIT **Date and Time** About July 28, 2009

**Hazards Involved**
High pressure propylene glycol release. Contact with eyes or skin is an irritant. Propylene glycol is slippery if on walking surfaces.

**Safety Precautions Taken**
Wear safety glasses with side shield. Know path to nearest eyewash station in DAB1 Kitchen area. Wear nitrile or rubber or latex gloves. Have plenty of wipes on hand. Have alcohol spray bottles to cut and clean up any spills.

**Special Conditions or Requirements**
Must leave MV-19 on accumulator open. This is a shrader valve that needs to have its core removed.
Use hydraulic pump. Must replace PSV-34 with 750 psig relief for test of EV-47 side of pump.
At 600 psig, close MV-7 to isolate instrumentation gages. Must move 750 psig relief to PSV-35 location to test MV-24 side of pump. Test gage is located at MV-20 port.
Must remove air out of the lines by first evacuating the lines with vacuum pump, then backfill from de-gas tank.

**Qualified Person and Test Coordinator** Russ Rucinski, ID# 8351N
**Dept/Date** PPD/MD/DZERO Ops, July 27, 2009

**Division/Section Safety Officer** Eric McHugh, ID# 13747N
**Dept/Date** PPD/ES&H, 7/28/09

**Results**
Leaks found and fixed at 1 ½" pipe union metal seal. Discovered internal pump to diaphragm leakage across pump discharge relief valve during pressure drop tests. Valved out pump at MV-25 to get accurate test results at full test pressure. Tested instrumentation section to 550 psig (110%). No pressure drop in ten minutes. Tested the rest of piping to 750 psig. Saw 10 psig drop in 15 minutes. Okay, good.

**Witness** Eric McHugh, ID# 13747N **Dept/Date** PPD/ES&H, 8/05/09

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Date: July 28, 2009

**COUPP WATER PUMP DISCHARGE PIPING & FILTER**
**Pressure Testing Permit***

**Type of Test**: [X]Hydrostatic [ ] Pneumatic

**Test Pressure** 45 psig **Maximum Allowable Working Pressure** 30 psig

**Items to be Tested**
Water pump discharge piping and filter housing. See flow diagram FNAL#9219.000-ME-444682 rev. J. 30 psig segment is bounded by MV-91, MV-92, MV-95, MV-93 and MV-96.

**Location of Test** DZERO ASS'Y HALL PIT **Date and Time** about July 28, 2009

**Hazards Involved**
A little water spray is possible.

**Safety Precautions Taken**
Safety glasses.

**Special Conditions or Requirements**
Use domestic water to fill section of piping. Purge out any air. If domestic water pressure does not reach the test pressure, use pressure regulated gas nitrogen supplied into MV-95 filter top bleed.

**Qualified Person and Test Coordinator** Russ Rucinski, ID# 8351N
**Dept/Date** PPD/MD/DZERO Ops, July 28, 2009

**Division/Section Safety Officer** Eric McHugh, ID# 13747N
**Dept/Date** PPD/ES&H, 7/28/09

**Results**
Small crack in pump housing repaired. 14:25 pressurized to 52 psig and isolated. 14:33 pressure at 48.5 psig. Possibly some dissolved air in the water. 8/5 7:45, pressure still at 35 psig 17 hours later. No water leaks present. System is tight.

**Witness** Bill Lee ID#14387N, R. Rucinski, ID#8351N, R. Barger, ID#2316N (Safety Officer or Designee) **Dept/Date** **PPD/DZero PPD/MD/DZero Ops**

* Must be signed by division/section safety officer prior to conducting test. It is the responsibility of the test coordinator to obtain signatures.

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Date: July 23, 2009

**COUPP COMPRESSED AIR LINES**
**Pressure Testing Permit***

**Type of Test**: [ ]Hydrostatic [X] Pneumatic

**Test Pressure** 77 +5/-0 psig **Maximum Allowable Working Pressure** 70 psig

**Items to be Tested**
Compressed instrument air lines of COUPP. See color coded flow diagram (FNAL#9219.000-ME-444682 rev. J included in piping engineering note. Segment is bounded by the air cylinder and PV-62. The air reservoir (MAWP=150 psig) is not part of the test. Air reservoir is ASME code stamped for 150 psig. Relief is set for 50 psi.

**Location of Test** DZERO ASS'Y HALL PIT **Date and Time** July 2009

**Hazards Involved**
Not much hazard. Could be a pop if something let loose. Could be a puff of dust or grit if a failure occurs.

**Safety Precautions Taken**
Wear safety glasses. Compressed air lines are commonly used without testing with no serious risks. I do not anticipate any problems.

**Special Conditions or Requirements**
Must plug PSV-60 to allow for the test pressure. Use compressed air and adjust PRV-10 to get to test pressure.
EV-8 should be in pressurization position. Have valve line up in hydraulic system lined up so glycol is allowed to be pushed into the de-gassing tank (no pressure build up) and glycol cylinder allowed to go to 8" travel limit.

**Qualified Person and Test Coordinator** Russ Rucinski, ID# 8351N
**Dept/Date** PPD/MD/DZERO Ops, July 2009

**Division/Section Safety Officer** Eric McHugh, ID# 13747N
**Dept/Date** PPD/ES&H, 7/28/09

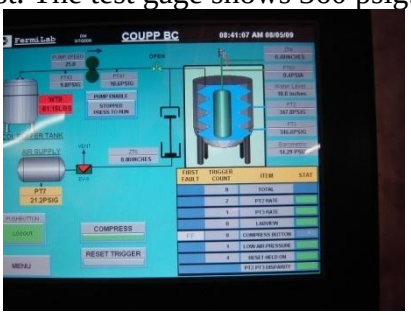
**Results**
Brought up to 77 psig and held. A snoop (liquid soap) leak check found leaks at the main relief thread, PSV-13 and on bushing that 1" copper line connects to tank. Leaks Fixed. 15:43 holding 78 psig pressure. Snooped all fittings. No leaks found. Pressure test completed.

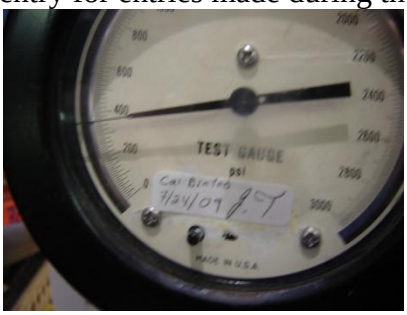
**Witness** R. Rucinski, ID# 8351N, R. Barger, ID# 2316N **Dept/Date** PPD/MD/DZero Ops
(Safety Officer or Designee)

* Must be signed by division/section safety officer prior to conducting test. It is the responsibility of the test coordinator to obtain signatures.

Wednesday, August 5, 2009 12:43:52 CDT: COUPP_60Kg/Operations: 558: Russ Rucinski

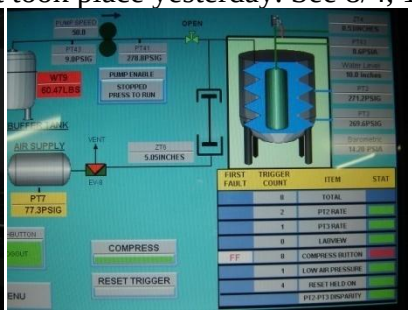
This is a screen shot of the hydraulic system up to 347 psig for the pressure testing of the FI-55 de-gassing pipe section pressure test. The test gage shows 360 psig. See today's 8:43 am entry for entries made during the test.

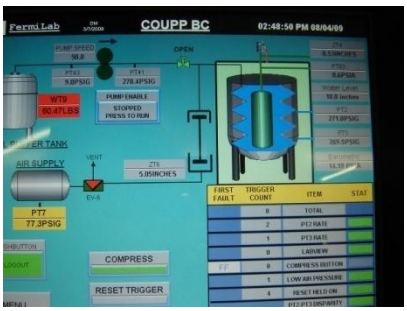



Wednesday, August 5, 2009 12:39:11 CDT: COUPP_60Kg/Operations: 557: Russ Rucinski Click here to download a copy of file

This is a screen shot showing PIT-7 at 77 psig for the compress air system pressure test. A picture of the gage itself also shows 77 psig. This test took place yesterday. See 8/4, 14:48 and 15:45 entries as well.



Attached File: CompressedAirPT_Permit.docx

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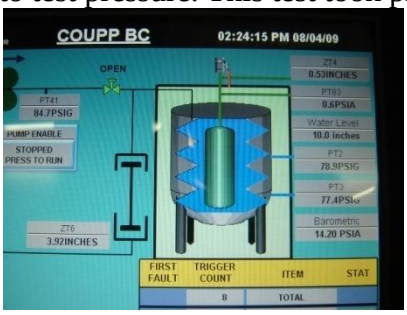
Wednesday, August 5, 2009 12:34:40 CDT: COUPP_60Kg/Operations: 556: Russ Rucinski

This is a screen shot taken during the de-gassing tank filter pressure test. The filter package was taken up to 78 psig. The picture shows the filter package at test pressure. No leaks were found. A block of wood was clamped onto the 50 psig relief valve, PSV-57 to allow us to get to test pressure. This test took place yesterday. See 8/4, 14:39 entry.



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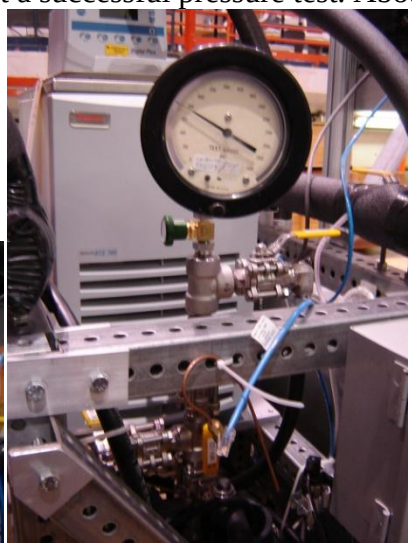
Wednesday, August 5, 2009 12:25:31 CDT: COUPP_60Kg/Operations: 555: Russ Rucinski

12:25, Test gage is at 740 psig. I call that a successful pressure test. About 10 psig drop in 15 minutes.



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Wednesday, August 5, 2009 11:38:25 CDT: COUPP_60Kg/Operations: 554: Russ Rucinski

11:40, ran pump to pressurize hydraulic lines further. PT2/3 are maxed out at 500 psig. Test gage reads 520 psig. Isolated pump by closing MV-25. Before ramping to higher pressure, I need to be sure that the instrumentation calibration will not be damaged.

*****Comment by Russ Rucinski on Wednesday, August 5, 2009 11:46:09 AM CDT***

*Ran pump up to 550 psig on the test gage and then isolated pump. I figure minimum test*

*pressure for the instrumentation has to be 550 psig = 110 %.*
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 11:58:18 AM CDT***
*Pressure held at 550 psig on the test gage for ten minutes. No leaks seen. Pressure test of instrumentation tree is successful. I reduced the pressure to 450 psig by running the pump in reverse. Then I isolated the instrumentation tree by closing MV-7. PT2=460 psig. PT3=457.6 psig. Ran pressure in rest of system to 750 psig for final pressure test. 12:01 test gage at 750 psig. System isolated.*
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 12:06:12 PM CDT***
*12:10 test gauge is at 740 psig.*
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 12:08:30 PM CDT***
*12:12 ran it back up to 750 psig and took photo. Isolated.*

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Wednesday, August 5, 2009 8:43:09 CDT: COUPP_60Kg/Operations: 553: Russ Rucinski

Found MV-30 open. Closed MV-30 to keep the pump block out of the pressure drop test. Re-opened MV25 and pumped pressure back up the closed MV25 to isolate pump from system.

8:40, PT2/3 = 347 psig. Test gage = 360 psig.
8:45, PT2/3 = 347 psig. Test gage = 360 psig.
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 8:56:32 AM CDT***
*8:58, PT2/3=346 psig. Test gage = 360 psig. I found Geoff Savage as an independent witness to the pressure test. I went over the piping and pressure test with Geoff until he understood and was able to confirm that we are up to test pressure. He signed the pressure testing permit as an independent witness.*
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 9:48:17 AM CDT***
*9:45, PT2/3 = 346 psig. MV-48 closed. Pressure in FI-55 pipe section bled down into de-gassing tank.*
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 10:13:17 AM CDT***
*Removed pipe plug from PSV-51. Started vacuum pumping on the de-gassing tank. MV-48 and MV-49 are closed.*

---

Wednesday, August 5, 2009 8:21:50 CDT: COUPP_60Kg/Operations: 552: Russ Rucinski

After opening up valves, the pressure PT2 and PT3 went up to 210 psig. This was because the large hose segment and section of drain line was isolated yesterday night (17 hours ago) with about 300? psig pressure locked in. The system is tight and holds pressure overnight!

Pumped up to 345 psig and isolated pump section by closing MV-25. 8:25, PT2 and PT3 = 347 psig. Test gage reads 360 psig.
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 8:26:49 AM CDT***
*8:30, PT2/2 = 332 psig*
*****Comment by Russ Rucinski on Wednesday, August 5, 2009 8:32:04 AM CDT***
*8:35,PT2/3 = 320 psig*

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Wednesday, August 5, 2009 8:09:11 CDT: COUPP_60Kg/Operations: 551: Russ Rucinski

Pressure in isolated pump section is PT-43=84.7 psig, PT-41=88.6 psig. A clear tube was attached to PSV-35 (SP=90 psig) and a droplet of glycol is seen in the tube so it relieved or leaked since we are near the setpoint. No other external leaks are seen.

PT2=161.1 psig and PT3=161.1 psig. The hydraulic lines held pressure overnight. ZT6=0.0". The hydraulic system appears to be tight.

Resuming pressure testing with it noted that hydraulic pump needs to be isolated to prevent internal leakage during pressure hold tests.

---

Tuesday, August 4, 2009 16:35:10 CDT: COUPP_60Kg/Operations: 550: Russ Rucinski

15:58 pumped up to 345 psig and stopped pump. Closed EV-47 to isolate pump. Pressure keeps slowly dropping. Bumped it back up a few times.

16:08 PT2=347 psig, PT3=345 psig, PT41=355 psig. Test gage = 360 psi. WT-9=60.8 lbs.

Looked thoroughly for drips or leaks but found none.

Did various isolations and have narrowed down the leak or pressure loss location to the pump area between MV-25 and MV-39. With those valves closed, the pressure in the rest of the system PT-2, PT-3 large hydraulic hoses, FI-55 section all stayed constant around 340 psig. The pump section dropped pretty quickly.

We are done for today. I bled pressures down to 160 psig. Left MV-25 and MV-39 closed. We will look for drips in the morning.

---

Tuesday, August 4, 2009 15:46:43 CDT: COUPP_60Kg/Operations: 549: Russ Rucinski

Now pressure testing the hydraulic lines again. Using the pump to pressurize to 345 psig. WT-9 = 61.1 lbs.

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Tuesday, August 4, 2009 15:45:52 CDT: COUPP_60Kg/Operations: 548: Russ Rucinski

Compressed air line pressure test completed. Brought up to 78 psig and snooped with no leaks. Bled the compressed air down to 25 psig. Removed pipe plug from PSV-60.

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Tuesday, August 4, 2009 14:48:48 CDT: COUPP_60Kg/Operations: 547: Russ Rucinski

Filter section isolated by closing MV-49. Opened MV-40 to bleed out pressure to de-gassing tank. C-clamps removed and PSV-57 re-enabled.

Increased air tank pressure to 77 psig for air system pressure test. 14:48 at 77.4 psig on PT7. Hydrualic system is at 273 psig. ZT6 = 5.06". We are at full system test pressure.
*****Comment by Russ Rucinski on Tuesday, August 4, 2009 2:53:32 PM CDT***
*Snooping the air tank and associated piping. Found a leak at the threads of the main relief valve PSV-13 and the large pipe bushing a the outlet.*
*****Comment by Russ Rucinski on Tuesday, August 4, 2009 3:00:28 PM CDT***
*Bleed off the air pressure. Redoing the teflon tape joints that were leaking.*

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Tuesday, August 4, 2009 14:39:58 CDT: COUPP_60Kg/Operations: 546: Russ Rucinski

Air tank pressure increased to PT7=12.7 psig. ZT6=2.66". PT2=PT3=35 psig. Increased air to 18.6 psig. PT2,3=53 psig. ZT6=3.33". At 65 psig, PSV57 started weeping. Reduced pressure to <10 psig and will try to better keep PSV57 closed.

Re-pressurized. Now, 8/4/09, 14:18 at 75 psig and holding. ZT6=3.92". Bumped up the pressure to 78 psig. 14:22, holding, ZT6=3.92". 14:38, still at 77 psig isolated. Bill Lee has agreed to be an independent witness along with photos.

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Tuesday, August 4, 2009 13:46:14 CDT: COUPP_60Kg/Operations: 545: Russ Rucinski

Re-configured valves for first hydraulic system pressure testing. Pump suction is open to the diaphragm tank, WT9=60.7 lbs. MV-32,37,38 closed. MV-23,24 open. I will withdraw liquid from the diaphragm tank to raise the pressure in the rest of the lines. MV-30,20,39,50,26,25,36,27,31,33,7,53,49,48,72,44, all open. EV-47 open. Boundary valves MV-40,75,76,3,12,5,6,28 closed.

Air tank is currently at 0.0 psig, cylinder position ZT6=0.0".

I will pressure test the entire system in stages. First to the lowest test pressure, 75 psig. Then that lowest rated section (filter F-58) will be valved out, pressure reduced and PSV-57 re-enabled. Then the pressure will be increased for the air piping test. This will increase the hydraulic pressure as well. After the air piping is completed, the air pressure will be reduced and the relief valve PSV-60 unplugged. Then the hydraulic system will be brought up to 345 psig. The the 300 psig section will be valved out, pressure reduced and PSV-51 unplugged. Then the pressure will be brought up to 600 psig. Then the pressure will be reduced slightly, and the instrumentation tree isolated. Then the system will be brought up to full test pressure, about 750 psig.

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To see the rest of the documents listed in the

Table of Contents, please see

Book 13a in the PPD/Mechanical Department, MD-ENG-199