

High Speed Motor Test Rig

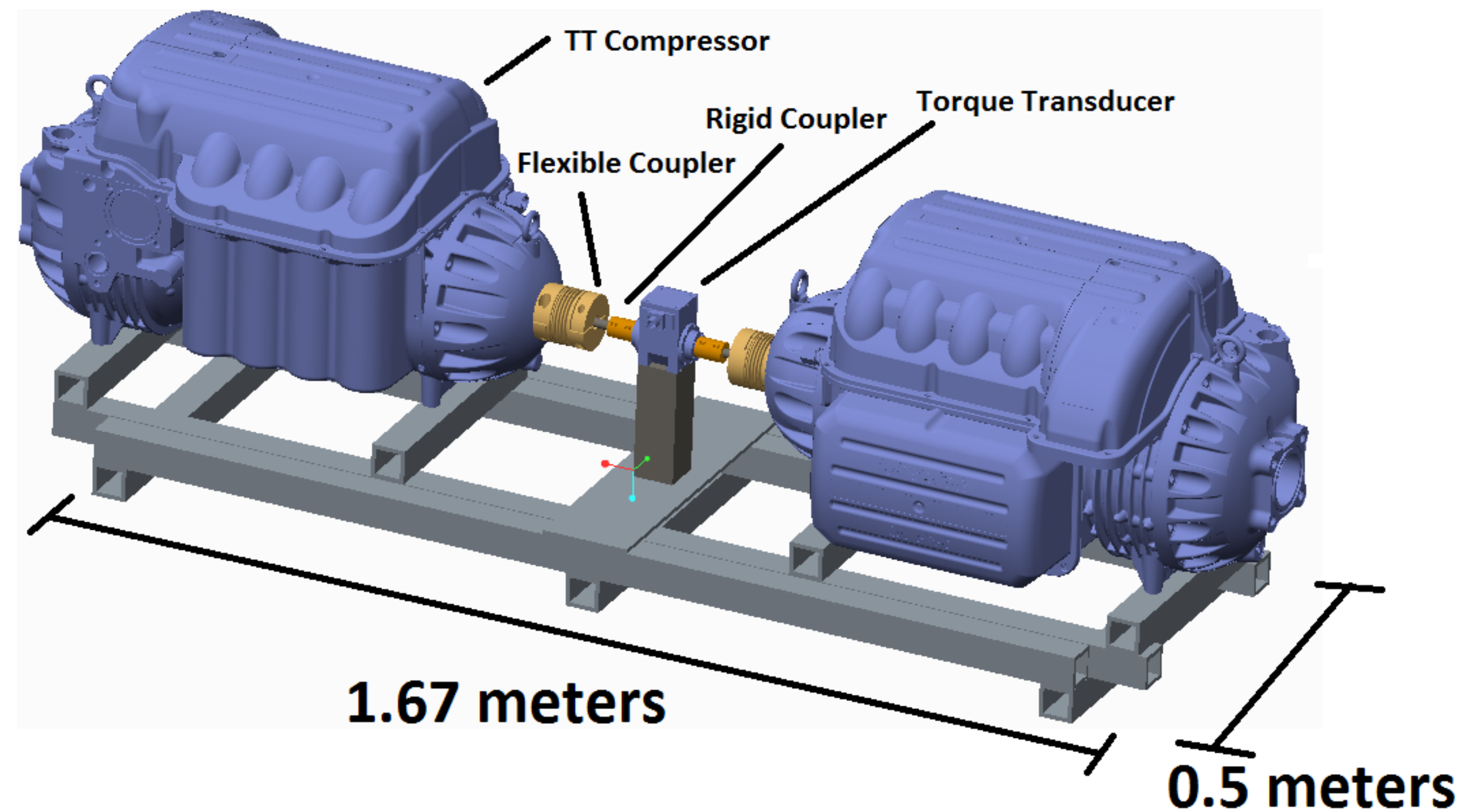
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Abstract

- Turbocor wants to couple the shafts from two compressor to test motor performances (power, efficiency, heat management).
- Due to high RPMS (40,000), a precise shaft alignment must be made.
- Two shaft couplings must be balanced and flexible to manage misalignment errors.
- A torque Transducer will be integrated to monitor efficiency.
- Shims and set screws will adjust elevation and lateral position.

Background

- Motor-Generator systems test motor performance by varying the load through a generator.
- This system will use a second compressor to represent the generator.
- Magnetic bearings to provide contact free levitation (one axial and two radial)
- If severe radial force is exerted, on the shaft, the system shuts down.
- TT500 compressor will be used in experimental procedures



Constraints

- Radial Force may not exceed 200 lbs
- System is to remain oil free
- Test rig must handle speeds up to 40,000 RPM
- Tolerances cannot exceed 0.2mm (lateral), 1° (angular), and 1mm (axial).

Components Selected

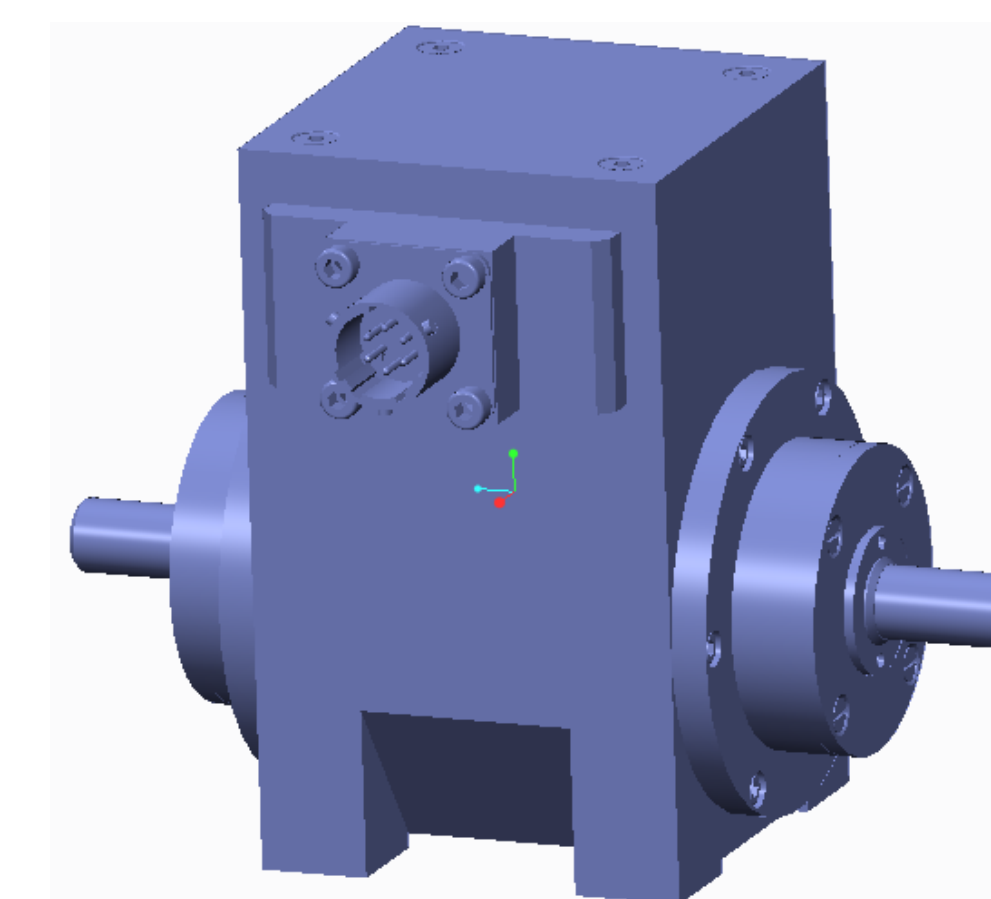
- Bellows Coupling: R&W BKC 150 (safety factor=2.2)
 - 160Nm rated torque
 - 80,000 RPM rated rotation speed
- Laser Alignment Tool: SKF TSKA 31
 - Measuring errors less than 5%
 - Accuracy of 10 μm
- Torque Transducer: Magtrol TMHS308 & 311 (safety factor=1.7)
 - 20Nm & 100Nm rated torque
 - 50,000 RPM & 32,000 RPM rated rotation speed.
- Shims: 304 Stainless Steel Standard
 - thickness of 10, 25 and 250 μm

Alignment Specifications

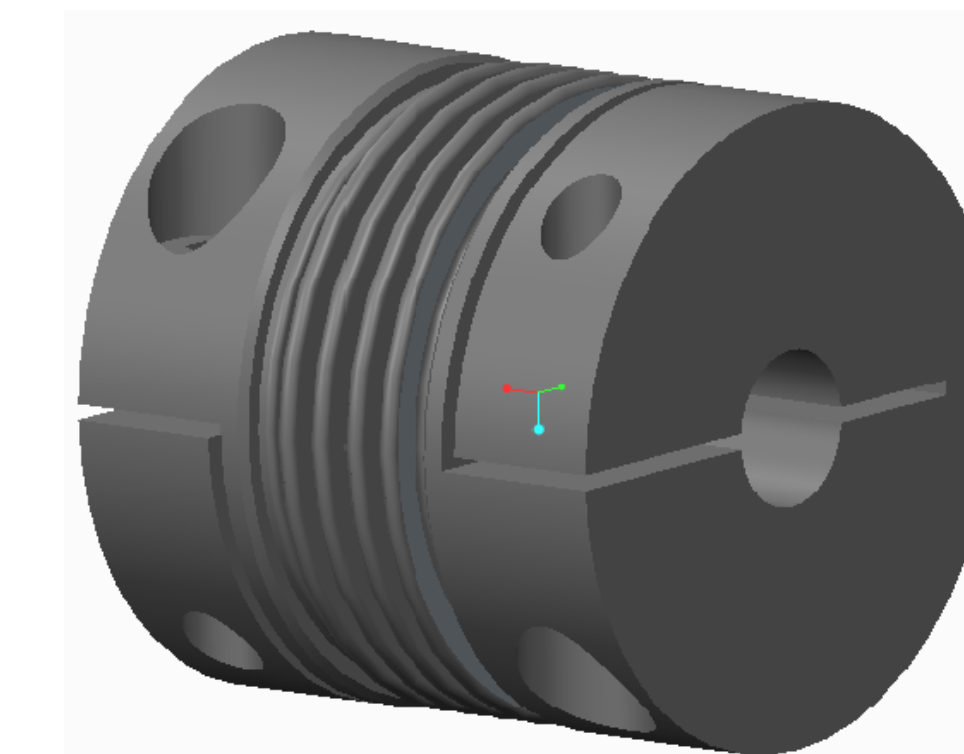
- Shaft angle (θ) induced from shim width (a):
$$\theta = \tan^{-1} \frac{a}{b}$$
- Shaft elevation displacement (y):
$$y = c - \cos(\theta) \cdot c$$
- b , distance between front and rear compressor mounts. c , shaft height above mounting surface

Assembly Procedure

1. Mount the torque transducer, rigid couplings, flexible couplings and lastly compressors.
2. Align the compressors vertically with the torque transducer using the shims.
3. Align the compressors horizontally with the torque transducer using the set screws



Torque Transducer



Flexible Coupler

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