Savannah River NUCLEAR SOLUTIONS℠

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Tritium High Vacuum Pump Test Plan

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Scope

- Comparison of Normetex vs. Eumeca/ Air Squared/ Edwards/ Busch
- Ultimate Vacuum
- Develop Flow Curve
- Provide basis for selecting the Normetex Pump Replacement

Performance

- Flow Rate
  - 9 cfm at 3 torr inlet pressure
- Ultimate Vacuum Pressure
  - Acceptable: Less than 0.01 torr at discharge pressure of 30 torr
  - Preferred: Less than 0.01 torr when discharging to atmosphere

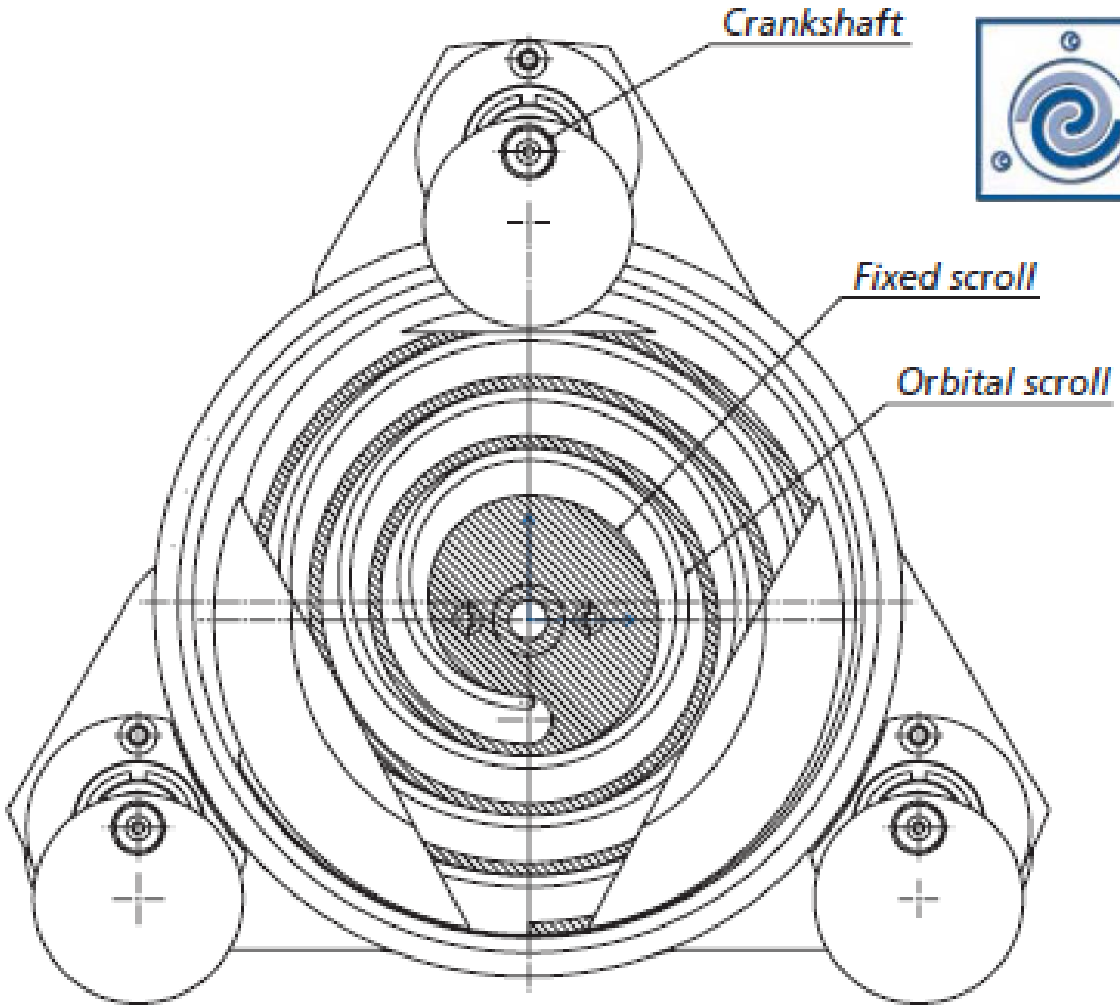
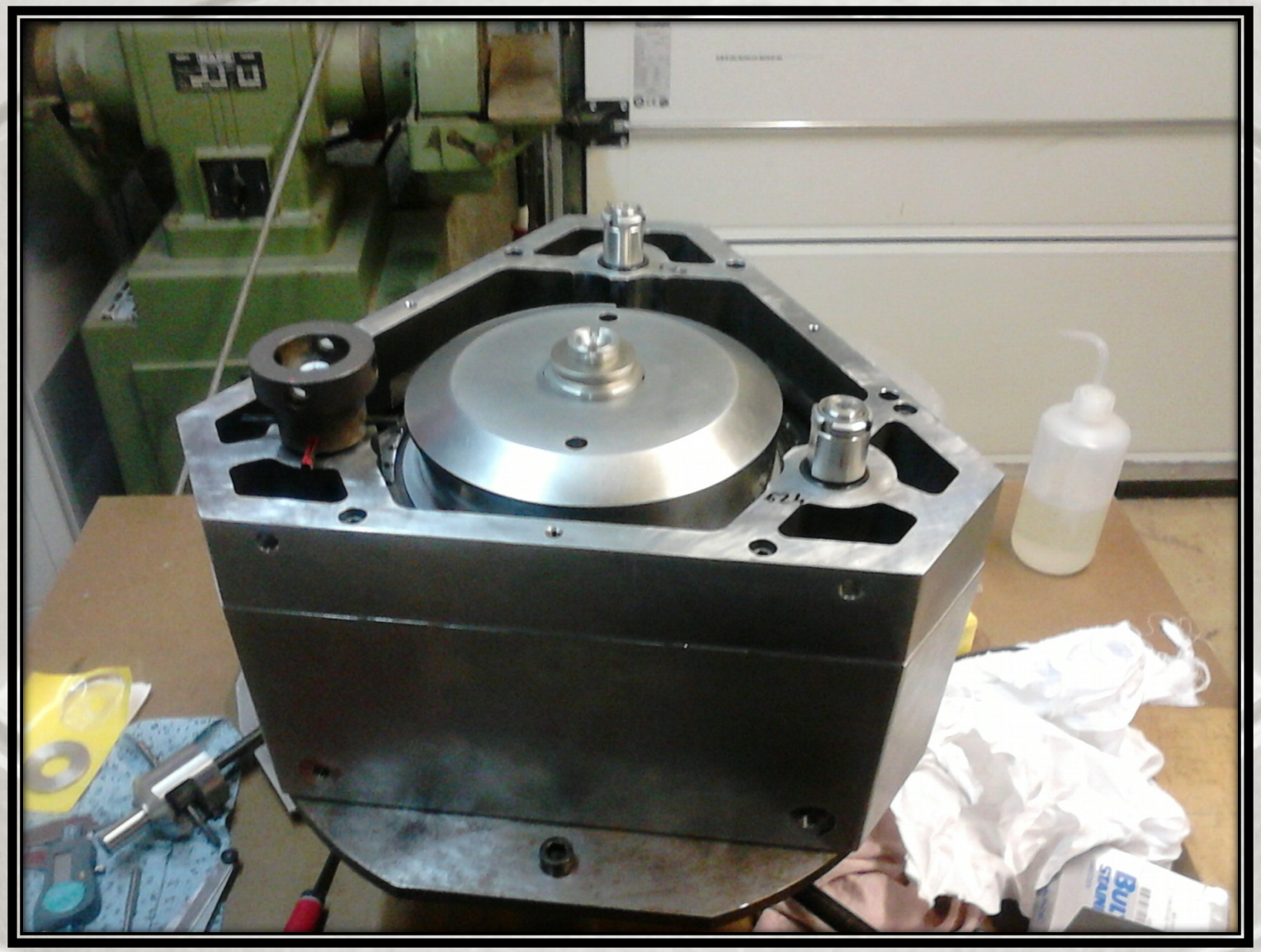


DIAGRAM OF THE MECHANISM

NORMETEX POMPES

The three shaft design keeps the orbital scroll motion very uniform.
Same design is seen in Eumeca and Air Squared.

Eumeca: Duplicate of Normetex



Eumeca: Duplicate of Normetex

EUMECA SARL

MODEL 15 m³/h (9 cfm)

OVERVIEW :

Our model 15 m³/h (9 cfm) is a scroll vacuum pump which is, like our other models, perfectly clean. Because of the simplicity of the design, low rotational speed, elimination of rubbing contact in the pump mechanism, and construction with corrosion-resistant materials, this pump is very reliable (30,000 hours of maintenance-free operation is typical in even the most severe applications). It is usually connected to a metal or elastomer diaphragm backing pump and then form a monobloc set which is easily transportable.

OPERATING PRINCIPAL :

The pumping device is made up of 2 overlaped scrolls ; one of them is moving and the other one is fixed. The movement is provided by 3 crankshafts (one is driving) with the same eccentricity. This movement causes the formation of chambers between the two spiral vanes. Once these chambers are formed, they remain closed, and as a result of the movement of one vane are progressively, continuously reduced in size and displaced towards a central exhaust port.

APPLICATIONS :

Our vacuum pumps are used all over the world to extract or circulate all kind of gases which can be aggressive, inert, toxic or radioactive (the only materials exposed to the vacuum environment are 316L and 420 stainless steel). Our model 15 m³/h is an ideal, dry, totally contamination-free roughing pump for applications such as evaporation, sputtering, scanning electron microscopes, tube evacuation and backfill stations. The pump has an ultimate vacuum capability of 5.10^{-3} mbar (with diaphragm backing pump) and, therefore, can serve as a roughing pump for systems using cryo, ion or turbomolecular pumps.

BENEFITS :

- Completely clean,dry and fluid tight vacuum pump
- Safety, reliability
- Low running and maintenance cost (no liquid nitrogen, no oil, long working life)
- Low noise and vibration level
- Air cooling (built-in fan)

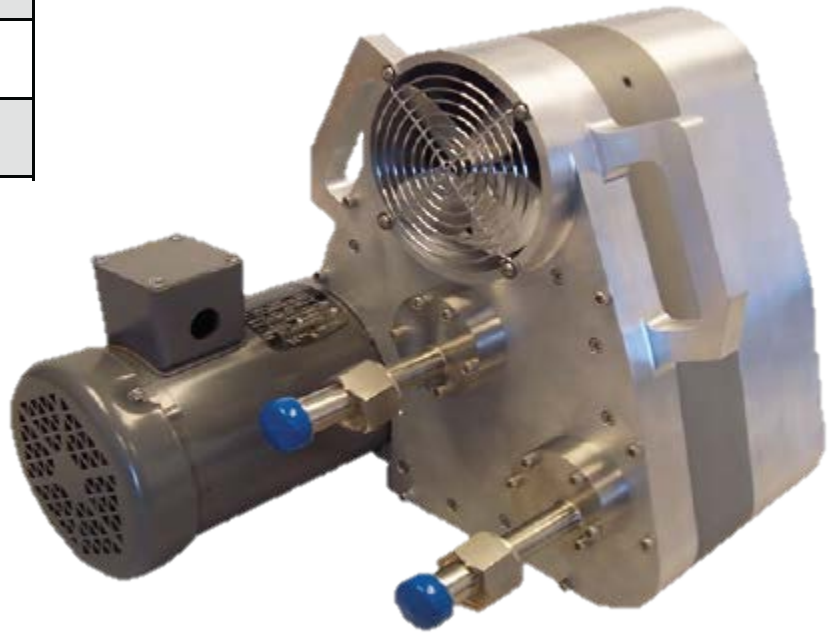
ACCESSORIES :

- Fine inlet and outlet metal filter
- Transport trolley

Technical Overview

	US	Europe
Max. Vacuum	< 200 mtorr	< 0.26 mbar
Max. Flow	8 cfm	227 lpm
Rated Power	0.5 hp	373 W
Motor Type	AC	
Avg. Sound Level	55 dB(A)	
Max. Amb. Temp.	104°F	40°C
Model Number	V15H34N6.0	
Part Number	031210	

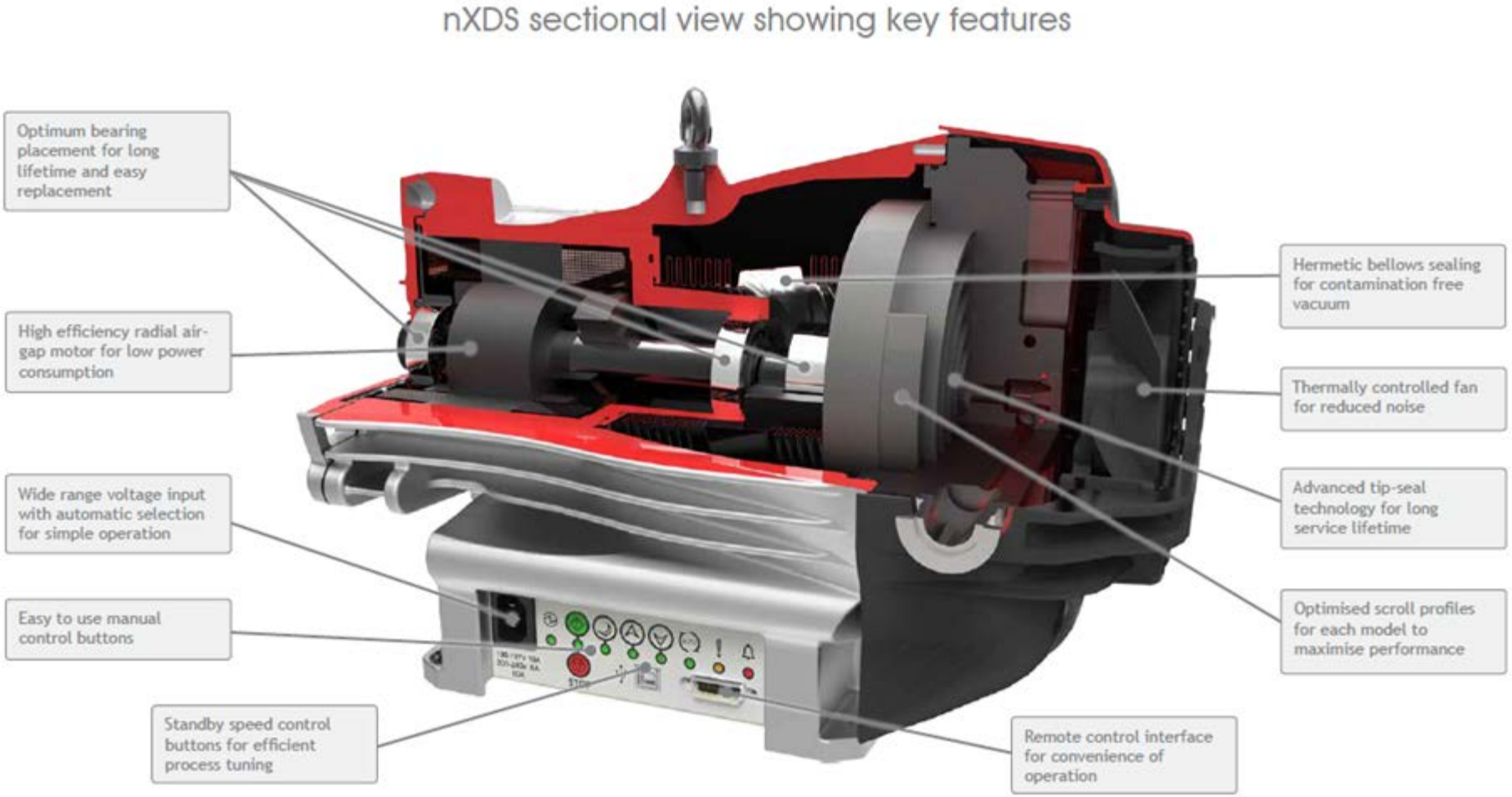
Air Squared, Inc.



100% Oil-Free
- Low Sound Levels
- Balanced, Smooth, Rotary Motion
- High Efficiency
- Long Product Life

- Continuous Duty
- Minimal Pulsation
- Hermetic
- Handles Air, Helium, Natural Gas, Oxygen, Hydrogen

Single Shaft support of the orbital scroll allows the scroll to wobble slightly when the tips seals are removed. Common to most scroll pumps.



Technical Data

	nXDS6i	nXDS10i	nXDS15i	nXDS20i
Nominal rotational speed	1800 rpm			
Displacement	6.8 m^3h^{-1} / 4.0 ft^3min^{-1}	12.7 m^3h^{-1} / 7.5 ft^3min^{-1}	17.1 m^3h^{-1} / 10.1 ft^3min^{-1}	28.0 m^3h^{-1} / 16.5 ft^3min^{-1}
Peak pumping speed	6.2 m^3h^{-1} / 3.6 ft^3min^{-1}	11.4 m^3h^{-1} / 6.7 ft^3min^{-1}	15.1 m^3h^{-1} / 8.9 ft^3min^{-1}	22.0 m^3h^{-1} / 13.0 ft^3min^{-1}
Ultimate vacuum (total pressure)	0.020 mbar/0.015 Torr	0.007 mbar/0.005 Torr	0.007 mbar/0.005 Torr	0.030 mbar/0.022 Torr
Minimum standby rotational speed	1200 rpm			
Speed control resolution (percentage of full rotation speed)	1%			
Max inlet pressure for water vapour	35 mbar	35 mbar	35 mbar	20 mbar
Max water vapour pumping rate	110 gh^{-1}	145 gh^{-1}	280 gh^{-1}	220 gh^{-1}
Maximum continuous inlet pressure	200 mbar	200 mbar	200 mbar	50 mbar
Voltage input	100-127, 200-240 (+/-10%)			
Voltage frequency	50/60Hz			
Motor power 1-ph*	260 W	280 W	300 W	260 W
Power connector 1-ph	IEC EN60320 C13			
Recommended fuse	10A, 250Vac rms			
Weight	26.2 kg / 58 lb	25.8 kg / 57 lb	25.2 kg / 56 lb	26.6 kg / 56 lb
Inlet flange	NW25			
Exhaust flange	NW25			
Noise level**	52 dB(A)			
Vibration at inlet flange	< 4.5 mms^{-1}(rms)			
Leak tightness (static)	< $1x10^{-6}$ mbar ls^{-1}			
Operating temperature range	+10 C to +40 C / +41 to +104 F			

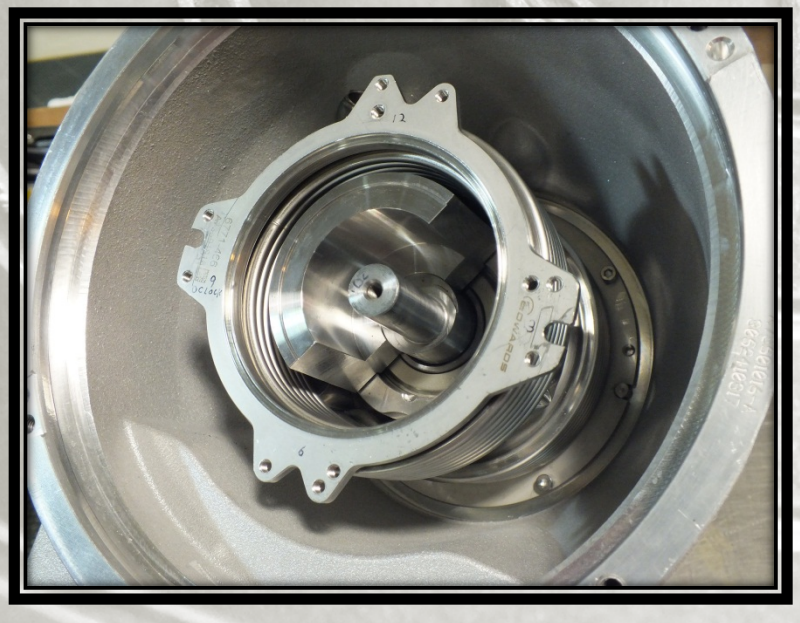
** Typical. See graphs on page 6.*

*** For low fan speed, typical at ultimate end when load/ambient conditions allow.*

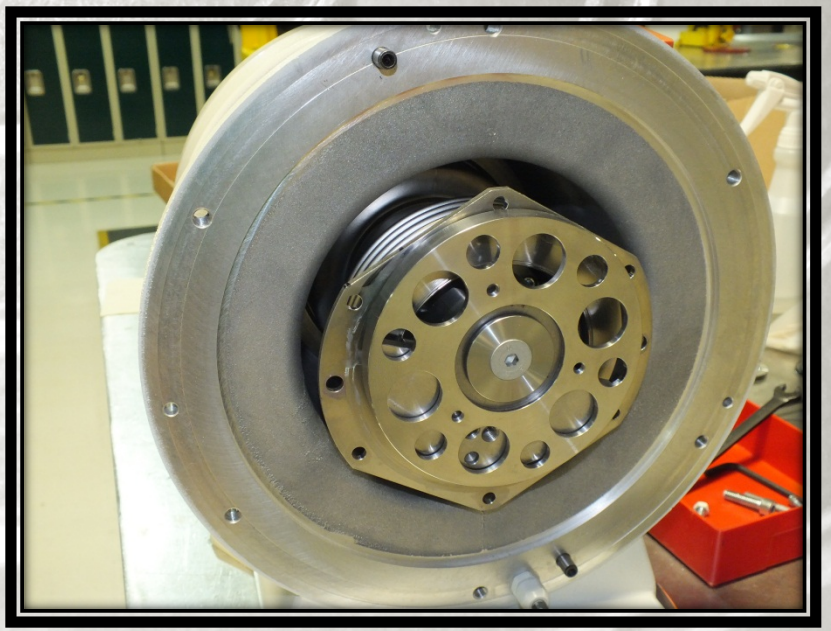
Bellows

- To keep process gas clean – Separates process gas from bearing grease.
- This design was standard on Normetex; but , is a new addition to Edwards and Busch pumps.

Edwards



Busch



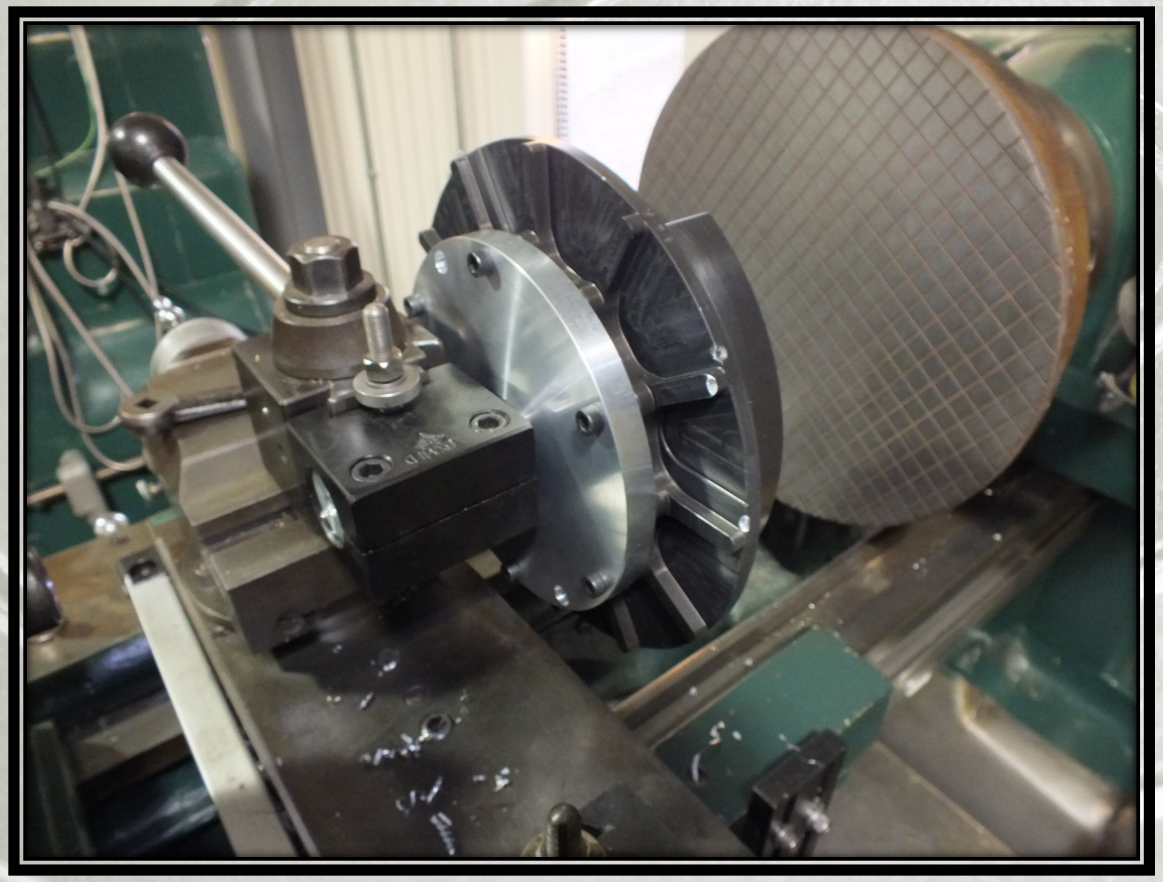
Modifications: Bronze Tip Seal

- Initially bronze flat wire replaced the Teflon tip seal.
- Polishing the bronze left too much contamination.
- All tip seals were removed and the aluminum scrolls were then lapped for flatness

EDWARDS

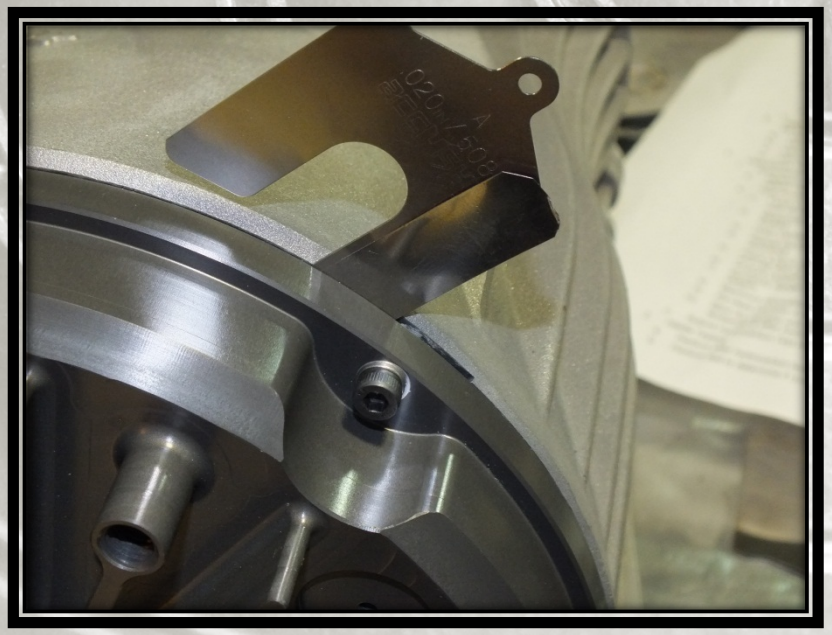
Modifications

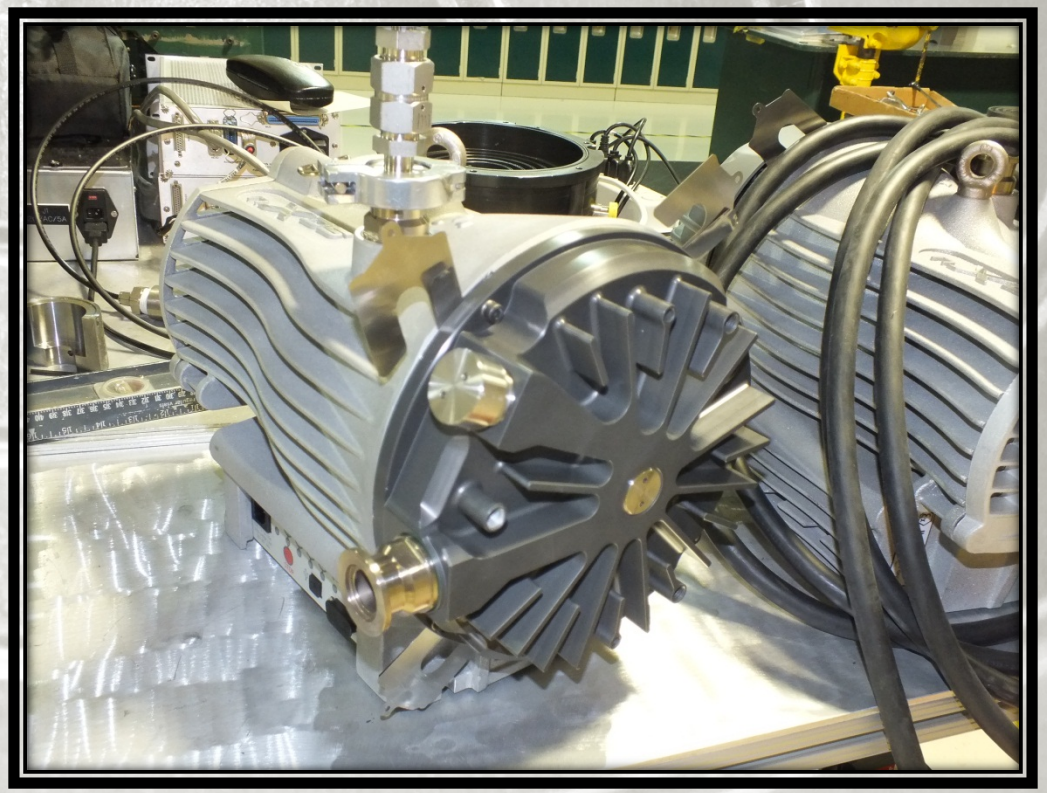
- Lap the scroll



Modifications

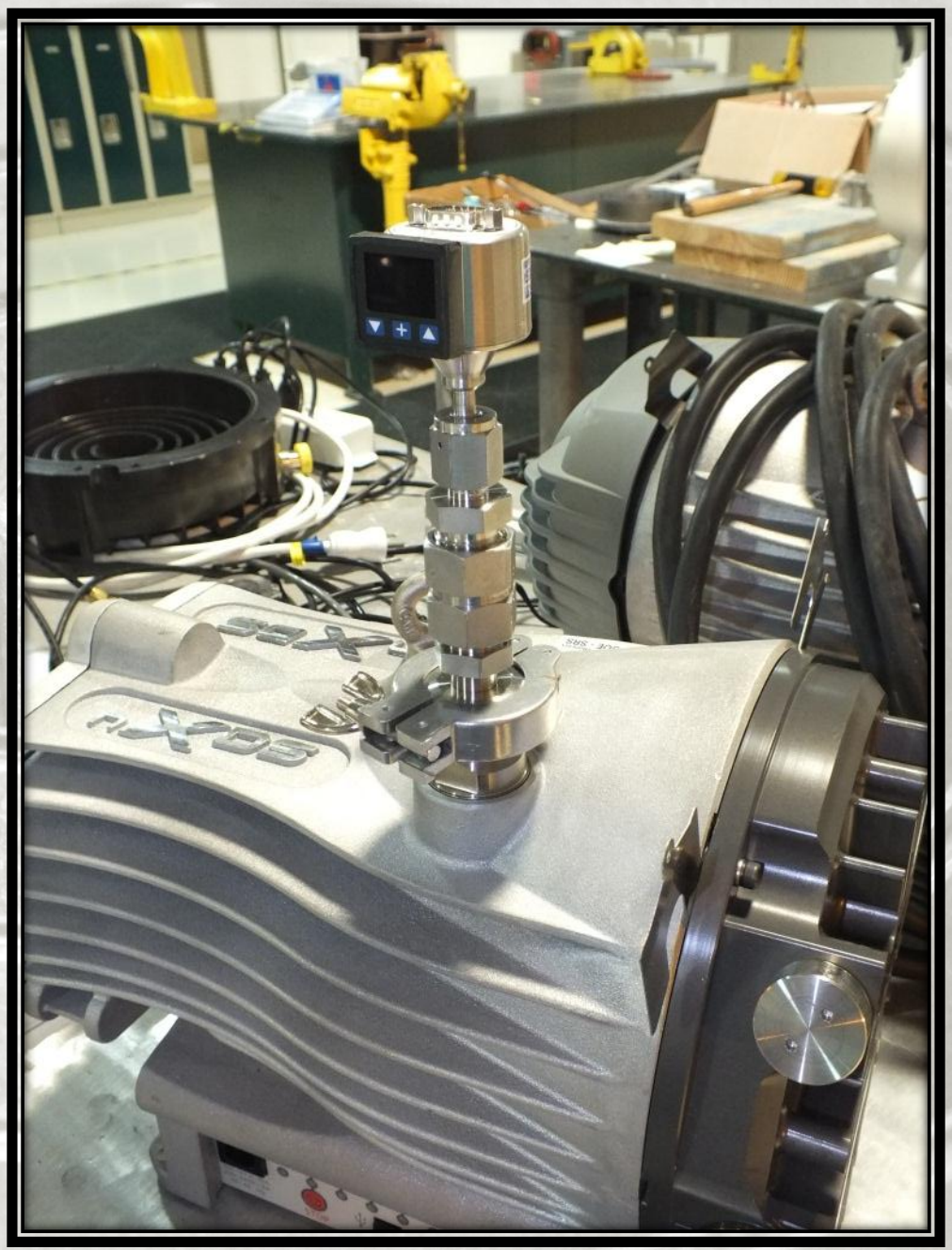
- Controlling clearance between 2 scrolls is a manual process and somewhat hit and miss.
- Shimming the Busch pump may prove to be more difficult. Shimming will have to be internal to the pump.



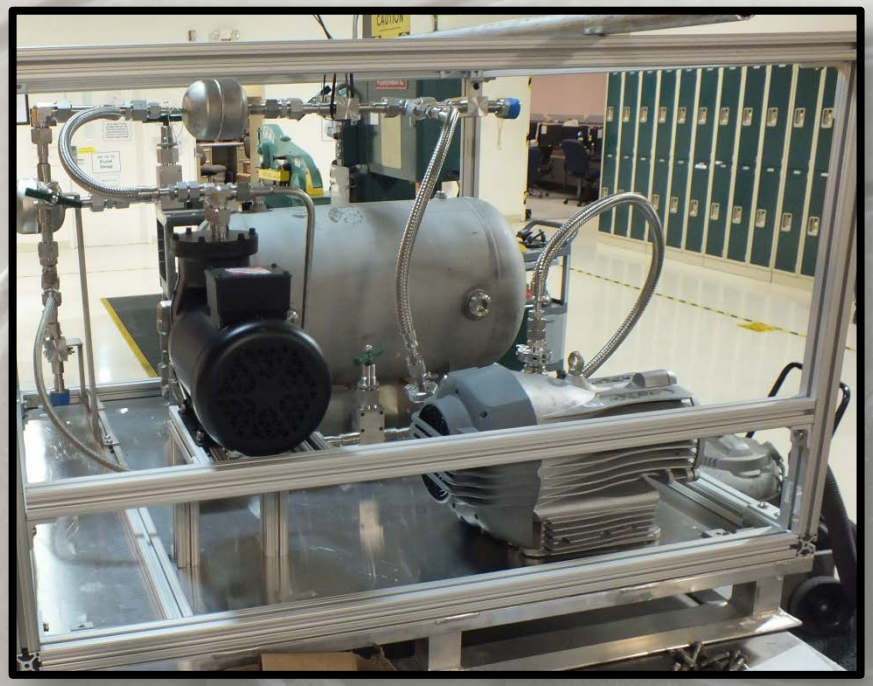


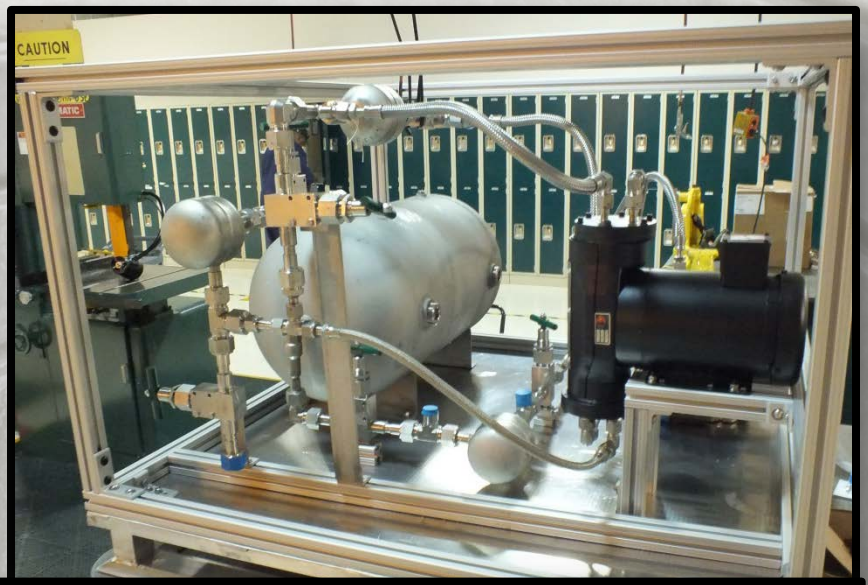
Test System

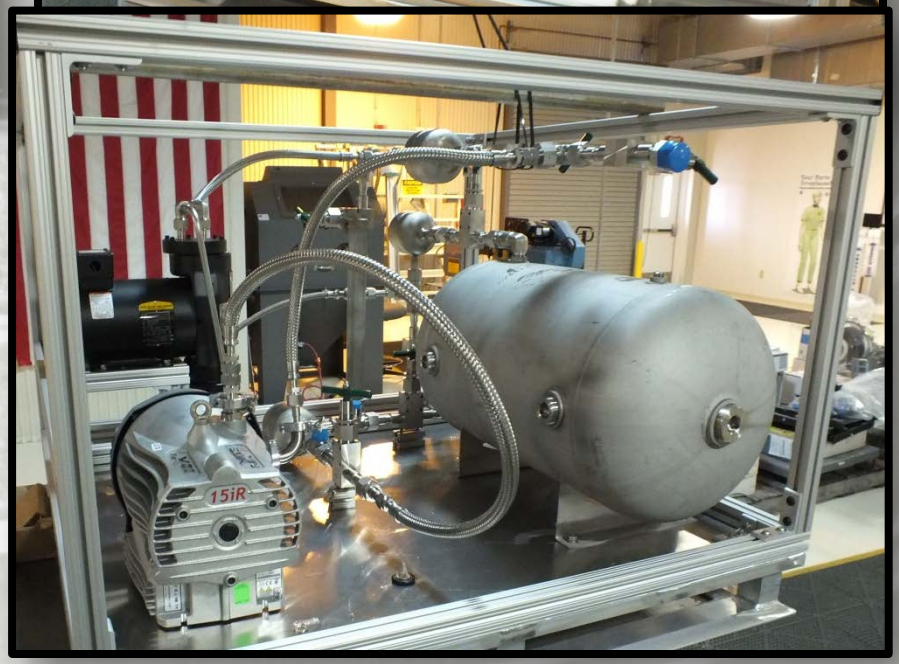
Measure ultimate vacuum with transducer close coupled to pump.



Test System



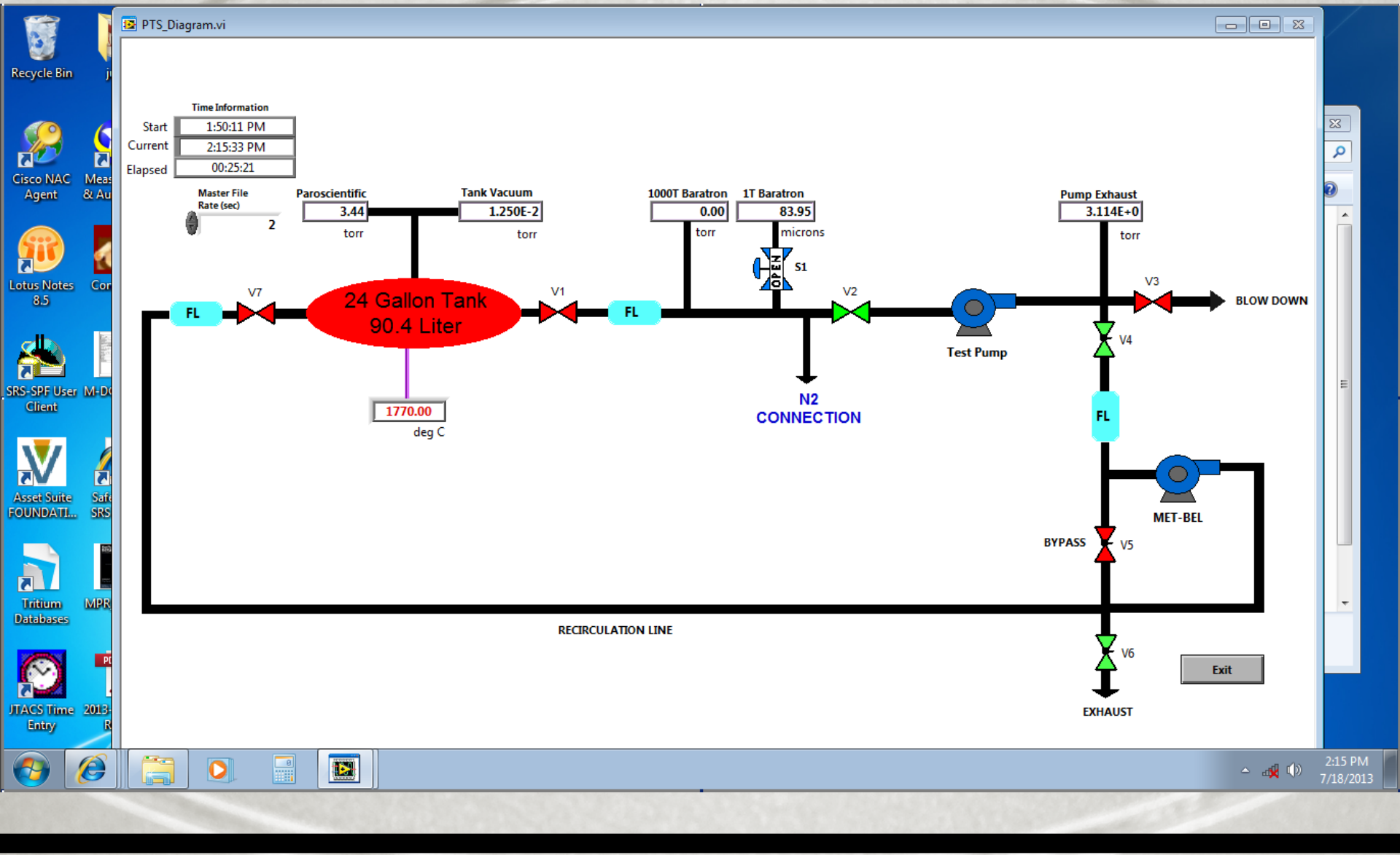


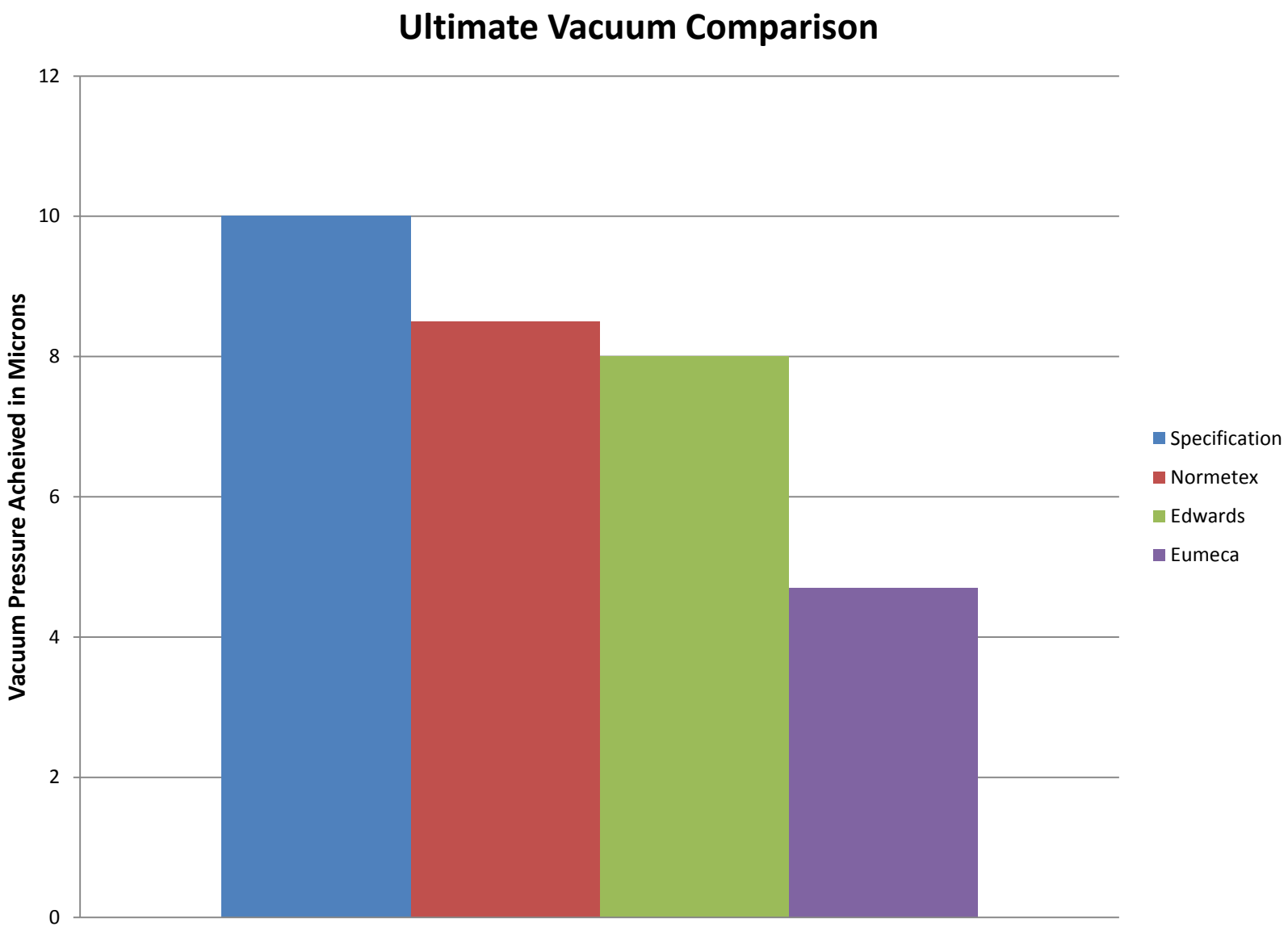


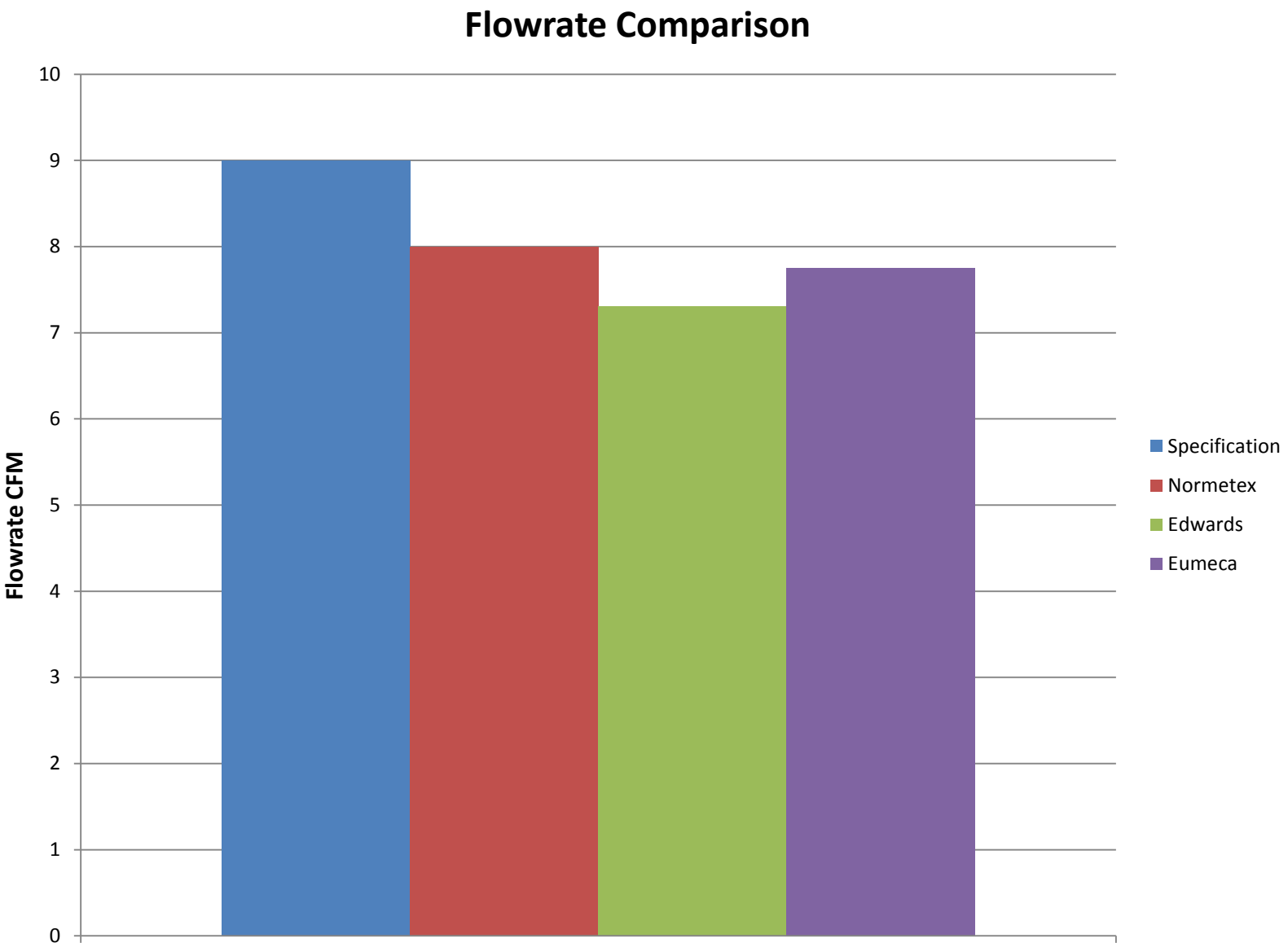
- Test rig will provides means to compare pumps under equal conditions.
- Met-Bel evacuates to less than 50 torr
- Evacuation volume 92.2 liters.
- Multiple pressure instruments and data collection system.
- Final testing done with nitrogen.

Test System

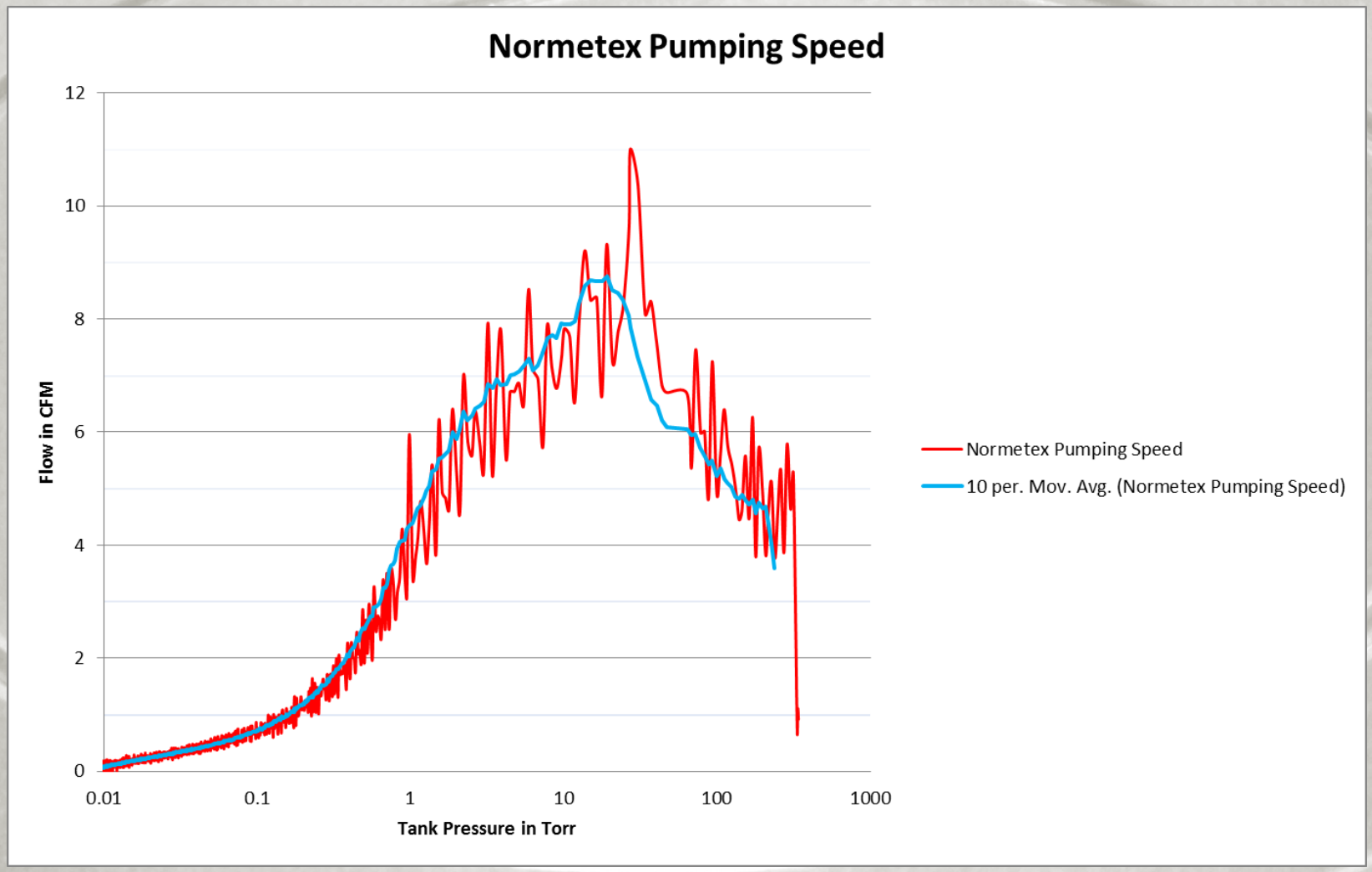
Data collection software



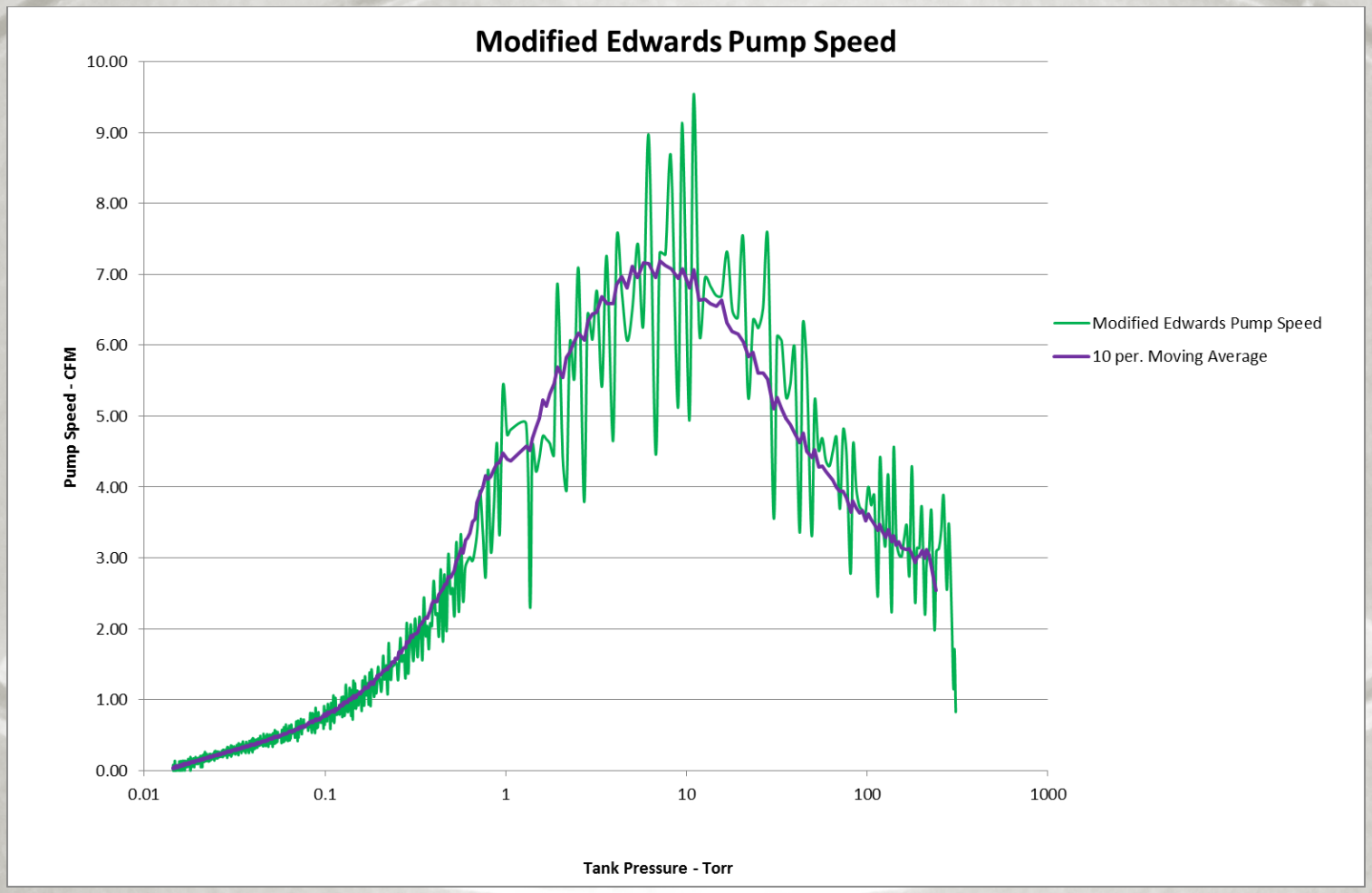

Ultimate Vacuum Comparison
Vacuum Pressure Acheived in Microns
12
10
8
6
4
2
0
Specification
Normetex
Edwards
Eumeca


Flowrate Comparison
Flowrate CFM
10
9
8
7
6
5
4
3
2
1
0
Specification
Normetex
Edwards
Eumeca

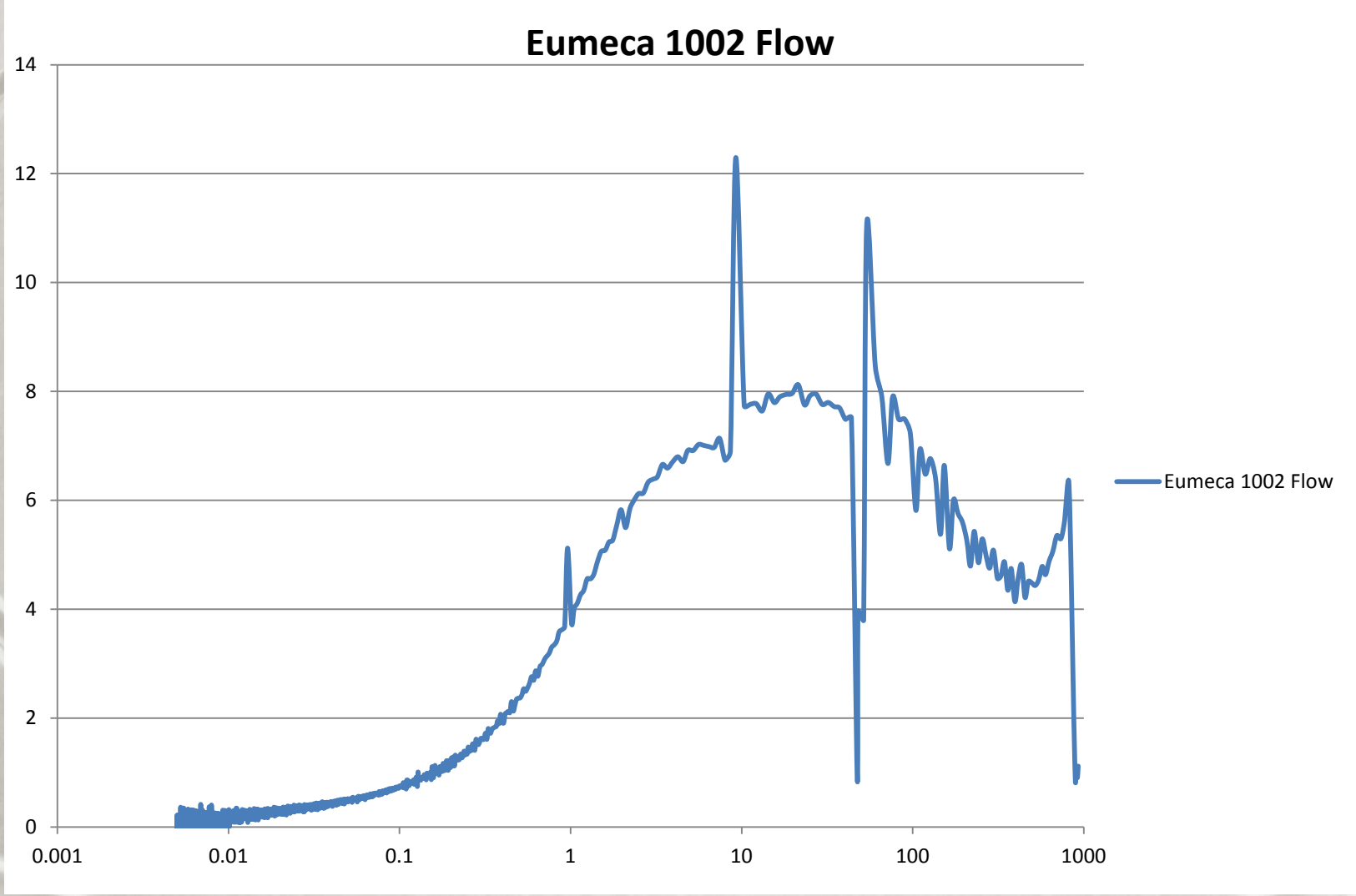
Output: Example



Output: Example



Output: Example



Final Report

The final report will provide test data to management on each pump and an engineering appraisal of the strengths and weaknesses of each pump/company. The report will include:

1. Flow curves for each pump
2. Ultimate vacuum for each pump
3. Pump down rate on the tank for each pump
4. Design review of each pump
5. Discussion of each company and how they fit our strategic plans
6. Pricing or cost estimates for each pump
7. A summary table of data
8. Recommendation for which vendor to select

   Criteria will be based on the following in order:

   A. Performance
   B. Long term viability of the business
   C. Price
   D. Other as determined