

P12452 – Vibration Isolation and Novel Cooling System

Final Project Summary

May 18, 2012

Members

Team

John Burns – Project Manager

Ryan Hurley – Principle Engineer

Chris Guerra – Thermo-Fluids Engineer

Matt Kasemer – Vibrations Engineer

Support

Bill Nowak – Faculty Guide

Dr. Jason Kolodziej – Primary Customer

Scott Delmotte – Dresser-Rand Contact

James Sorokes – Dresser-Rand Contact

Agenda

- Project Background
- Customer Needs Summary
- Design Summary
- Results
- Future Work
- Lessons Learned
- Acknowledgements

PROJECT BACKGROUND

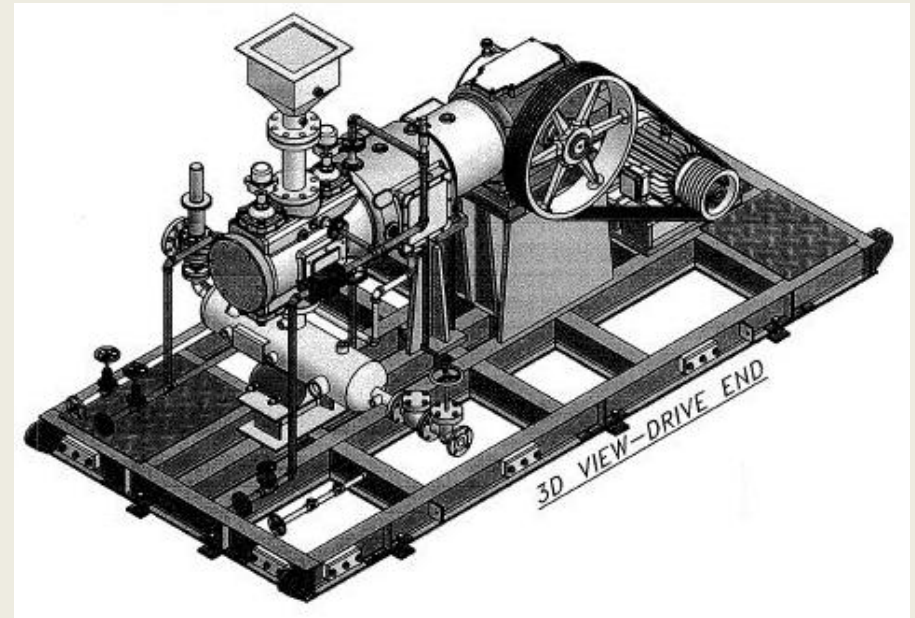
Reciprocating Compressors

- Typically used to compress process gas in refineries
- Traditionally configured as opposing throws to reduce vibration, with hard-mount to large concrete pad.
- Both forced and thermosyphoning systems used for cooling.



RIT Reciprocating Compressor

- Smallest reciprocating compressor Dresser-Rand manufactures
- Bore – 6 inches
- Stroke – 5 inches
- Operating Pressure – ~45psia
- 360 cycles per minute (6 Hz)



P12452 Project Scope

- Understand operating conditions of the compressor
- End Goals
 - Design, evaluate, install and test a vibration isolation system.
 - Design, evaluate, implement and analyze a thermosyphoning system.

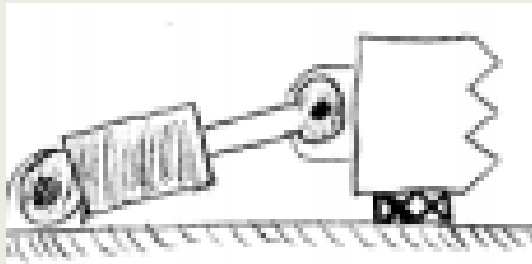
Customer Needs Summary

- Primary customer needs to address:
 - Vibration Isolation:
 - ~50% vibration reduction
 - System should be removable
 - Novel Cooling:
 - Keeps compressor at safe operating temperature
 - Transition from thermosyphoning to pump-driven system should be as simple as possible

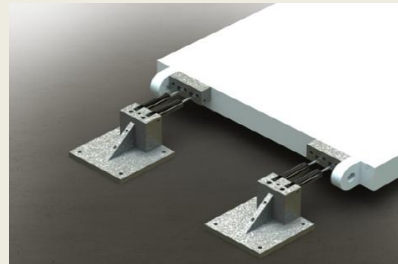
DESIGN SUMMARY

Vibration Isolation Solution

- Parallel design paths:
 - Magnetorheological (MR) Dampers (LORD Corp.)
 - Infinite adjustability, educational value, donated
 - Standard automotive shocks (Monroe)
 - Low cost, no outside power requirements, readily available



Brainstorming



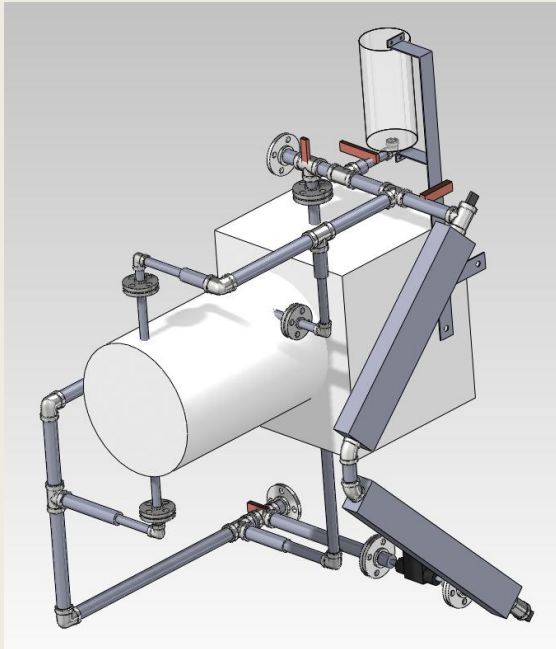
Initial Design



Final Install

Thermosyphoning System

- No use of outside power
- Cooling amount is self adjusting

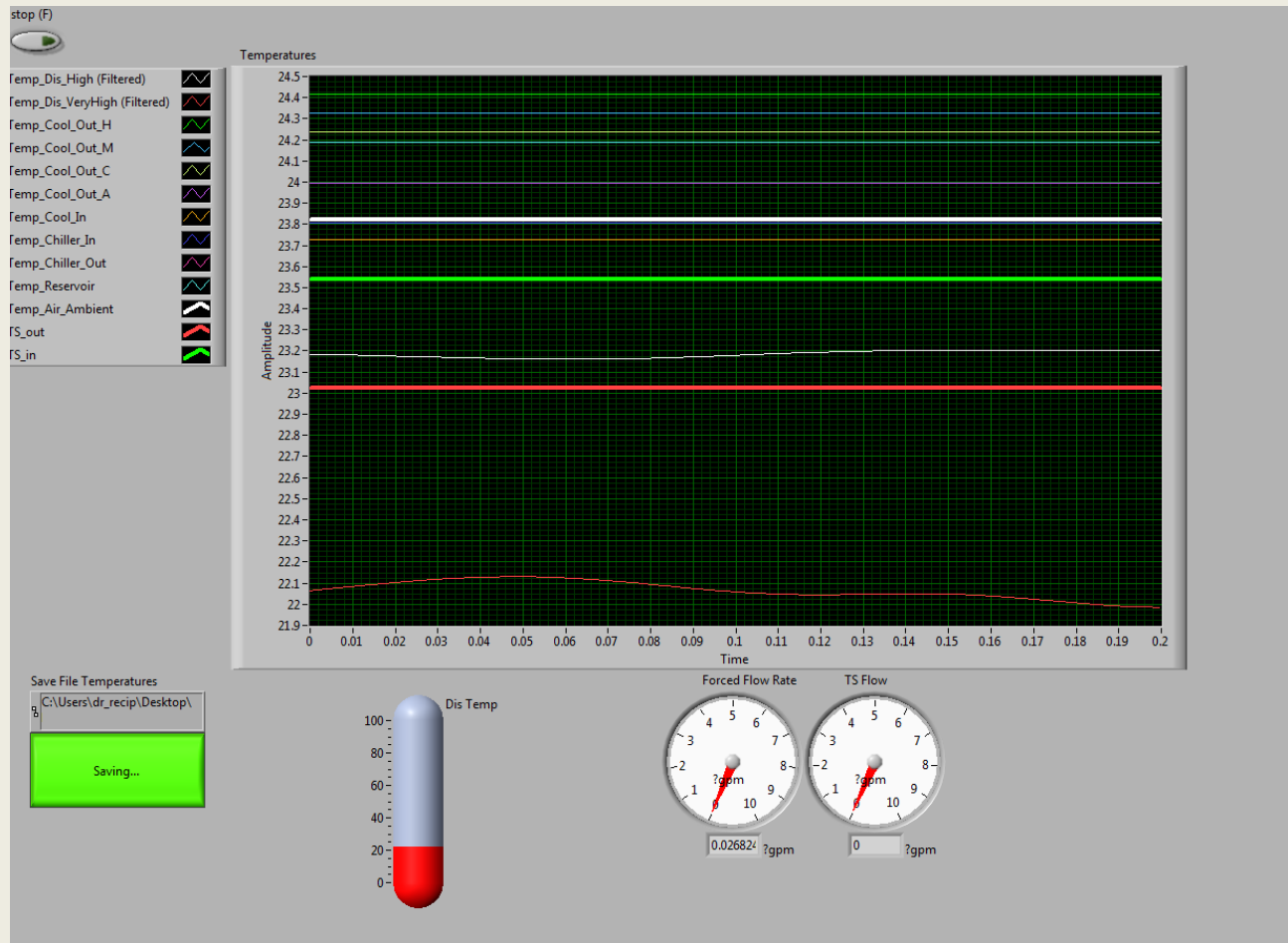


Initial Design



Final Install

Thermosyphoning VI



Project Budget

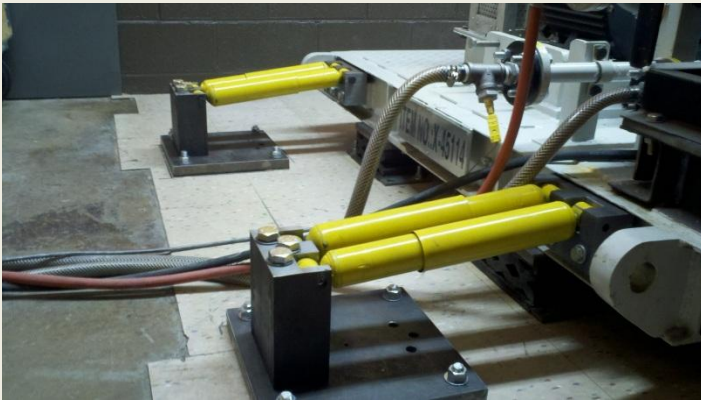
Project Budget:	\$ 5,000
<i>Predicted Cost:</i>	<i>\$ 1,761</i>
Actual Cost:	\$ 1,942
Misc. Expenses**:	\$ 266
Total Project Cost:	\$ 2,208
Percentage of Budget Used:	44%

**Misc. Expenses include tools, mileage & food reimbursements, etc.

RESULTS SUMMARY

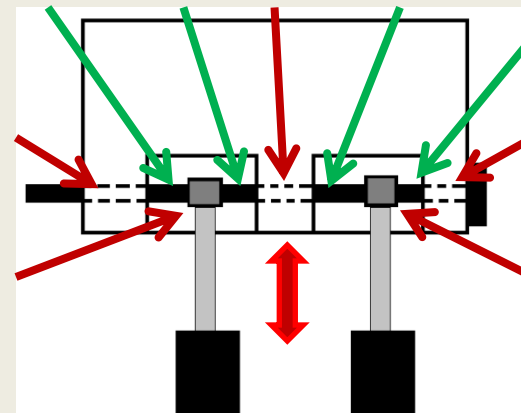
Vibration Isolation Results

Some issues were encountered with the automotive dampers



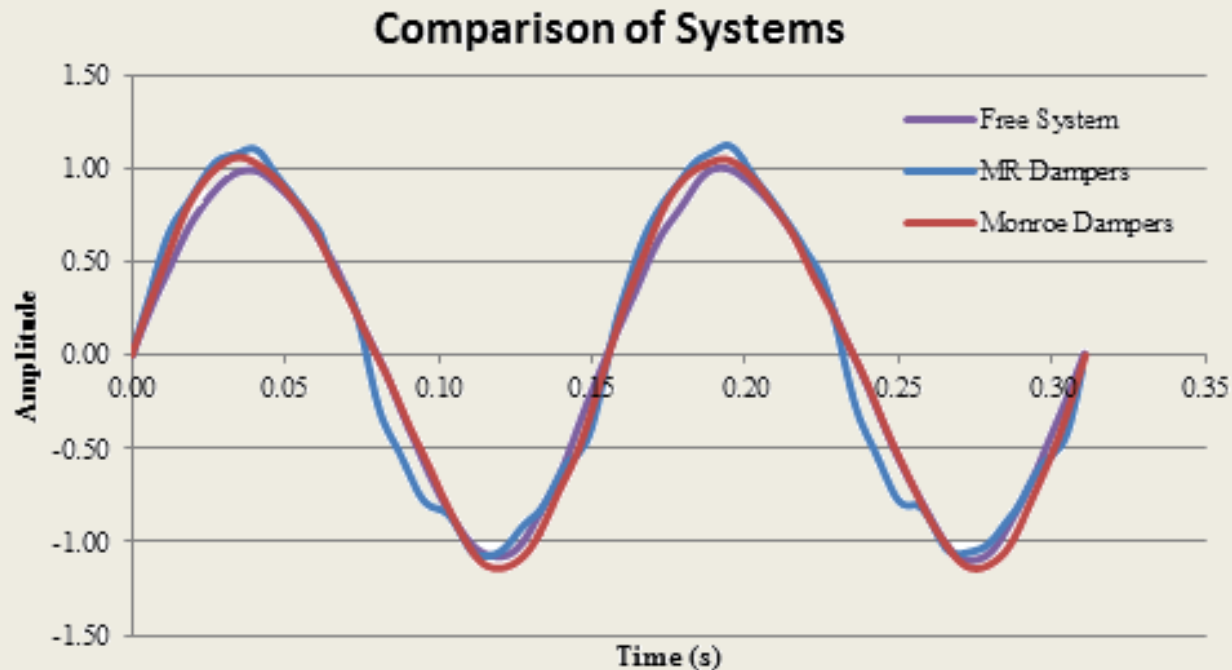
The original design of the MR damper mounting system proved to be inadequate, with an unforeseen tolerance stack-up and design flaw adversely impacting performance.

The automotive dampers proved to be ineffective in damping any of the vibrations present in the system. This was not a huge issue, because they were originally designed as a failsafe backup to the MR damper design.

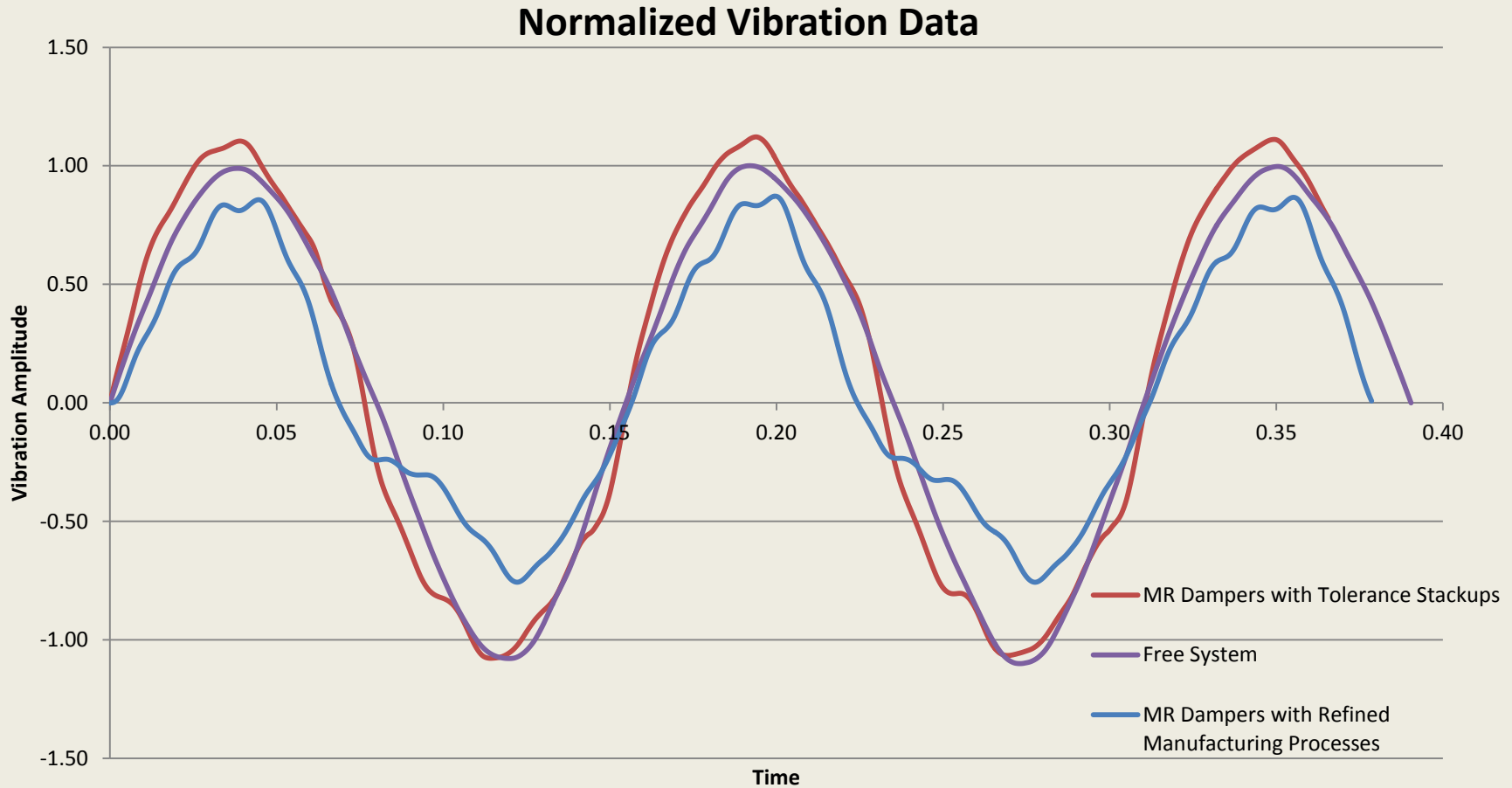


Red Arrows: Tolerance Stackups
Green Arrows: Bending

Vibration Isolation Results- Cont'd

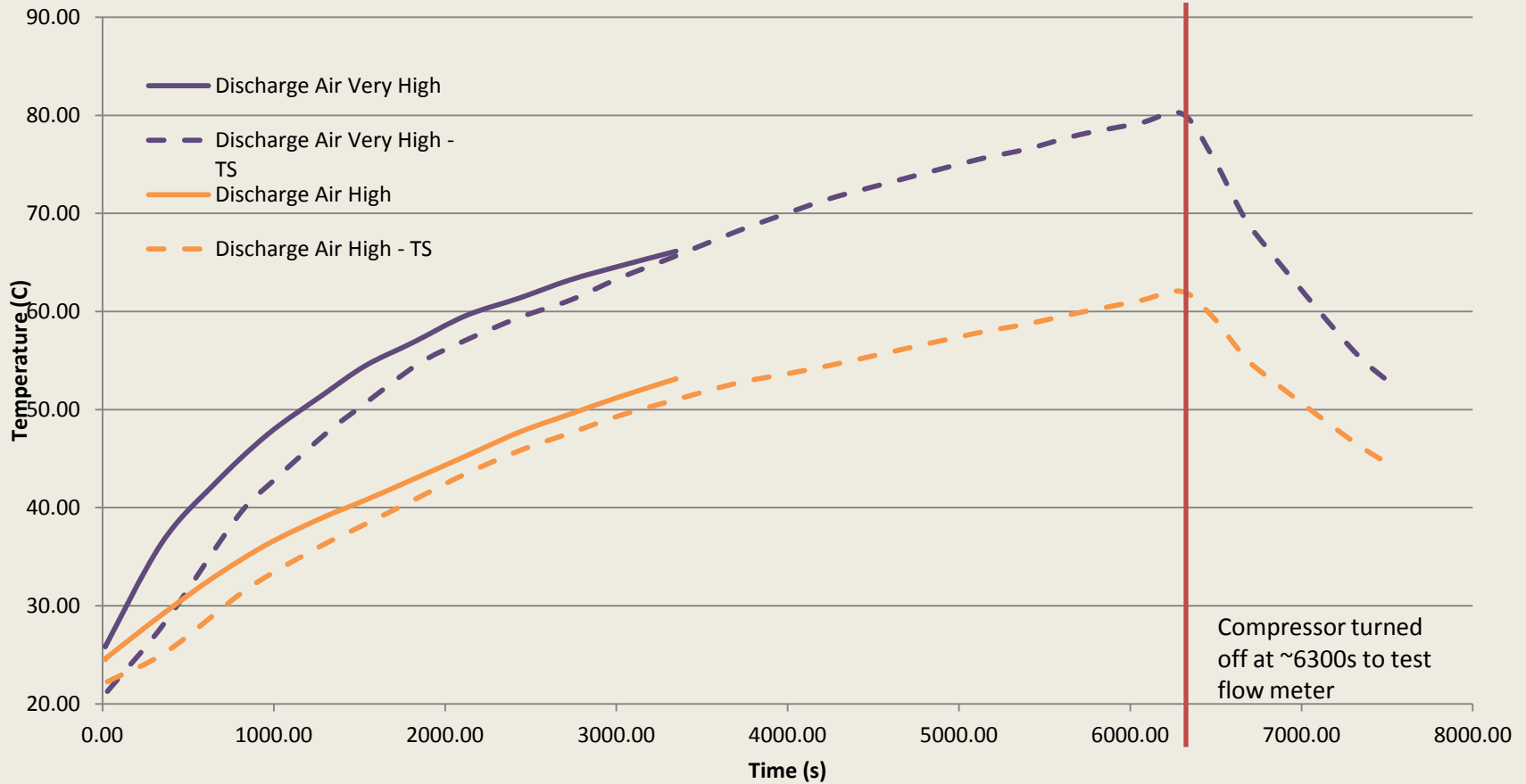


Vibration Isolation Results- Cont'd

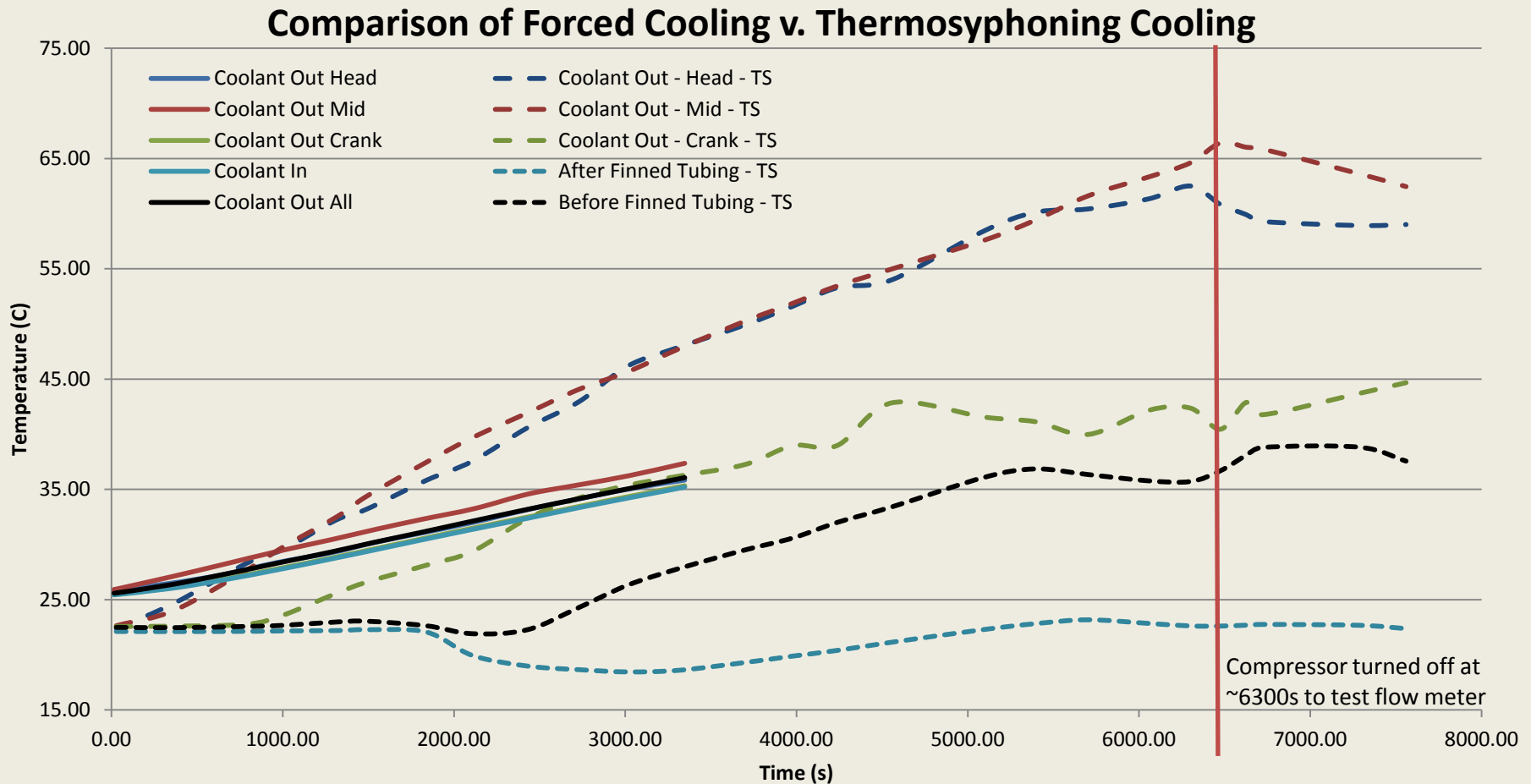


Thermosyphoning Results

Discharge Air Temperature Comparison



Thermosyphoning Results



Future Work

- Investigate and reduce vibration transmission to floor
- Different finned tubing arrangements
- Flow issue through thermosyphoning system
- Research opportunities

Lessons Learned

- Machining always takes longer than you predict!
- Leave time for redesigns
- Shop managers are lifesavers
- Designs needs to be validated again after ANY design changes.
- Evaluate every assumption and is repercussions thoroughly
- Thermosyphoning is still magic...

Acknowledgments

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- Dr. Marca Lam
- Dr. Mark Kempinski
- Dr. Amitabha Ghosh
- Dave Hathaway
- Rob Kraynik
- Steve Kosciol

Questions?

