

Magnetically Coupled Pump System for Cryogenic Propellant Destratification



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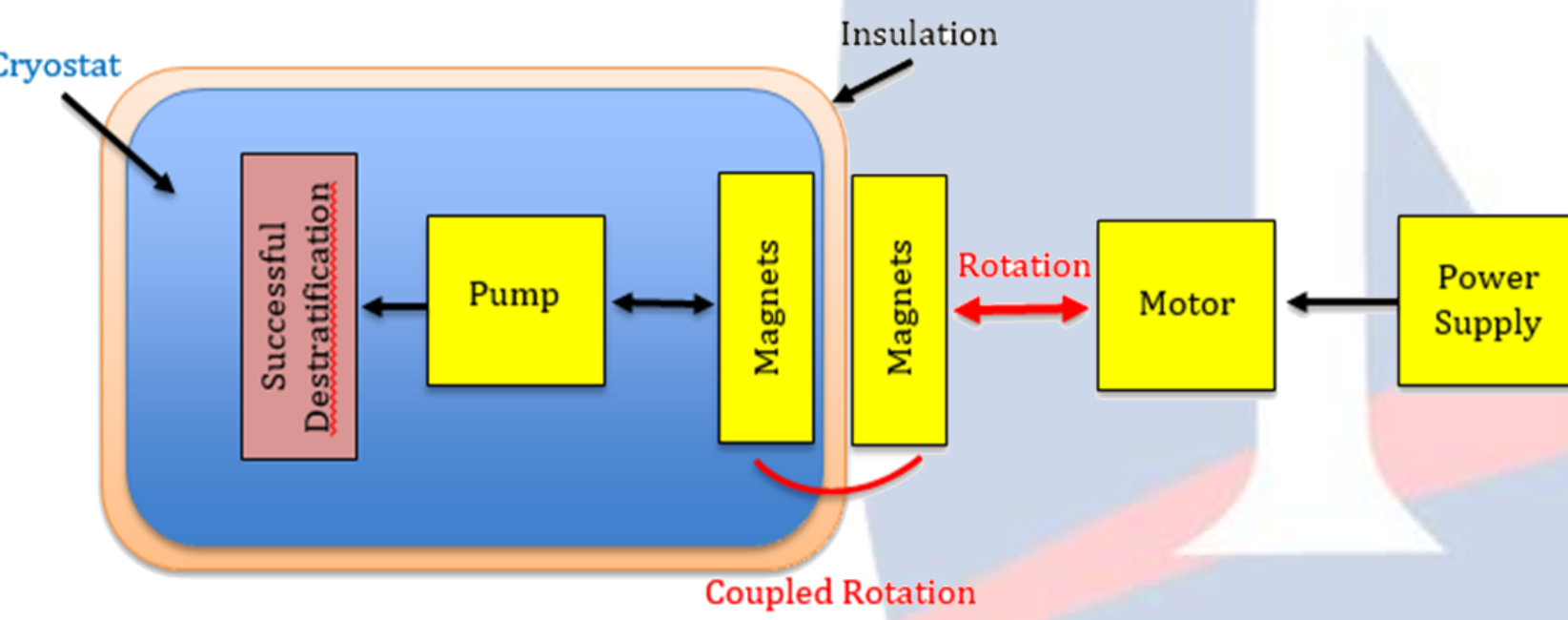
Purpose

Background:

- Long term storage of cryogenic rocket fuel such as LH₂ and its oxidizer LO₂ present technology issues related to pressure control and destratification.
- By reducing temperature stratification, more time is allotted before the venting of the tank is required.
- In low gravity conditions, venting is difficult since the liquid and vapor positions are not known and can result in propellant loss.

Goal Statement:

Design an electric motor-pump/mixer unit that makes use of magnetic coupling technology.



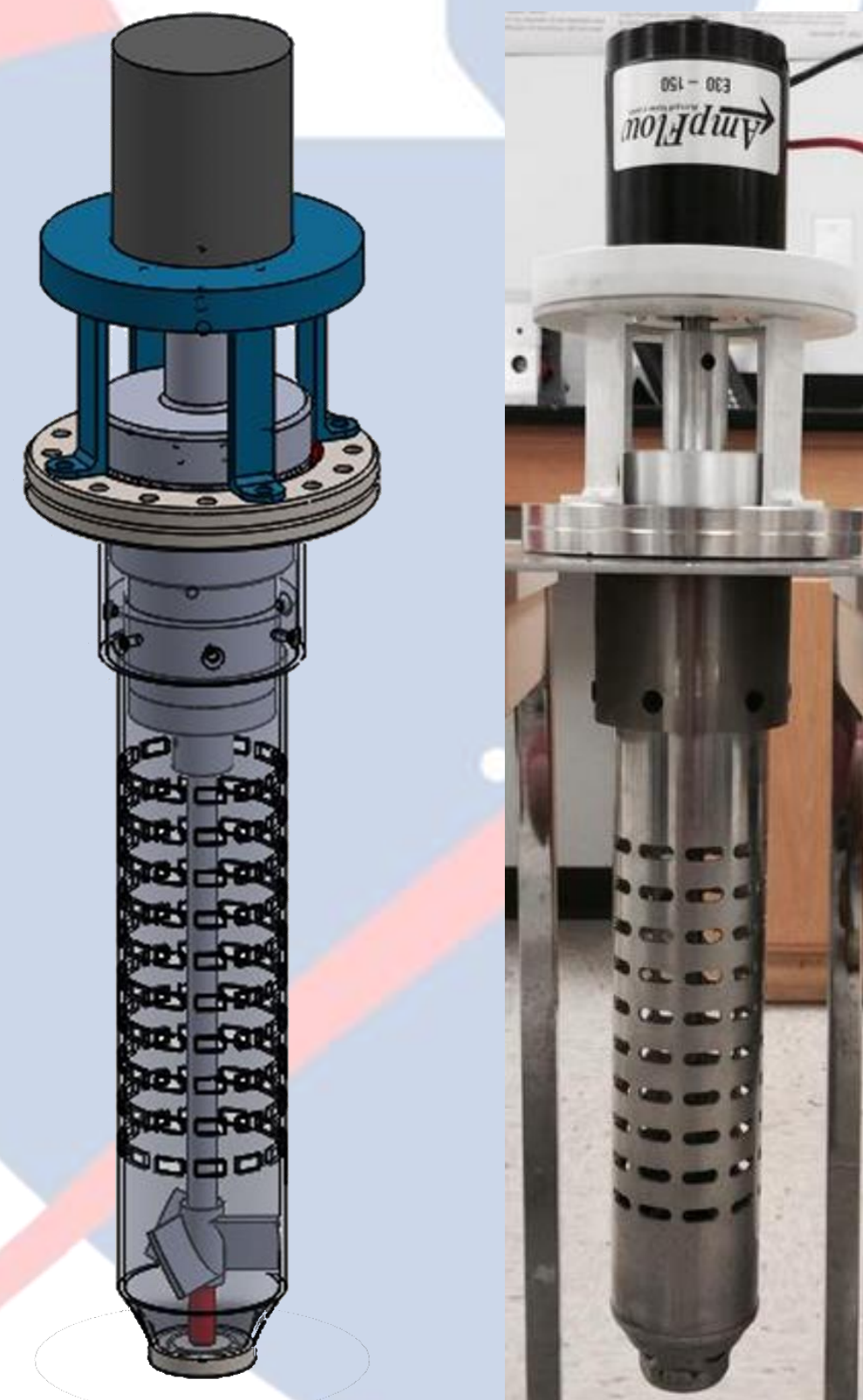
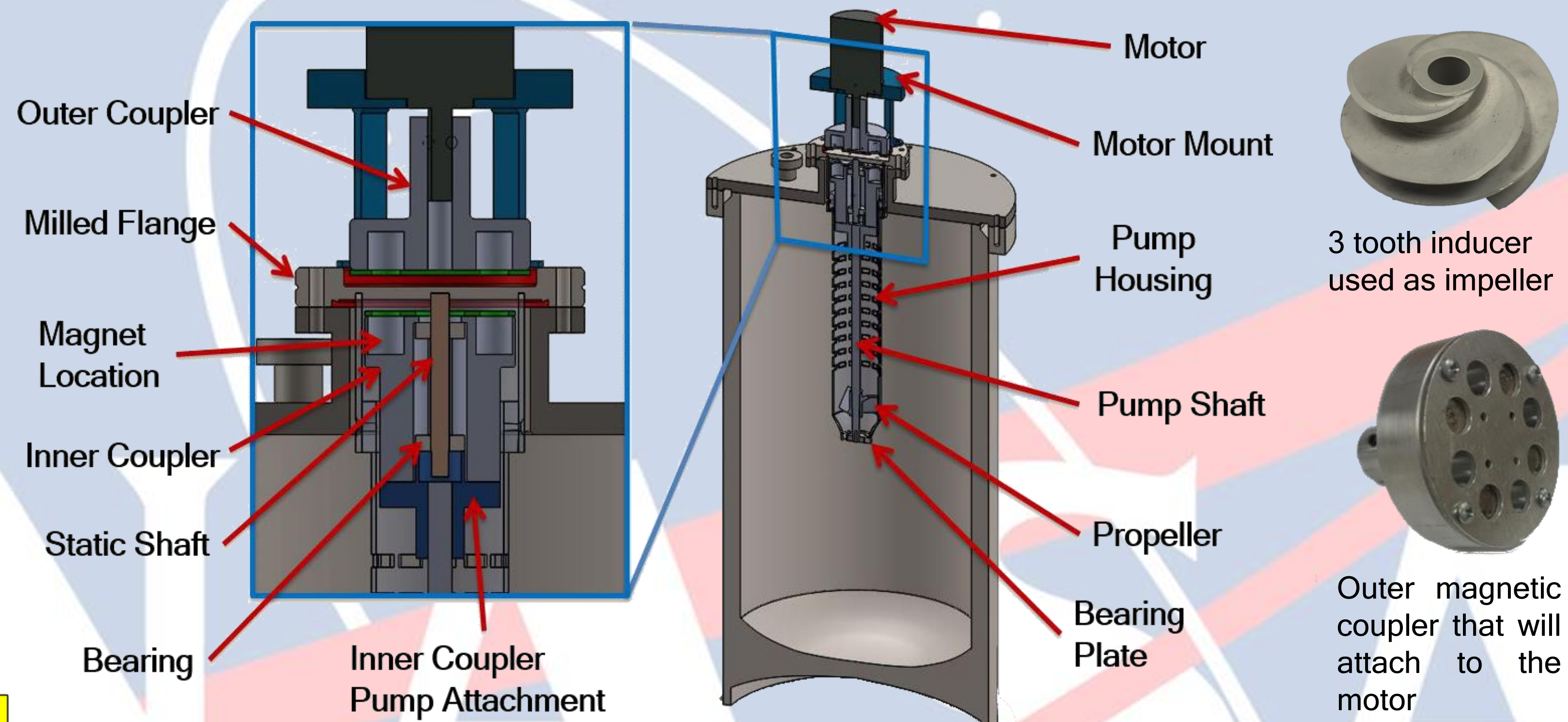
Objectives

- Minimize heat addition in the cryogenic tank
- Must produce a volumetric flow rate of 5-15 gpm
- Motor must be on the outside of the tank
- The entire system must be mounted to a 6" flange and fit through a 3.75" port on the top of the tank
- Must be able to run in water and liquid nitrogen

Future Improvements

- Reduce friction and scraping from bearings and impeller
- Testing the flow rate in cryogens
- Testing the frequency of pressure release over extended periods of time
- Reduce vibrations caused by the motor

Prototype Design



- (Left) CAD drawing of pump system
- (Right) Prototype of pump system

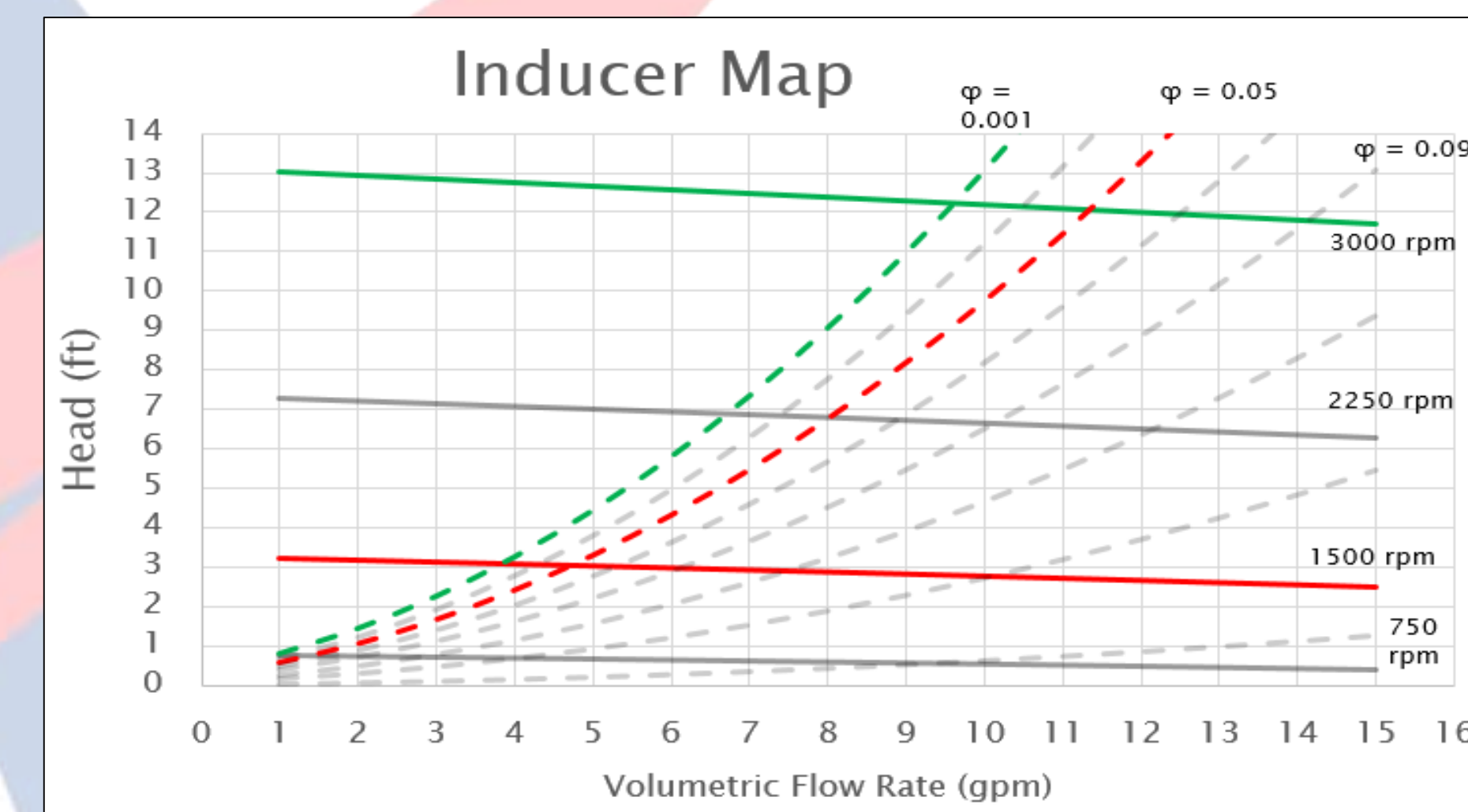


- Piping system apparatus to test the flow rate of the pump in water
- Flow rate displayed was 14 gpm at max voltage



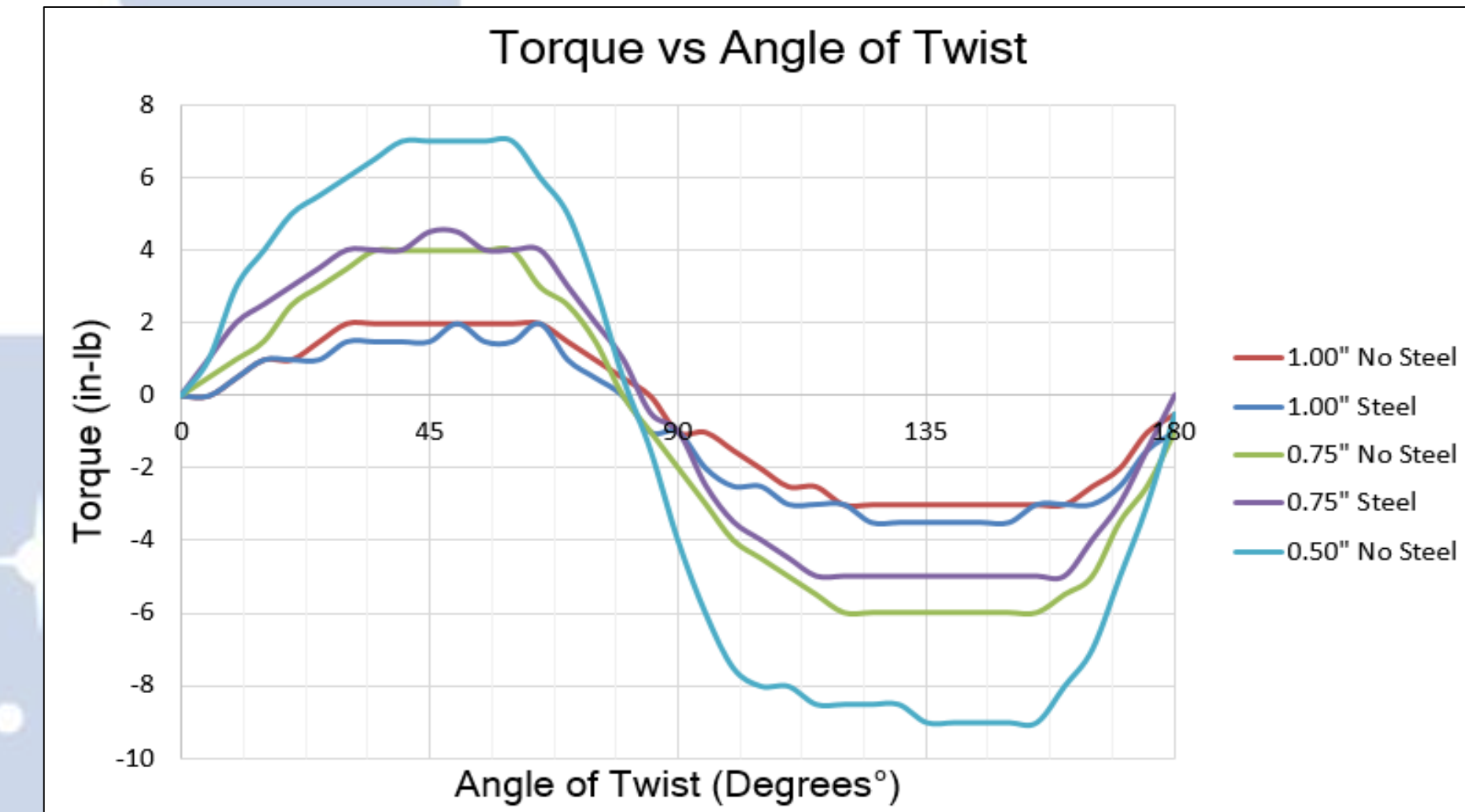
- System tested in liquid nitrogen to ensure functionality in cryogens
- 5 psi pressure relief valve

Testing and Results



Inducer map showing pressure head vs volumetric flow rate to aid in motor selection:

- Red line: The minimum RPM needed.
- Green line: Selected RPM.



Torsion test results for couplers at various distances.

- Four magnets was proven to produce a greater degree of coupling strength
- "Steel" : 1/8" sheet of steel between couplers
- "No Steel" : Nothing between the couplers

Acknowledgements

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