VTT Rotor: Back EMF Test Fixture Midterm Presentation II

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Presentation Outline

- Background
- Design Challenges
- Motor Selection
- Prototype
- Design Components
- Schedule
- Conclusion

Background

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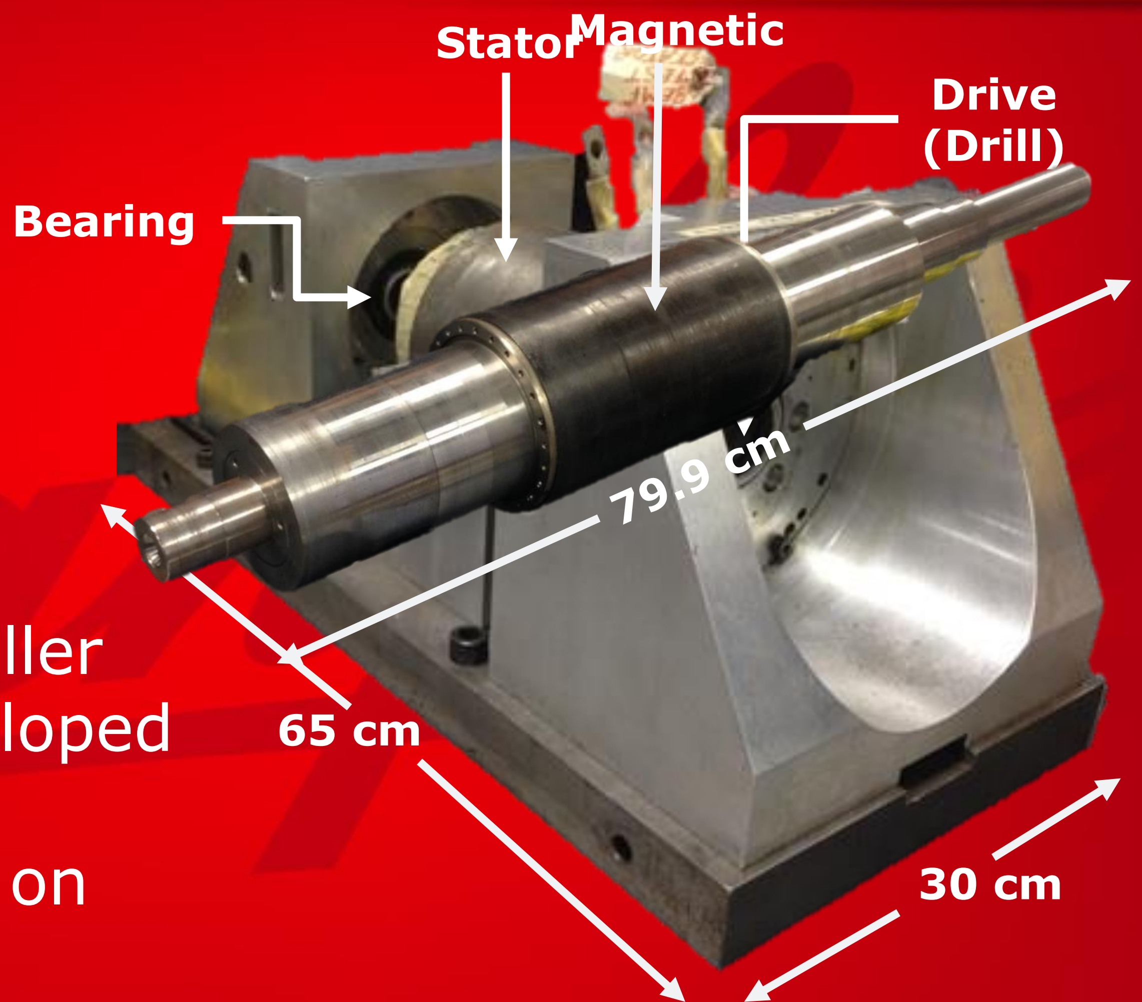
- Danfoss Turbocor is the world leader of the oil-free centrifugal compressor product category
- Compressors utilize magnetic rotor shafts that levitate during rotation to reduce friction
- Launching a new, larger compressor in 2015:
  - VTT Compressor
- Will utilize larger rotors, manufactured by a third party company

Motivation

- Need test fixture to qualify rotors
- Will measure back electromotive force (EMF)
- Test fixture for smaller rotors already developed
- Several constraints on design



Project Goal

- Fully designed, manufactured and tested back EMF test fixture

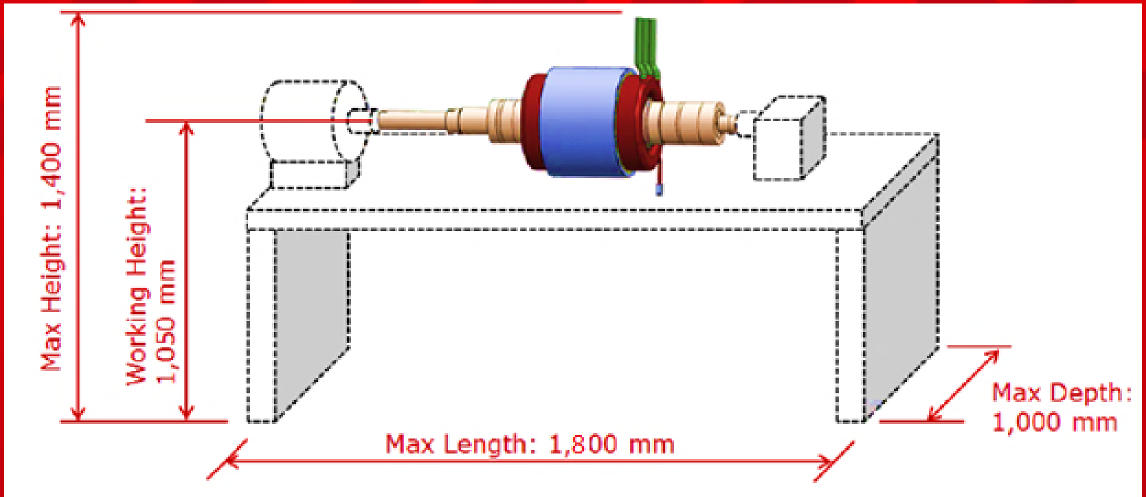
- Submission package to Turbocor:
  - 3D Prototype
  - Bill of Materials
  - Drawing Package

- Conform to all constraints outlined by Turbocor

- Budget: $4,000

Design Challenges

- Overcoming magnetic force of 60-80 pounds
- Centering rotor within stator
  - Deviations in the height of components will compromise validity of quality tests
  - Motor shank needs to support rotor weight
- Spatial Constraints:



Overcoming Magnetic Force

1)

- 60-80 pound magnetic force exerted when rotor is inserted into stator

- Three options considered:
  - 1) Ball Screw
  - 2) Rack and Pinion
  - 3) Pnuematic Actuator

2)

- Weighted Decision Matrix:
  - Indicated **Ball Screw** is most effective option

3)

Live Center and Housing

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- Live Center will center the rotor
  - Cost: $128.95
  - 5,500 RPM, 660 pound capability
- Live Center will be inserted into adapter to make tapered section straight
  - Simplifies manufacturing
- Will be press fit into the support system
  - Secured by outside plate screwed into front of live center

Live Center Selected

Live Center Housing

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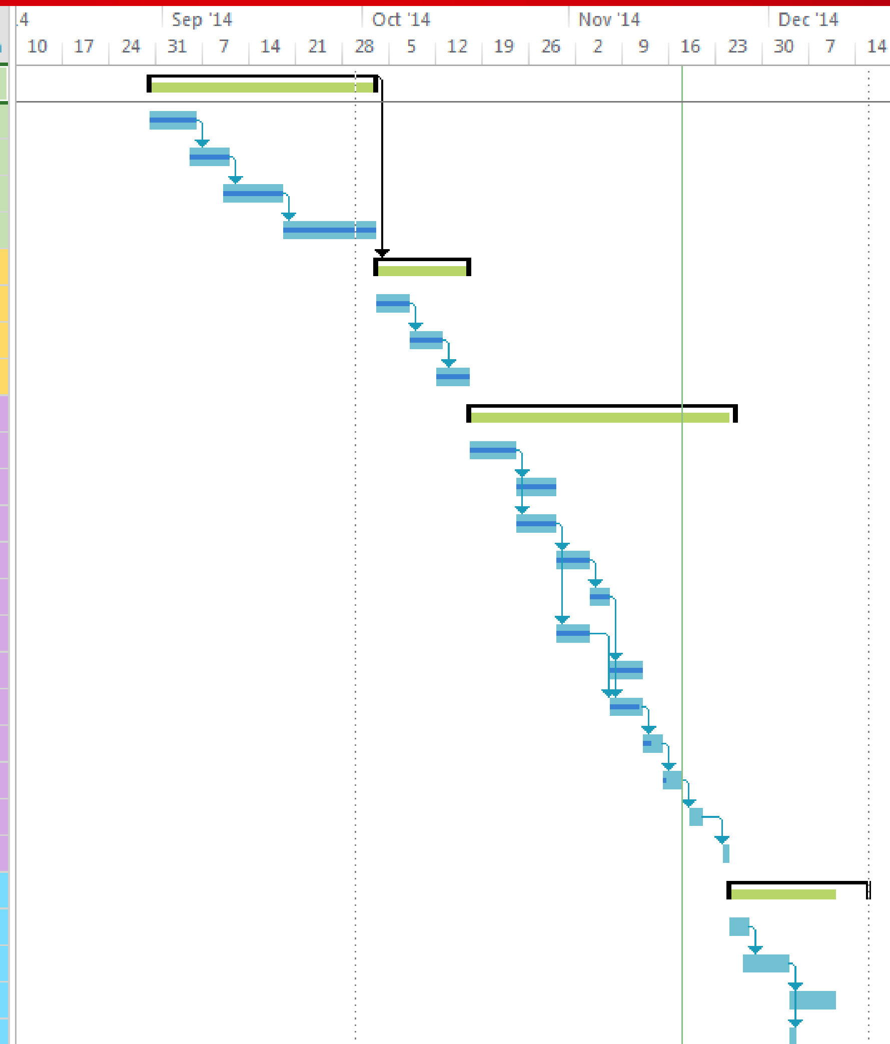
Gantt Chart

GANTT CHART

	Task Name	% Complete	Duration
1	**Preliminary Design Stage**	**100%**	**25 days**
2	Research	100%	6 days
3	Initial Design Conception	100%	4 days
4	Design Development	100%	7 days
5	Redesign	100%	10 days
6	**Advanced Design Analysis**	**100%**	**10 days**
7	Initial Prototype Selection	100%	3 days
8	Further Research	100%	4 days
9	Final Prototype Selection	100%	5 days
10	**Final Design Stage**	**81%**	**31 days**
11	Motor Selection	100%	5 days
12	Motor Connection/Vibration Reducer	100%	5 days
13	Method for Overcoming Magnetic Force	100%	5 days
14	Live Center Support	100%	3 days
15	Live Center Track	100%	3 days
16	Stator Housing	100%	3 days
17	Choose Clamp/Lock-In Mechanism	100%	3 days
18	Test Fixture Baseplate	85%	3 days
19	Tolerances	40%	3 days
20	Finalize Design	30%	3 days
21	Final Design Review	0%	2 days
22	Cost Analysis	0%	1 day
23	**Parts Ordering**	**0%**	**15 days**
24	Bill Of Materials	0%	3 days
25	Turbocor Approval	0%	5 days
26	Testing Procedure Development	0%	5 days
27	Ordering	0%	1 day



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Conclusion & Future Work

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- Individual components (motor, ball screw, live center, linear guides) have been selected

- Currently finalized designs for live center housing, stator housing, base plate

- Final Design Review at Turbocor:
  - November 25th

- Spring Semester: Manufacturing and Testing

Questions or Comments?

- For more information, see our website:
  VTT Rotor: Back EMF Test Fixture Website

Andre Steimer