AP-0 Lens RAW System Measurements Summary
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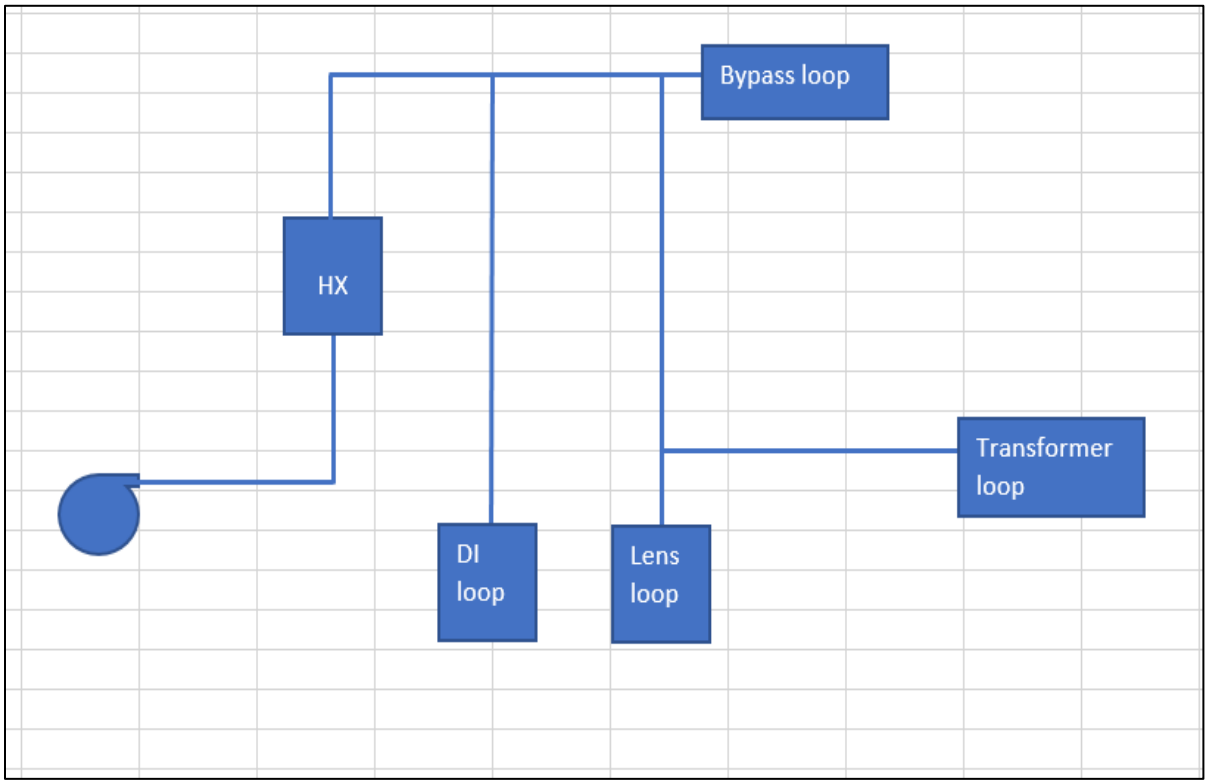
Valve manipulation and system balancing was done on the AP-0 Lens Cooling System. A simplified flow schematic highlighting the individual system loops is shown below:



Prior to throttling any of the valves, the flow parameters were recorded. They are shown in the below table:

AP-0 Lens system observed parameters				
Item	Parameter	Units	Value	Comments
1	Pump discharge pressure	Psig	120	Visual gauge.
2	Pump suction pressure	Psig	7.5	Visual gauge.
3	Lens flow	Gpm	3.5	New flow meter installed in 2017.
4	Transformer flow	Gpm	0.64	
5	By-pass flow	Gpm	3	Visual flow meter.
6	DI loop flow	Gpm	2.5	Visual flow meter.

The goal is to determine how the system may be balanced to send more flow through the Lens loop. Thus, the valves were manipulated in two different configurations. First, the by-pass and the DI

loops were valved out. Prior to this, the pressure in the expansion tank was relieved. The recorded parameters for the first configuration are shown in the below table:

AP-0 Lens system observed parameters (By-pass and DI loop valved out)				
Item	Parameter	Units	Value	Comments
1	Pump discharge pressure	Psig	138	Visual gauge.
2	Pump suction pressure	Psig	0	Visual gauge.
3	Lens flow	Gpm	4	New flow meter installed in 2017.
4	Transformer flow	Gpm	0.64	
5	By-pass flow	Gpm	0	Visual flow meter.
6	DI loop flow	Gpm	0	Visual flow meter.

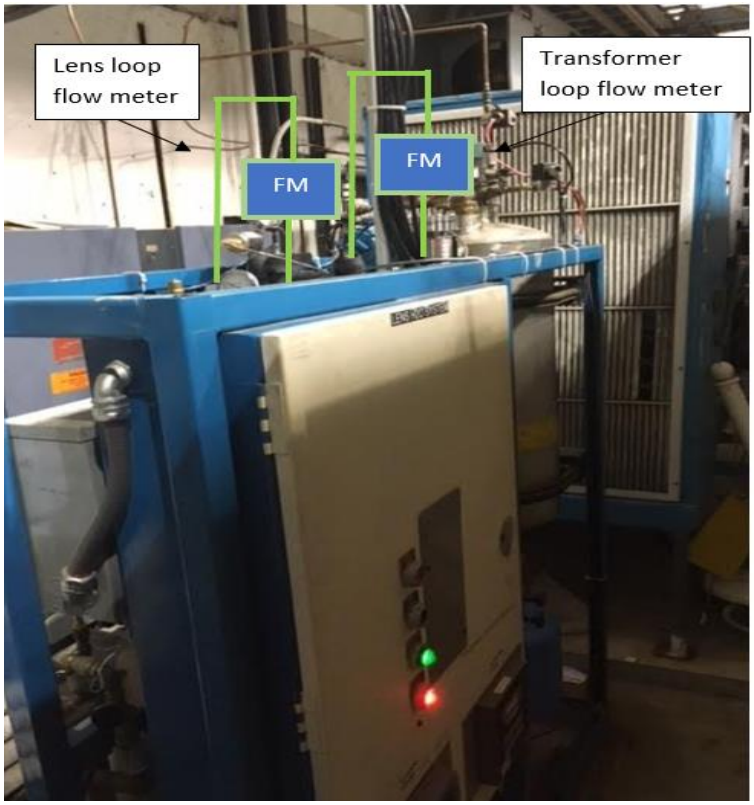
Second configuration involved valving out the by-pass, DI, and transformer loops. The recorded parameters are shown below:

AP-0 Lens system observed parameters (By-pass, DI loop, and Transformer loop valved out)				
Item	Parameter	Units	Value	Comments
1	Pump discharge pressure	Psig	150	Visual gauge.
2	Pump suction pressure	Psig	0	Visual gauge.
3	Lens flow	Gpm	4.1	New flow meter installed in 2017.
4	Transformer flow	Gpm	0	
5	By-pass flow	Gpm	0	Visual flow meter.
6	DI loop flow	Gpm	0	Visual flow meter.

From the above table, one may conclude that the maximum flow that can be pushed through the Lens loop without changing the pump or the piping is 4.1 Gpm.

Installing reliable flow meters for tripping the beam permits was also discussed. NuMI style visual flow meters with reed switches are recommended. A flow meter on the Lens supply and another one on the Transformer loop supply maybe installed. These may be installed downstream of the existing UFM vortex shedding flow meters with flow going up. The series o flow meters that may be selected are King Instruments 7610 series: https://kinginstrumentco.com/7610-series-glass-tube-flowmeters/

The flow meters are between 14-20 inches long. However, there is sufficient space right above the skids where they may be easily installed:


Lens loop
flow meter
Transformer
loop flow meter
FM
FM