



Midterm II Presentation:



High Speed Motor Generator Test Rig

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Presentation Overview

- Recap
- Compressor specifications
- Research
- Component selection
- Challenges to come
- Questions

Recap - Problem Definition

1. Danfoss Turbocor needs to qualify their motor's performance in regards to:
 - Power
 - Efficiency
2. No test rig currently exist that is capable of qualifying Turbocor's compressor motors due to:
 - Magnetic bearings (radial load issues)
 - High speeds between 20,000-50,000 rpm
 - Misalignment

Goals and Objectives

GOALS

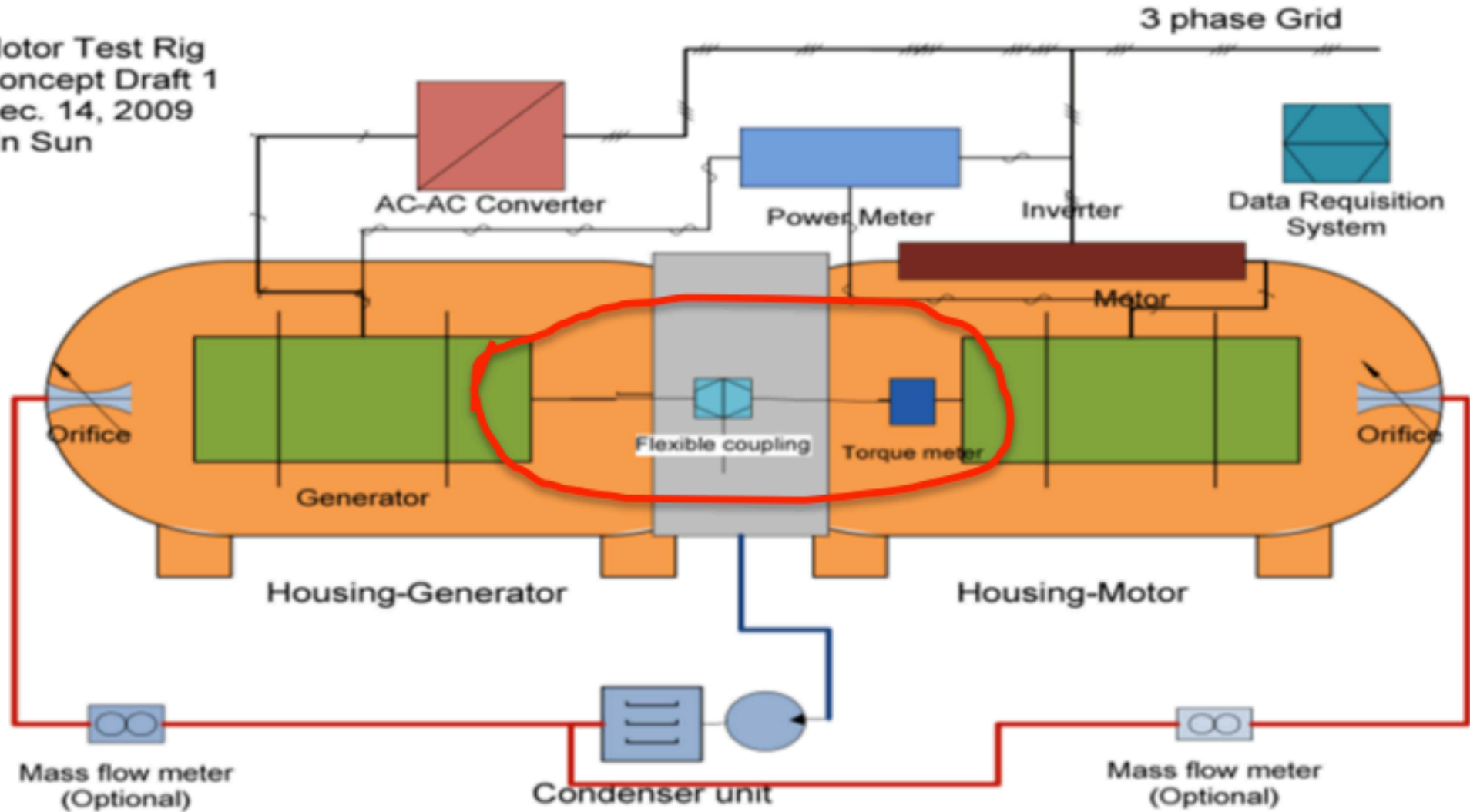
- Select components that meet customer requirements.
- Design and construct a base platform.
- Establish alignment system to meet precision requirements .

OBJECTIVES

- Simple maintenance
- High alignment precision
- Simple construction
- Safety (while operating and building)

Recap – Project Scope

Motor Test Rig
Concept Draft 1
Dec. 14, 2009
Lin Sun



TT Compressor Series Specifications

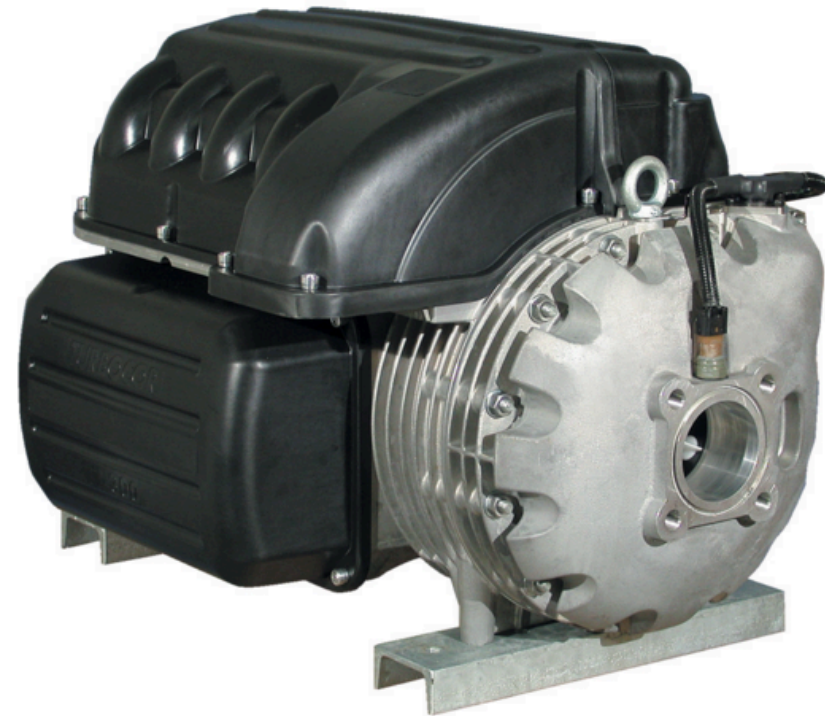
Compressor	Shaft Torque [Nm] (Max)	Speed [rpm]
TT300	22.8	37762
TT350	38.0	30598
TT400	37.2	25091
TT700 (Four Poles)	73	17000

- To meet safety requirements, the system will be design around a maximum torque of 100Nm and 50,000 RPM.

TT500 Compressor Series

Compressor acquisition

- Training on levitation and calibration (changing mass and load distribution - impeller)
- Software acquisition
- Radial strength limit (200 lbs)



Recent Progress

CAPS tour

- Helped visualize final design and safety requirements
- Verified alignment tools
- Safety

Alignment systems

- Laser alignment tools
- Elevations and lateral adjustment

Torque transducers

- RPM and Torque rating inversely related



Figure 2: CAPS Motor-Generator system

Recent Progress

CAPS system utilizes a Curved Jaw coupler.

- Allows angular misalignment, but minimal lateral misalignment.

Coupling Selection:

Bellows:

- High torsional stiffness
- Flexibility to accommodate for misalignment

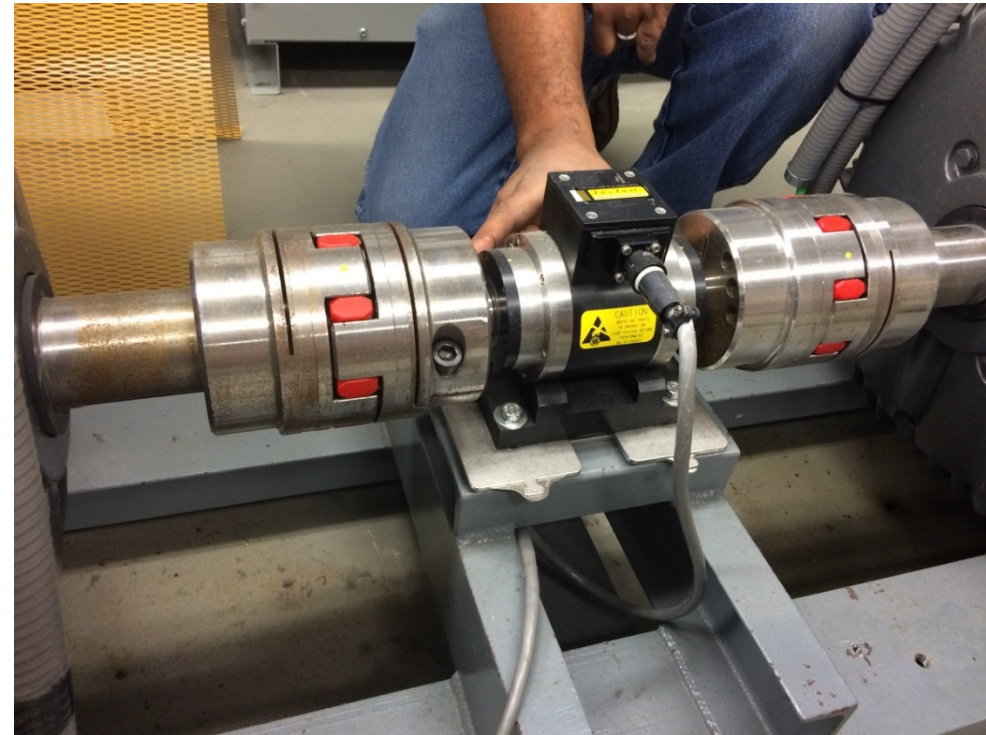


Figure 3 :CAPS Tour Transducer and Couplings

Project Design

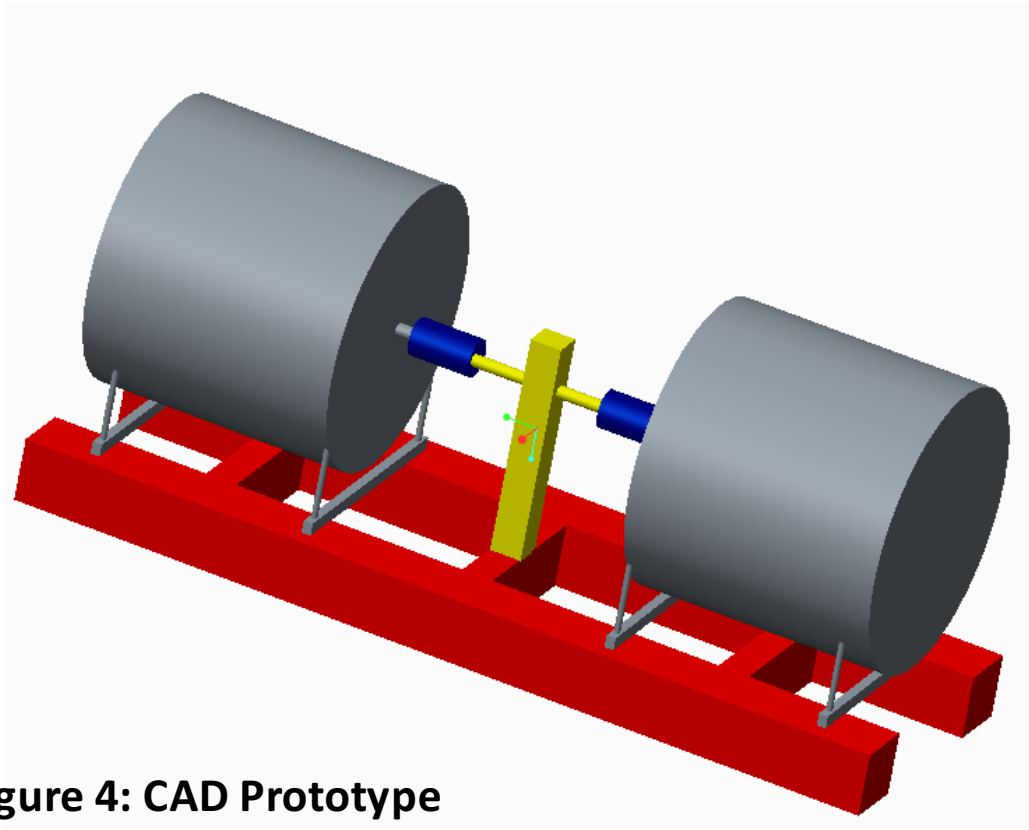


Figure 4: CAD Prototype

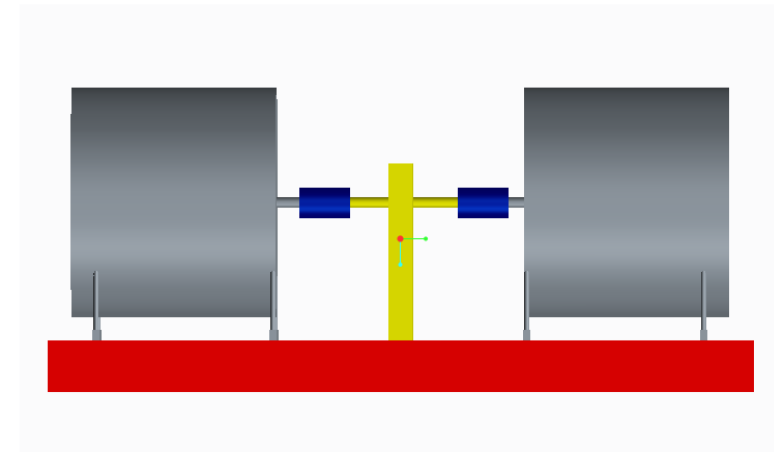


Figure 5: Side View

Morphological Chart

	Concept 1	Concept 2	Concept 3
Alignment Tool	TSK 11 (Smart Phone compatible)	TSKA 31	Fluke 830
Torque Transducer	Magtrol TMHS 308	Kistler 4530A	Magtrol TMHS311
Horizontal Alignment	Set Screws	Caster Wheels/Rails	Manual
Vertical Alignment	Set Screws	Shims	Hydraulic
Base Stand	Channeled Steel	Boxed Steel	Single Piece Aluminum
Coupler	Gam KHS200 Bellows Coupling	R&W BKC	R&W BKL

Component Selection Reasoning

Flexible coupling - Bellow coupling:

- Misalignment Compensation
- Precise transmission of velocity, angular position and torque
- Handle axial, angular and parallel shaft misalignment

Alignment tool - Laser

- Reduced errors from backlash improving data accuracy
- Dynamic machine tolerance check

Selected Torque Transducer

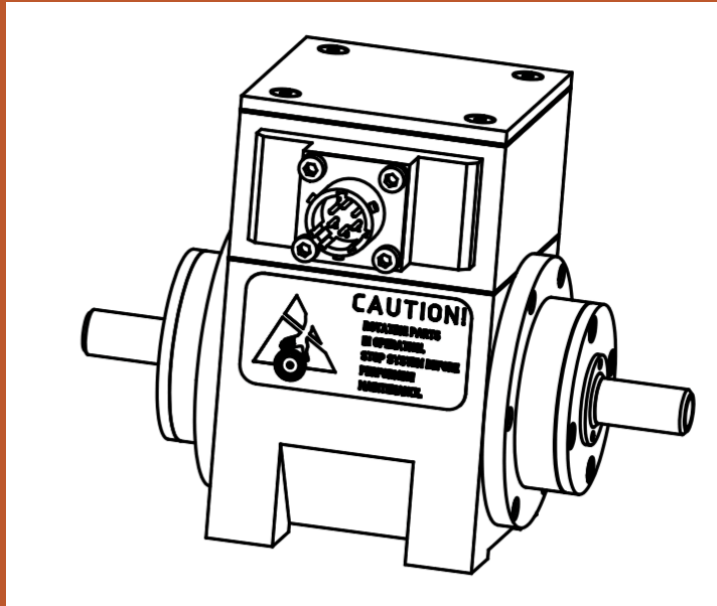


Figure 4: Magtrol TMHS 308

Torque Transducer Specifications

Model	Rated Torque	Rated RPM
Magtrol TMHS 308	20 Nm	50,000 RPM
Magtrol TMHS 311	100 Nm	32,000 RPM
Futek	50 Nm	30,000 RPM
Kistler 4530A	100 Nm	30,000 RPM
Kistler 4530A	20 Nm	50,000 RPM

Selected Coupler

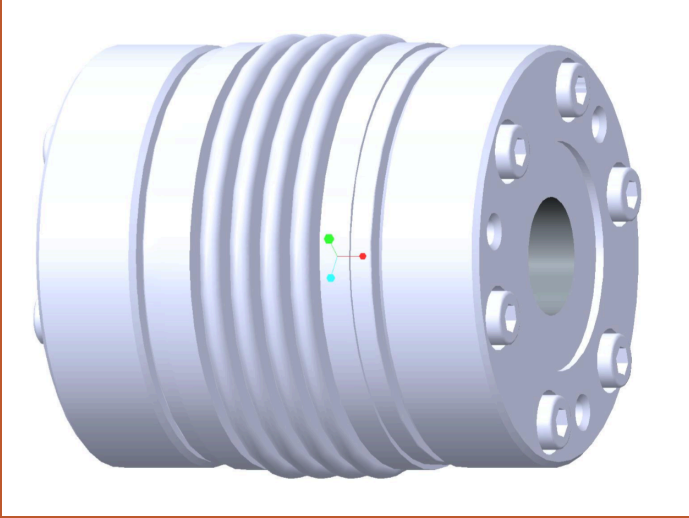


Figure 5: GAM KHS200

Coupler Specification

Model	Rated Torque	Rated RPM
GAM KHS (200)	200 Nm	50,000 RPM
R&W BKL (60)	60 Nm	40000 RPM
R&W BKC (150)	150 Nm	80000 RPM

Selected Alignment System Tool



Figure 5: Fluke 830

Alignment System Tool

Model	Measuring errors/accuracy	Weight
SKF TSKA 31	<0,5% $\pm 5 \mu\text{m}$ / $10 \mu\text{m}$	4.75 kg
SKF TSKA 11	Less than 2% / $10 \mu\text{m}$	2.1 kg
Fluke 830	Less than 2% / $1 \mu\text{m}$	5.6 kg

Product Specification



Figure 6: AMC Shim [4]

Shims

Manufacturer	Material	Thickness
American Metals Co.	304 Stainless Steel Standard	0.0005"
American Metals Co.	304 Stainless Steel Standard	0.001"
American Metals Co.	304 Stainless Steel Standard	0.010"

Challenges to come

- Defining base plate dimension
 - Depending on torque transducer
- Cost evaluation for final design
- CAD construction of overall design
- Material and component acquisition

Conclusion

- Overall design
 - Alignment systems composed by shims for vertical alignment and bolts and screws for horizontal alignment.
- Components selected:
 - Vertical and horizontal adjustments
 - Set screws and bolts
 - Shims
 - Alignment system tool
 - Laser alignment tool - Fluke 830
 - Torque Transducer
 - Magtrol TMHS 308
 - Flexible coupling - Bellow coupling
 - GAM KHS200

References

1. <ps://www.magtrol.com/drawings/salesdrawings/415-304-000V011.pdf> [1]
2. <ps://ms23.catalogds.com/cgs/output/11744372/KHS-200.pdf> [2]
3. <ps://www.fluke.com/fluke/aue/vibration-meters-and-laser-alignment-tools/fluke-830.htm?pid=78734> [3]
4. <ps://www.metalshims.com/Images/pages/stainlessteelshims1503.jpg> [4]

Questions?
