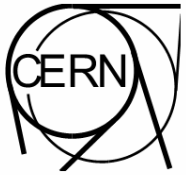

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MERIT

On Surface Cryogenic System Comissioning
Preliminary Test Results
(Draft)

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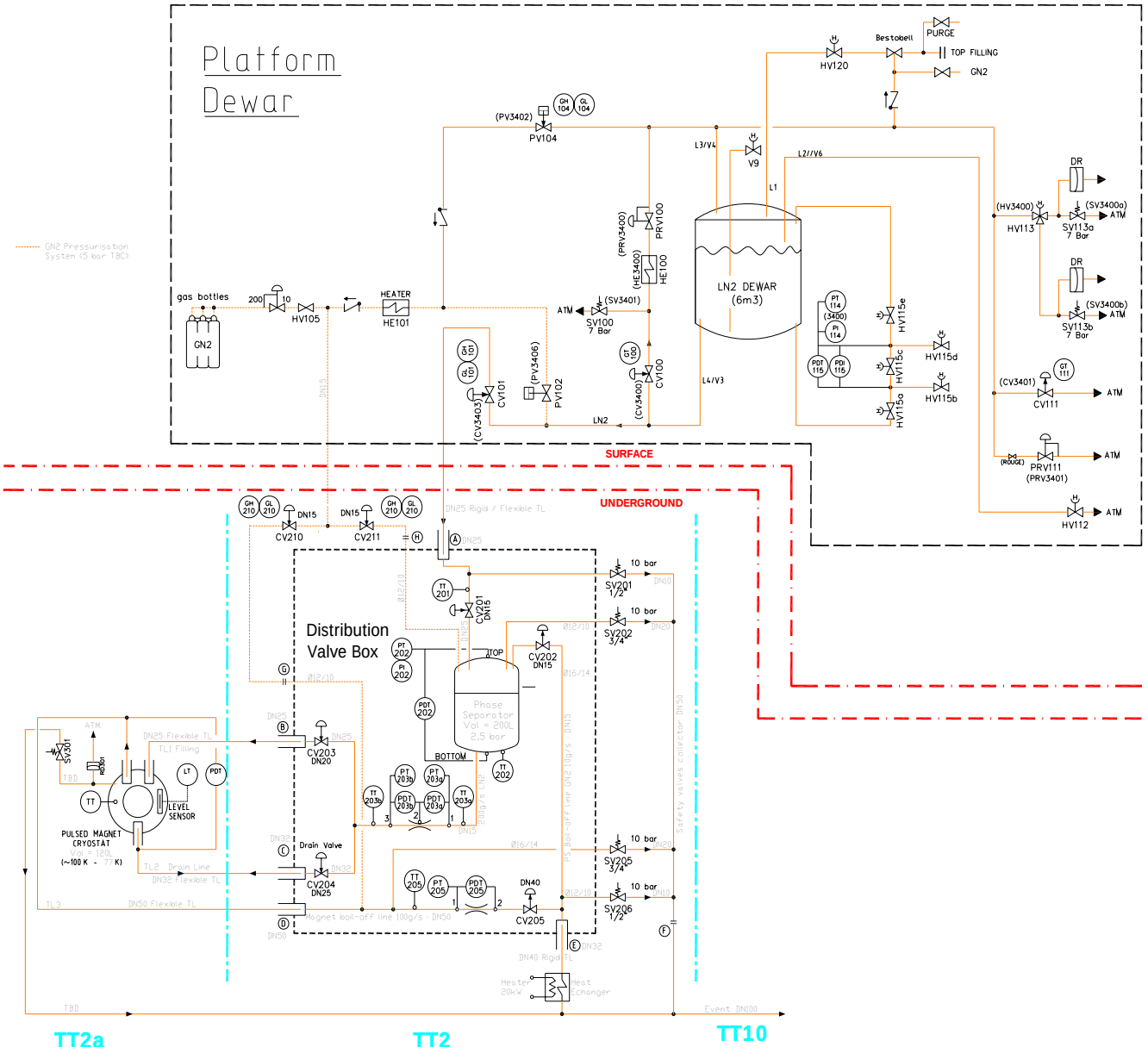
The Cryogenic System allows us to fully control the filling and emptying procedure by regulating any of the following aspects:

- Pressure Variations
- Level Control
- Flow Control
- Control Valve aperture

In order to test the full capability of the cryogenic system without interacting with the solenoid magnet, a buffer vessel was designed and installed which would resemble as much as possible the volume of the magnet, as for full piping connections.

Our preliminary tests show that we are able to spread the operating limits further then were initially proposed.

OPERATION PROCEDURE



Step 1 : Fill Phase Separator from LN2 Dewar

- open CV101 and when the line is cold (<100K) gradually open CV201;
- when the phase separator reaches <100K, fully open CV201;
- pressure in phase separator is constantly maintained by CV202.

Step 2 : Fill Cryostat from LN2 phase separator

- open CV204 which connects the phase separator to the magnet cryostat;
- pressure in cryostat Is maintained by CV205;

Step 3 : Empty liquid nitrogen from cryostat

- close CV205;
- nitrogen gas from storage bottles GN2 is passed through cryostat by opening CV210;
- when the line is pressurized at 4.8 bar, open CV204 transfering the fluid back to the phase separator;
- close CV210 & CV204 and gradually open CV205 to release remaining gas in the system.

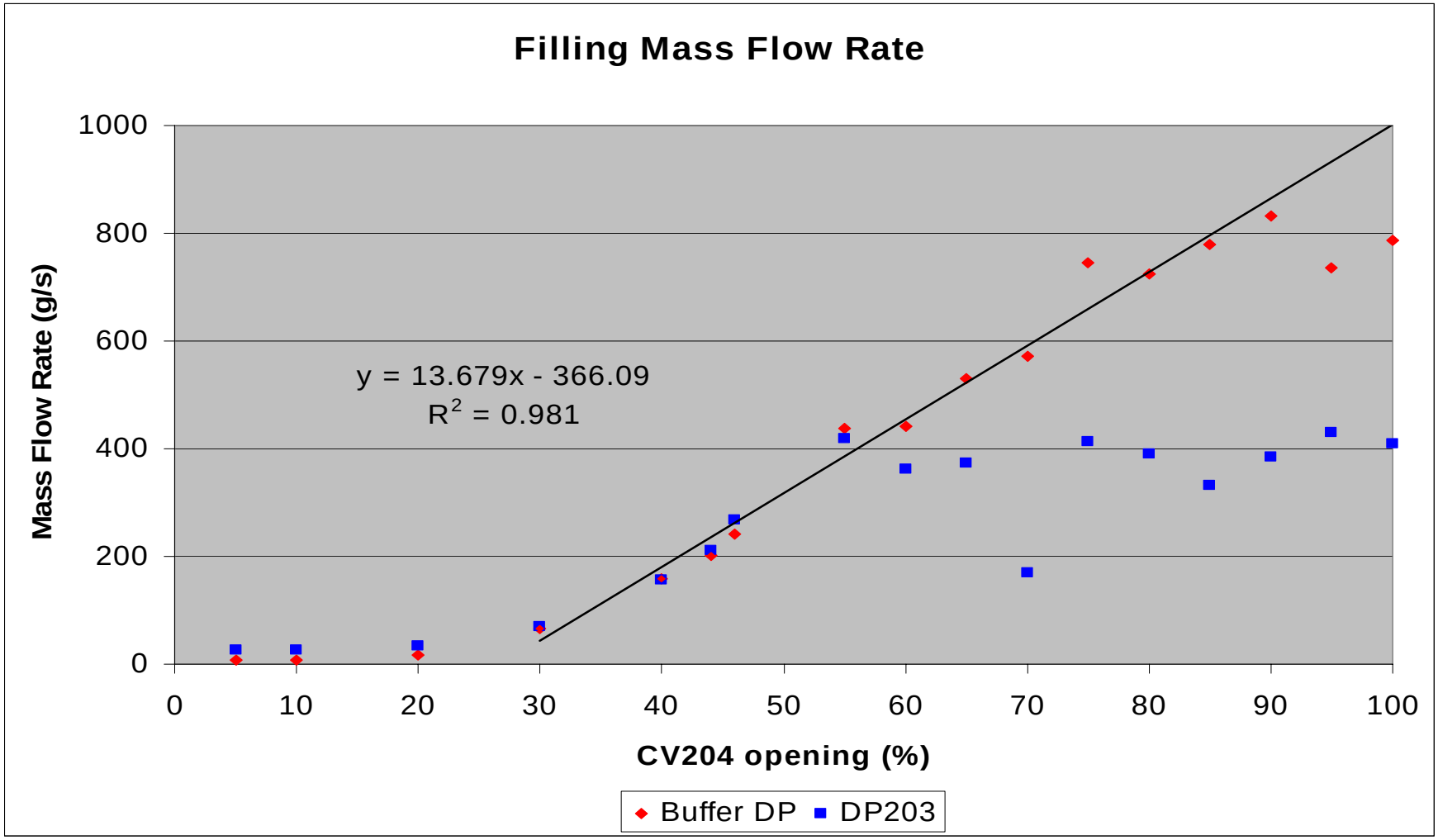
Step 4 : Power Magnet and perform Physics experiment (magnet rises to 100K).

Step 5 : Re-cool magnet from Phase Separator and LN2 Dewar (when needed).

Operation	Step	CV101	CV201	CV202	CV204	CV205	CV210
Fill Phase Separator from LN2 Dewar	0	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE	CLOSE
	1	OPEN	CONTROL				
	2		OPEN	CONTROL			
	3		CONTROL				
Fill Cryostat from LN2 phase separator	0				OPEN	CONTROL	
	1						
	2				CLOSE		
Empty liquid nitrogen from cryostat	0					CLOSE	
	1						OPEN
	2				OPEN		
	3						CLOSE
	4				CLOSE	CONTROL	

FILLING

The following curves represent corresponding mass flow rate, according to the CV204 opening percentage.

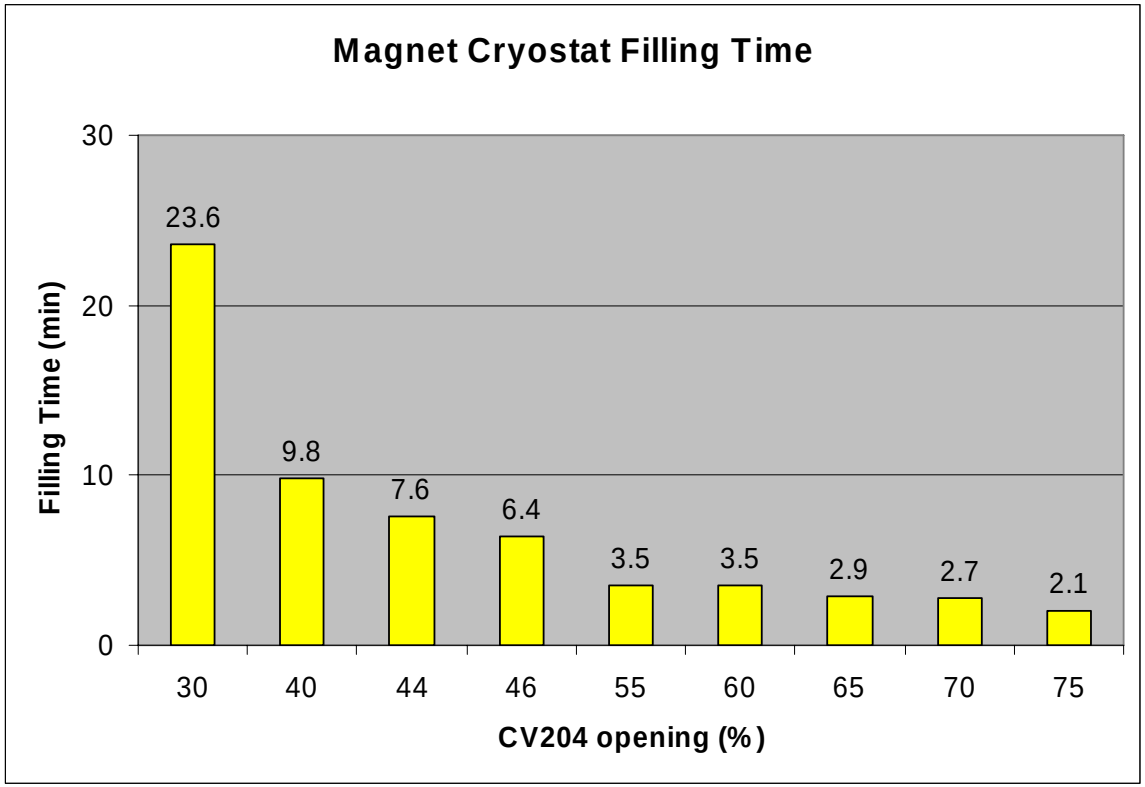


- Up to 30% opening, the system will transfer less then 70 g/s of liquid nitrogen.

- Above 60% opening, the pressure sensor DP203 will reach its limit (210mbar) and will become out of range.

- A maximum of 830 g/s liquid nitrogen can be transferred at 90% opening, above this point the flow is to high to provide quality measurements.

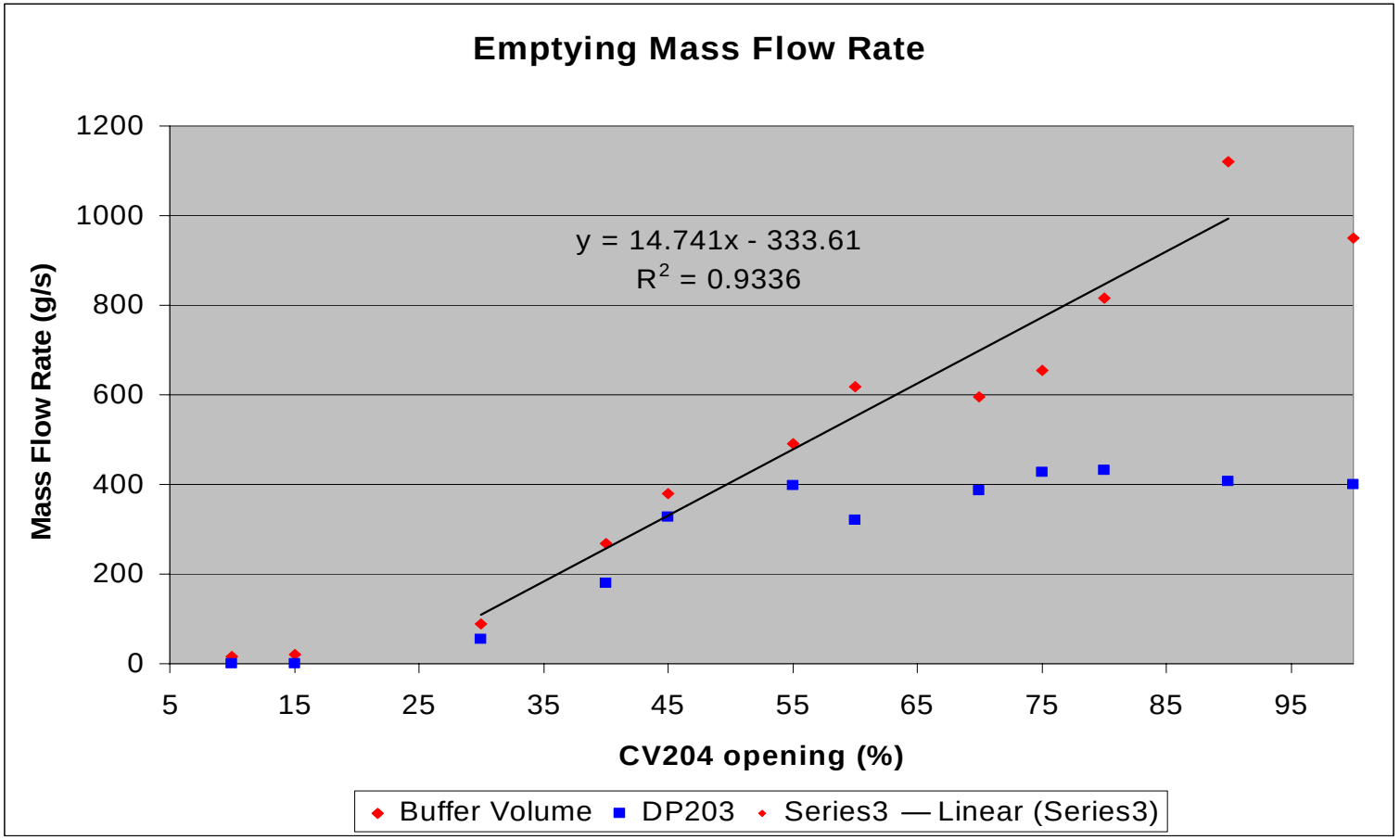
Due to the experimental requirements, a total of 120 liters of liquid nitrogen will be used in order to cool the magnet, the following graph displays the filling time according to the CV204 opening.



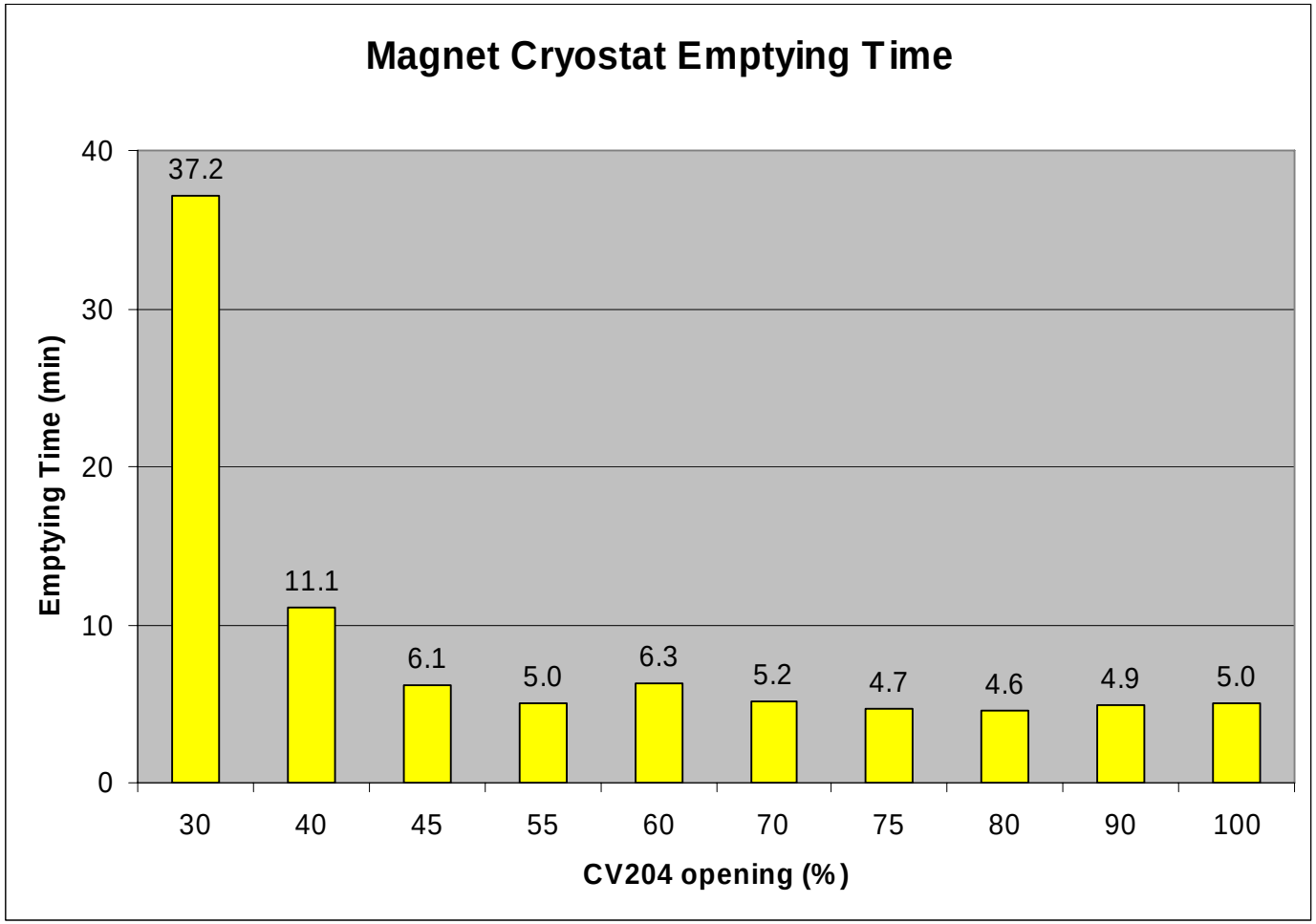
At an ideal flow of 200g/s, the solenoid will be filled in approximately 7 minutes. The control valve CV204 will be open at 45%, thus assuring complete control of the system. And this value is within the operating range of the pressure sensors.

EMPTYING

The emptying process is controlled by PT205 – CV205. A constant pressure of 1.2 bar is maintained until the emptying process begins. At this point, the line will be pressurized up to 5.2 bar, and the LN2 will be expelled from the buffer vessel back to the phase separator.



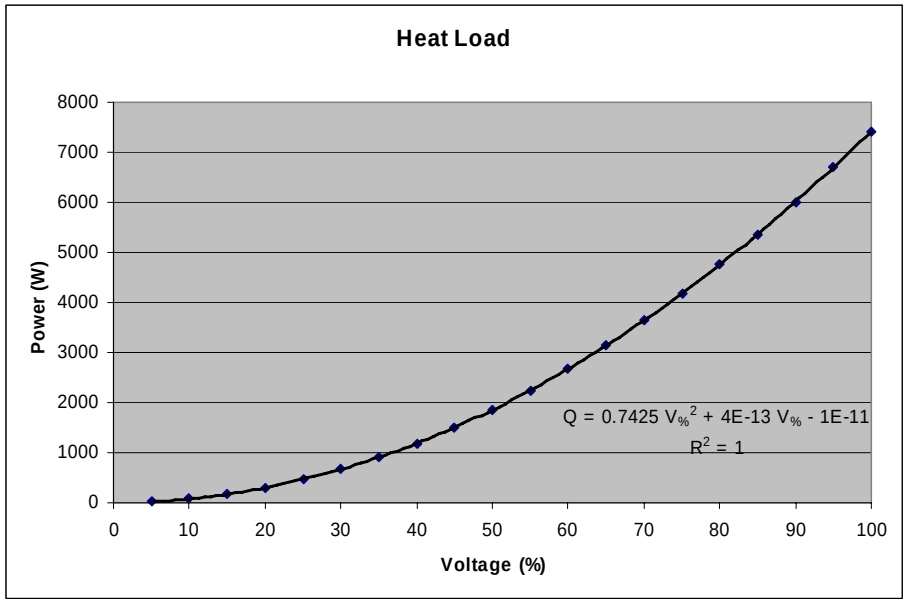
At the same 45% CV opening, an estimated flow of 380 g/s is expected. Once the emptying process begins the cryostat will be ready for physics in approximately 6 minutes.

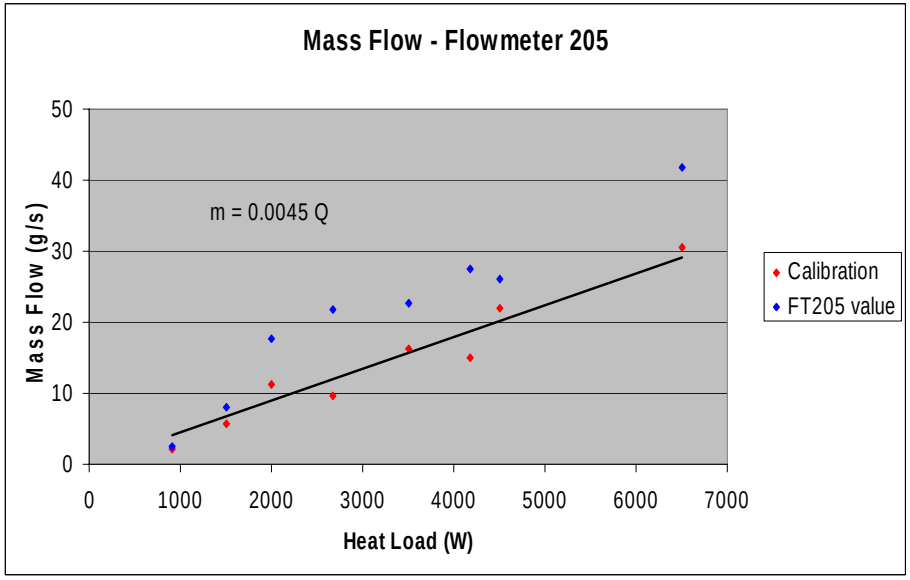


HEATING

A venturi flowmeter was installed in the exhaust line, in order to quantify the nitrogen that has evaporated and will pass thru the heat exchanger to be safely released.

With the use of the 7500W heater applying various heat loads it was possible to correctly calibrate the venturi flowmeter FT205.





With this calibration curve it was possible to correct the error of the output calculated value of the mass flow thru the flowmeter FT205.

CONCLUSION

Throughout the commissioning phase, both flowmeters have been calibrated, and the filling/empty process has been fully tested. Minor software issues have been resolved and there is a complete understanding of all the intrinsic functionalities of the cryogenic system.

- The filling process will be done at 200 g/s (CV204 opened at 45%).

$$mass\ flow_{fill} = 13.7\, CV_{204\%opening} - 366.1 \quad (g/s)$$

- For the emptying process the CV204 will equally be opened at 45%, due to the pressurized gas, the flowrate will be 380 g/s.

$$mass\ flow_{empty} = 14.2\, CV_{204\%opening} - 316.2 \quad (g/s)$$

In this scenario the complete cycle will last 20 minutes, including the cryostat being submerged for 5 minutes.