Muon Design Note #3

TITLE: Determination of the MAWP for the Hydraulic System and Testing

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OBJECTIVE: To determine the maximum allowable working pressure (MAWP) for the hydraulic system. Then hydrostatically test the system to Fermilab specification #S-31-508-TEK which is given in Appendix A.

ACTIVE COMPONENTS LIST

Item	MAWP
1. 1/4" O.D. tube by 0.65 wall	A. 6,947 psi
2. Truly Tubular 1/4" union fittings	B. 3,400 psi
3. Swage Lock 1/4 S.S. compression fittings, unions and tees	C. 3,400 psi
4. Pneutrol NMF-20BK mechanical valves	C. 2,000 psi
5. Abex GMBH Denison relief valves	E. 2,800 psi
6. AGCO Helicoid gage	D. 5,000 psi
7. Enerpac per 2042 pumper	C. 10,000 psi
8. Oildyne hydraulic cylinders AA 3/4 x 1-1-1-4M-1	C. 5,000 psi

A - Calculation shown in Appendix B.
B - MAWP = burst pressure/5 from Truly Tubular catalog.
C - MAWP from manufacturers catalog.
D - Maximum pressure reading of gage.
E - Set pressure range of relief valve 0 to 2,800 psi.

Pressure

The maximum allowable working pressure (MAWP) of the system is 2,000 psi. This is the proper MAWP for the system because the lowest MAWP for any active component is 2,000 psi.

Test Procedure:

Hydrostatically pressure test the entire hydraulic system following the procedure given in Fermilab specification #S-31-508-TEK. The flow schematic for the hydrostatic test is given in Fig. 1 below. Before starting the test the following manual valves MV-101-A...X-HY, MV-102-A...X-HY, MV-103-HY and MV-105-HY must be open. Safety relief valve SV-101-HY and SV-102-HY must be disconnected from the system. MV-104-HY must be closed. Don't forget to cap the openings that were created by doings the above procedure. After the appropriate pressure is reached, close valve MV-105-HY to hold this pressure for the specified amount of time. Before increasing or decreasing the pressure the above valve must be opened.

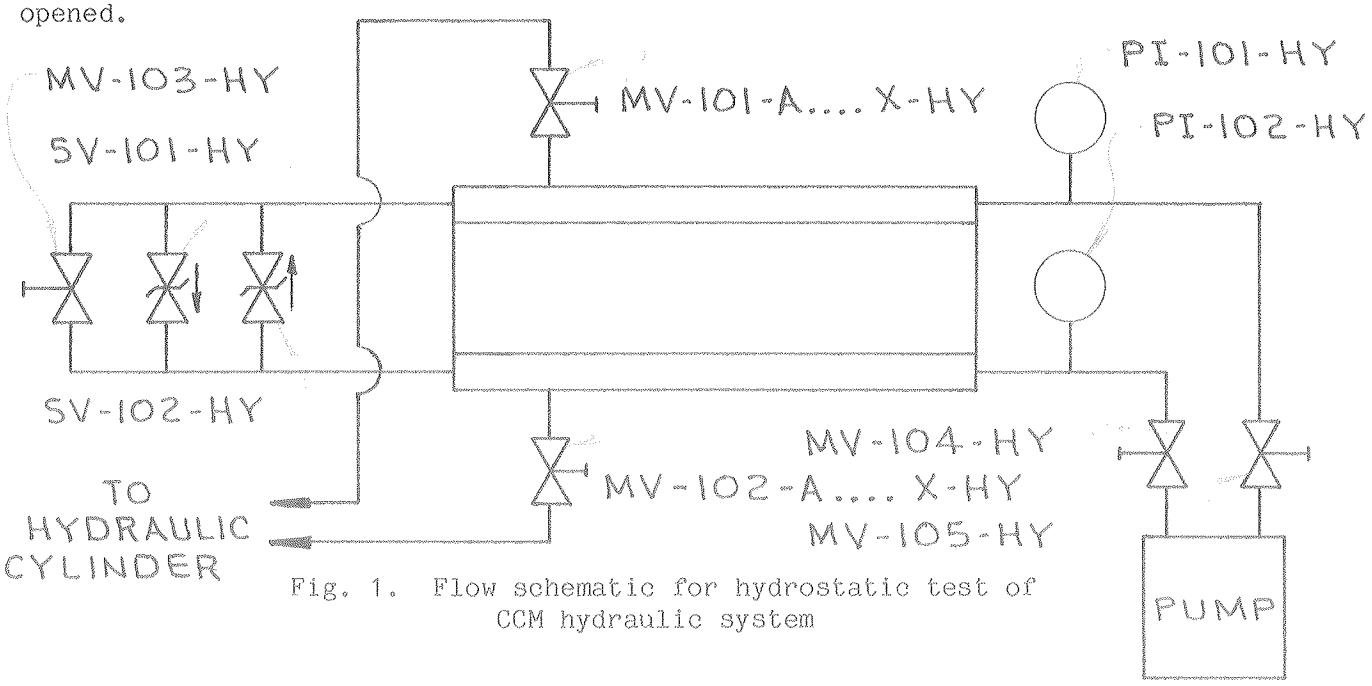

Fig. 1. Flow schematic for hydrostatic test of CCM hydraulic system

Conclusion:

The hydraulic piping system had only one minor leak, discovered during the test which was not immediately repairable. The leak is so small and in such an awkard location it was decided not to repair the leak. The system is only operated several times for short durations during cooldown, therefore the amount of fluid lost is minimal. Otherwise the hydraulic system is mechanically sound.

Operator Steve Smith Date 6/26/85

Witness Ramon A. Rechenmacher Date 6/26/85

Witness Steve Gallo Date 6/26/85

Appendix A
Hydrostatic Test Procedure

The procedure outlined below should be followed when performing a hydrostatic test:

1. The test apparatus shall be inspected to see that it is tight and that all low pressure filling lines and other appurtenances that should not be subjected to the test pressure have been disconnected or have been isolated.

2. Vents or other means shall be provided at high points of the equipment in the position in which it will be tested to purge air from all pockets while filling the equipment. A drain shall be provided to drain liquid after the hydrostatic test is completed.

3. Pressure test gauges shall be of the indicating type and connected directly to the equipment. The indicating gauge shall be provided at a spot visible to the operator throughout the duration of the test.

4. Test gauges shall have been calibrated within two (2) months of the test unless prescribed otherwise.

5. The test pressure shall not be applied until the equipment and its contents are at about the same temperature.

6. Unless otherwise specified, gradually increase test pressure to 1/2 of the maximum and hold for about 5 minutes.

7. Increase pressure in increments of 10% of maximum hydrostatic pressure, and hold at those pressures for 5 minutes until full hydrostatic test pressure is reached.

8. Hold at maximum peak pressure for 5-15 minutes unless otherwise specified.

9. Drop pressure back to 3/4ths of the peak pressure, and hold for sufficient time to allow for inspection of the equipment.

10. A permanent record of test shall be kept on file.

*NOTE: During this interval, it is extremely important to clear test area of all workers. Test area should remain clear until pressure has been dropped to 3/4ths of peak pressure.

Pressure Test Data Sheet

Maximum test pressure = (1.50)(MAWP) = A = 3,000 psi

Initials		
	(1) Test Pressure =	A/2 = 1,500 psi hold time = 5 min - 09:40
	(2) Test Pressure =	A/2 + A/10 = B = 1,800 psi hold time = 5 min - 09:53
	(3) Test Pressure =	B + A/10 = C = 2,100 psi hold time = 5 min - 10:04
	(4) Test Pressure =	C + A/10 = D = 2,400 psi hold time = 5 min - 10:13
	(5) Test Pressure =	D + A/10 = E = 2,700 psi hold time = 5 min - 10:26
	(6) Test Pressure =	E + A/10 = A = 3,000 psi hold time = 10 min - 10:35
	(7) Test Pressure =	(0.75)(A) = 2,250 psi look leaks for - 11:07
	(8) Reduce test pressure to zero.	

Remarks:

a) At 2,700 and 3,000 psi, pressure drops off rather quickly. I'm not sure where we are leaking. It looks like were back feeding through the main hard valve back to the enerpac (compressor).

b) Found leak in compression fitting - repaired. (Upper coil #10).

c) Found small leak weld joint leak lower #3. Locaton is by catwalk vertical run. NOTE: Leak is small enough that we decided not to repair it.

Appendix B
Internal Pressure Calculation for The Hydraulic Tubing

Ref. B31.3: Chemical Plant and Petroleum Refinery Piping

From Section 304-1-2

$$P = \frac{2 S E t}{D}$$

$D = 0.250$ in

$t = 0.065$ in

$SE = (1.67 \times 10^3)(0.8) = 13.4 \times 10^3$ psi