Motor Test Rig:

Improving Alignment and Incorporating Torque Transducer

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- In this case, we'll be using two compressors provided by Danfoss Turbocor.
- A transducer placed between will measure the axial loads and determine the power efficiency

WHY TURBOCOR'S COMPRESSORS ARE DIFFERENT

- Magnetic bearings

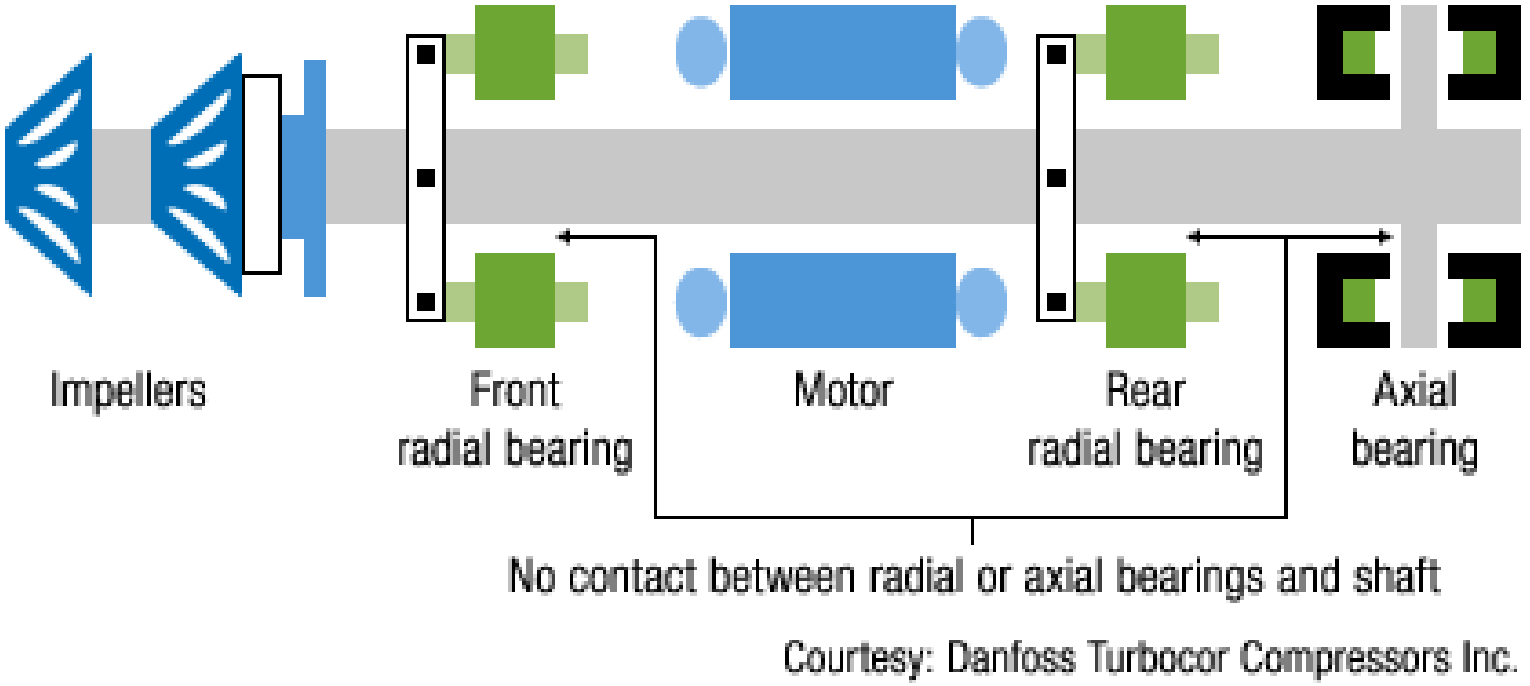

Fig. 1. Danfoss Turbocor Compressor System

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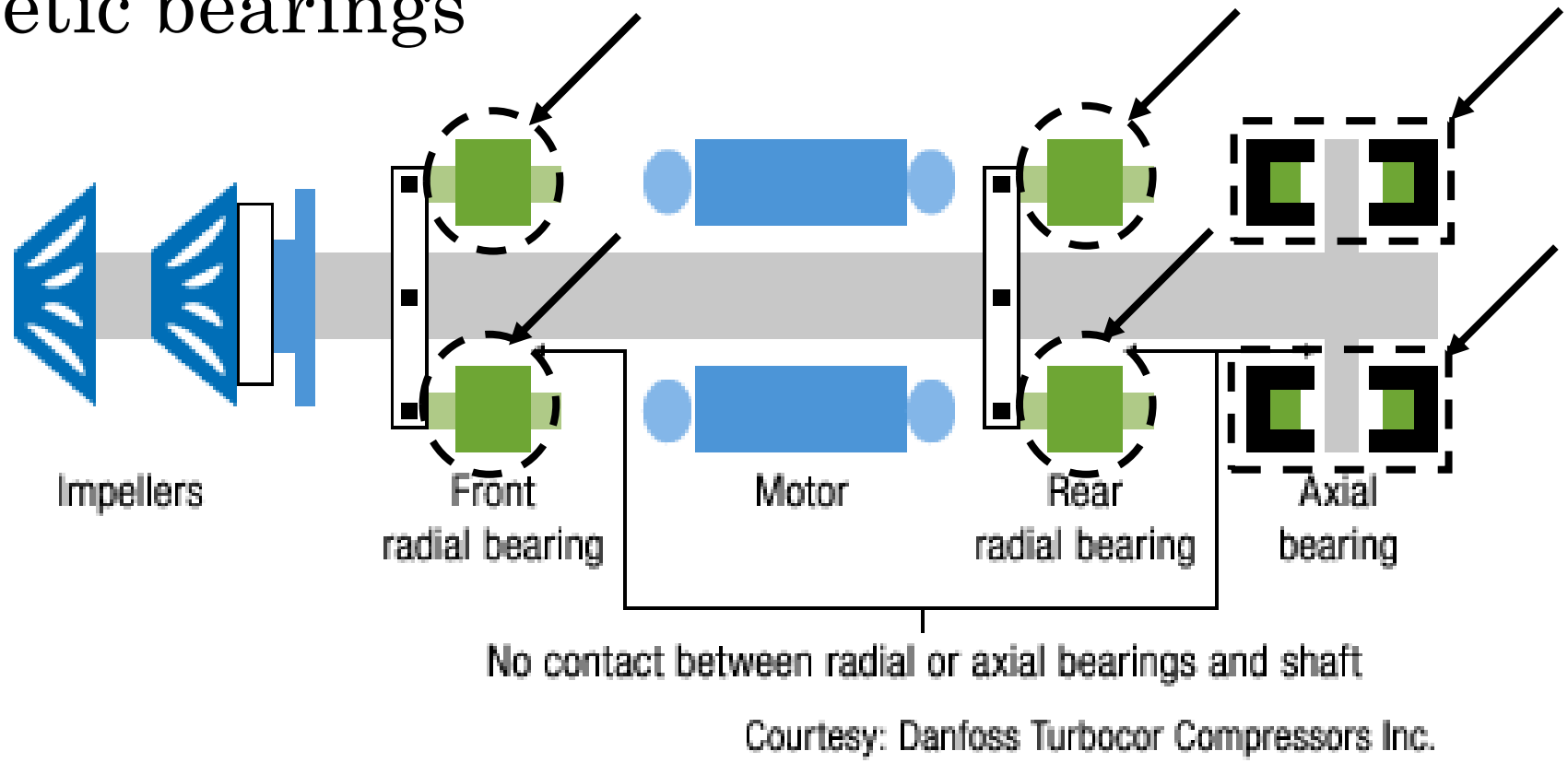

Fig. 2. Danfoss Turbocor Compressor System

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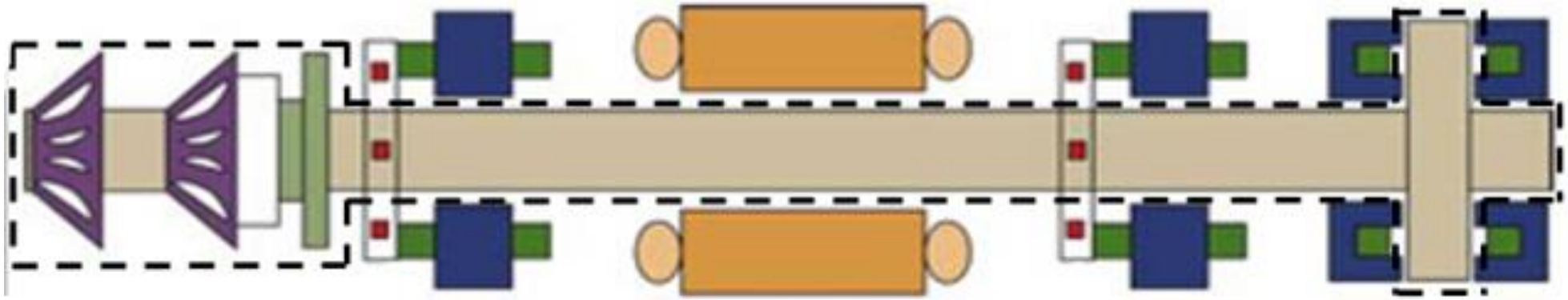
- Magnetic bearings
- Levitating shaft



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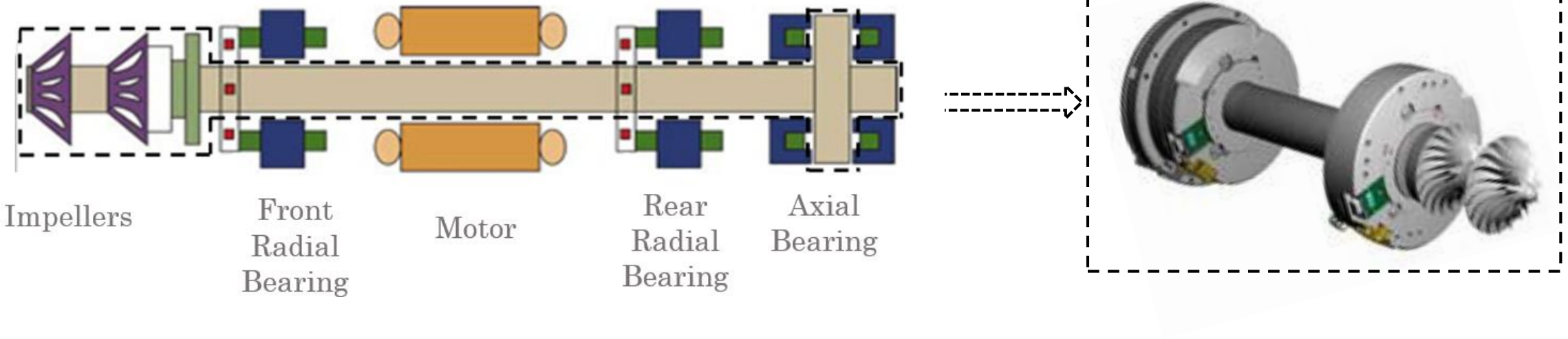

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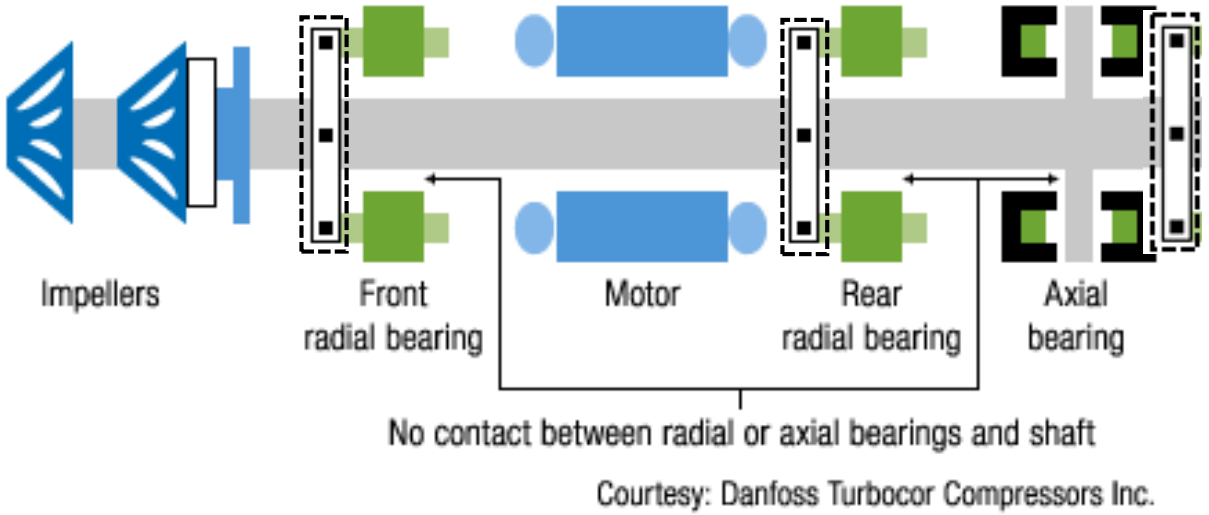

Fig. 5. Danfoss Turbocor Compressor System

WHY TURBOCOR'S COMPRESSORS ARE DIFFERENT

- Magnetic bearings
- Levitating shaft
- Oil-free coolant
- 9 extremely precise sensors
- Internal shaft has limited access

LAST YEAR'S DESIGN

Successes:

- Constructed adjustable frame that both compressors fit on

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- Only able to run with duct tape and someone grabbing a hold of the center shaft

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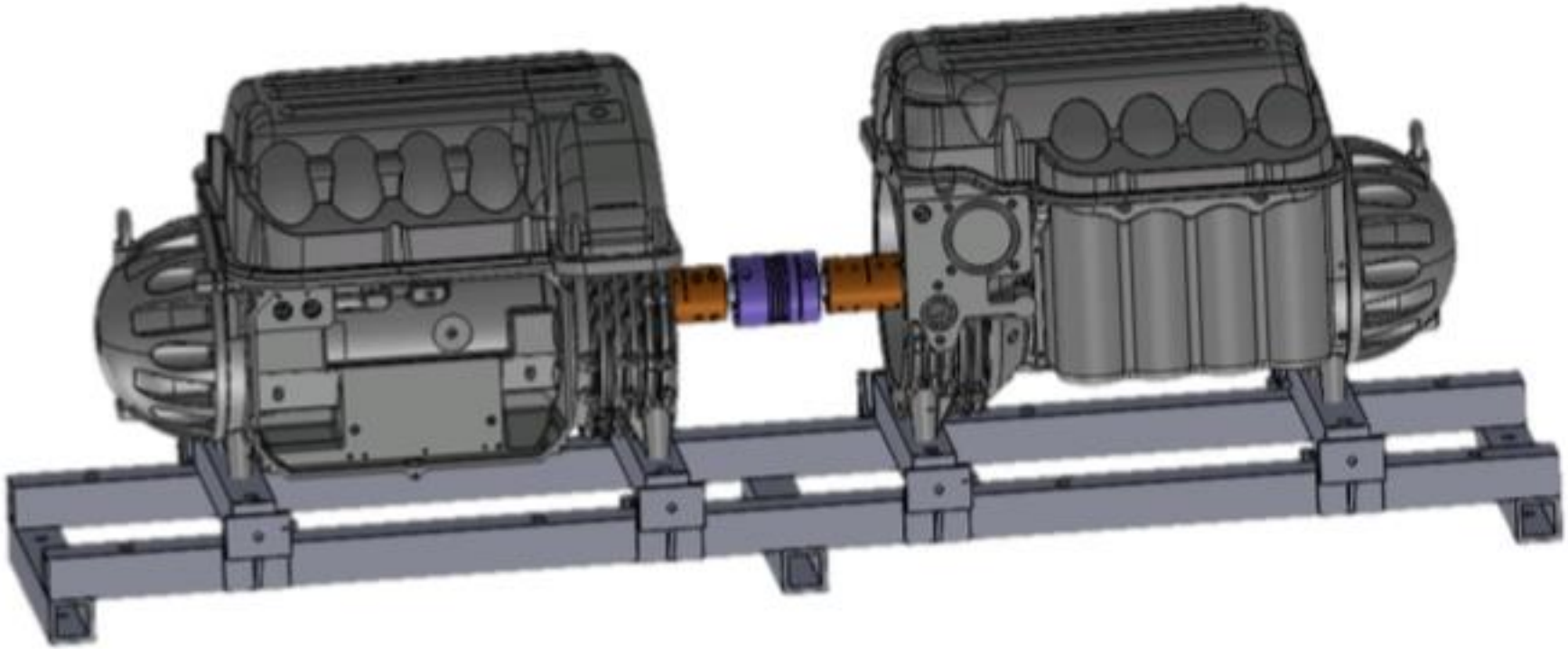


Fig. 6 Last Year's Final Design

DIAL ALIGNMENT (LAST YEAR)

- Costs less
- Subject to human error

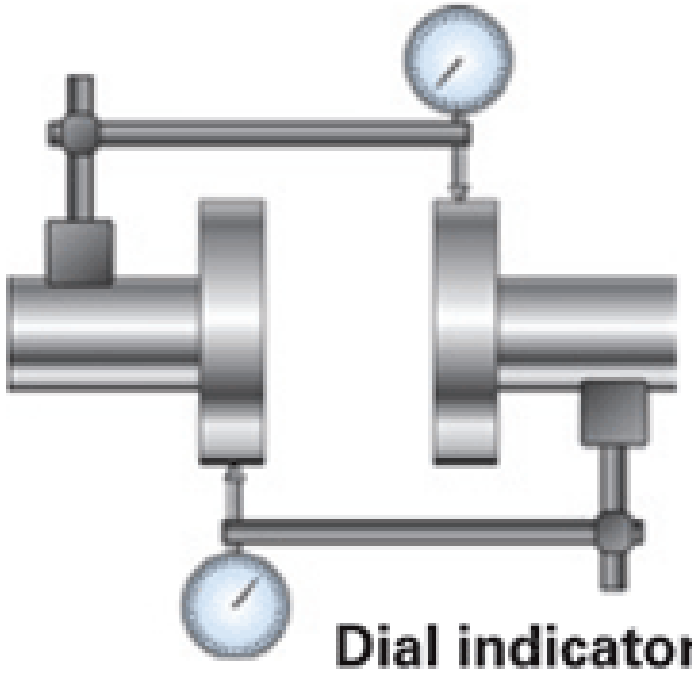


Fig. 7 Human Dial Alignment

LASER ALIGNMENT (THIS YEAR)

- Quite expensive – $3,250
- Has a high level of accuracy

Fig. 8 Laser Alignment

PHYSICALLY ALIGNING THE RIG

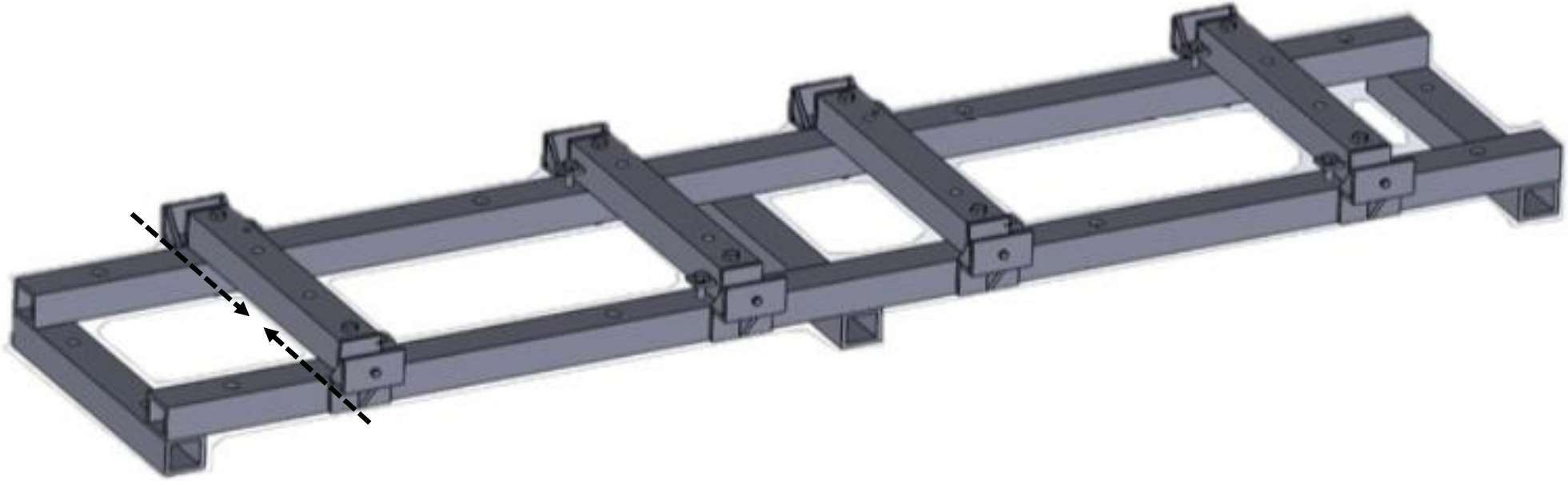


Fig. 9 Base Frame

PHYSICALLY ALIGNING THE RIG

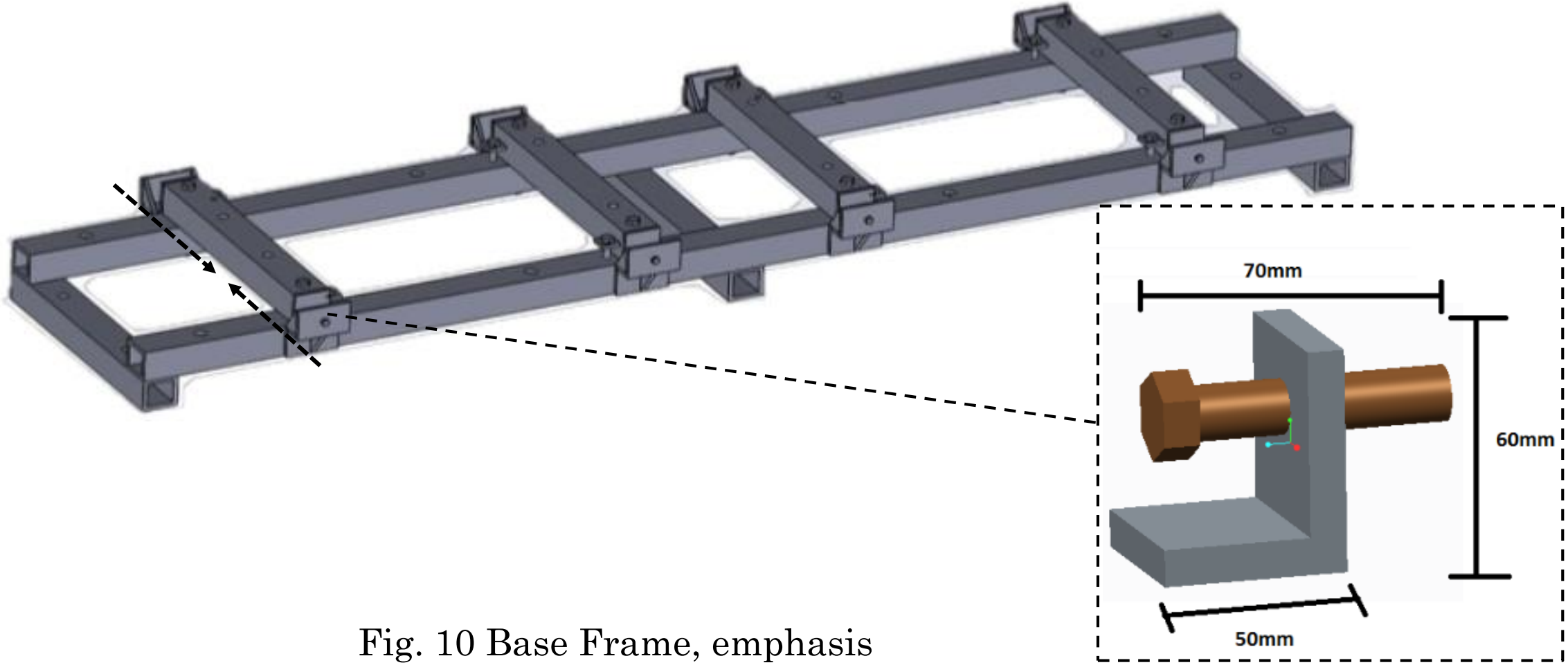


Fig. 10 Base Frame, emphasis on Lateral Screw

FLEXIBLE COUPLING

- Last year's senior design team went ahead with the flexible coupler for the following reasons:

    1. Backlash free due to the frictional clamp connection
    2. Ability to cope with the high rotational speeds
    3. Be tolerant of misalignment
    4. Lightweight

- Cons of using a flexible coupler:

    1. At high speed, the least eccentricity would lead very high levels of vibration which could be detrimental to the system as a whole.

Fig. 11 Flexible Coupling

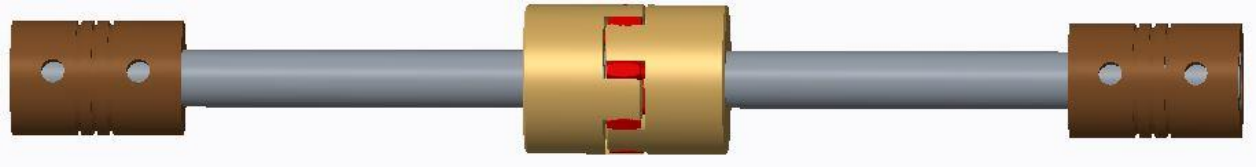
JAW COUPLING

- Jaw designs are considered "failsafe" because the coupling is not necessarily destroyed or rendered inoperable if the spider breaks away
- Simple design with only three parts -- a spider housed between two metal hubs -- allows easy installation, disassembly and visual inspection
- No metal-to-metal contact between driving/driven parts
- Greater radial softness due to material of the elastomer spider

Fig. 12 Jaw Coupling Cad Drawing

DESIGN 1 CONCEPT

- Two Rigid Couplers
- Curved Jaw Coupler
- Two shafts



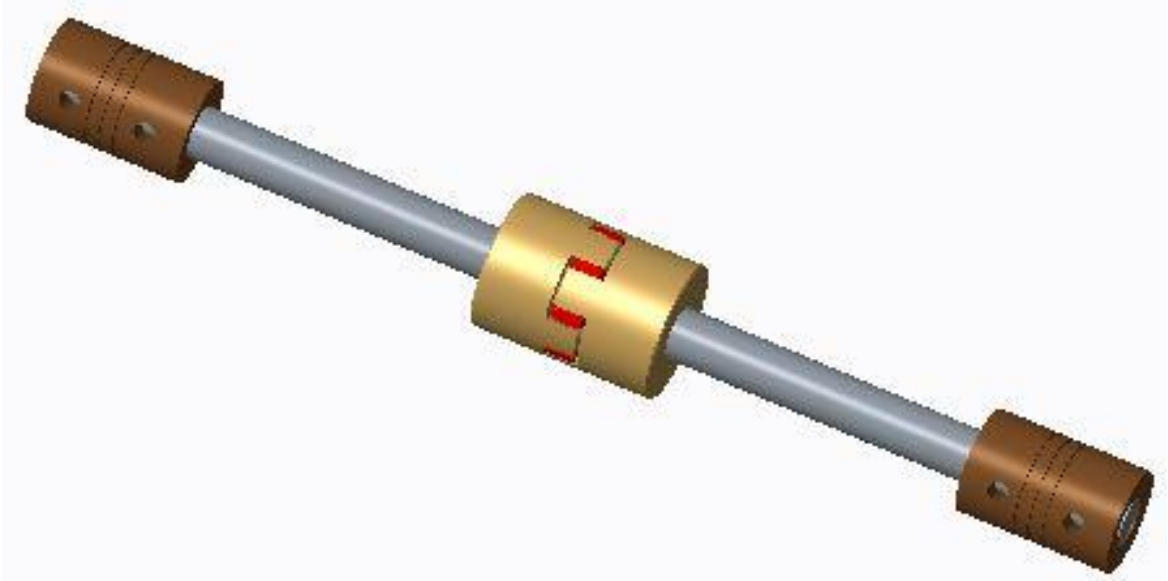


Fig. 13 Design 1 Concept

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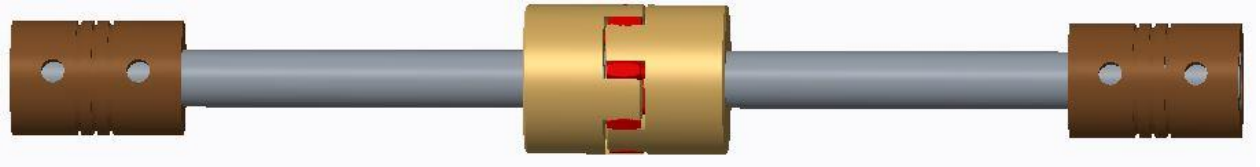
Benefits of this design:

- Curved jaw couplings allow more tolerance for misalignment than flexible couplers



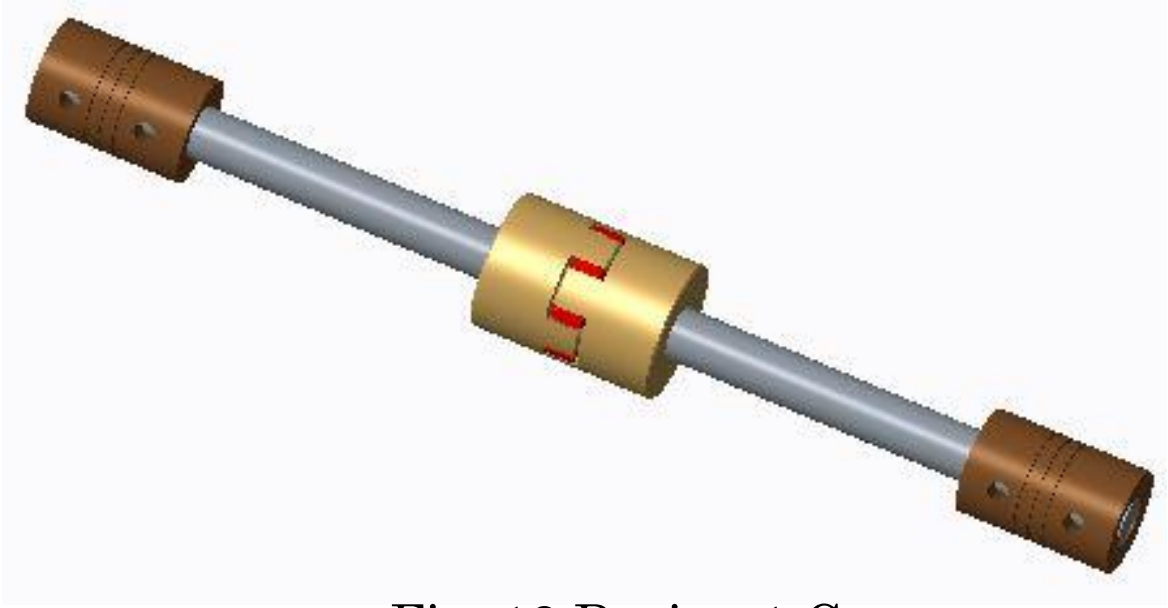


Fig. 13 Design 1 Concept

DESIGN 2 CONCEPT

- Two Curved Jaw Couplings
- Single Shaft

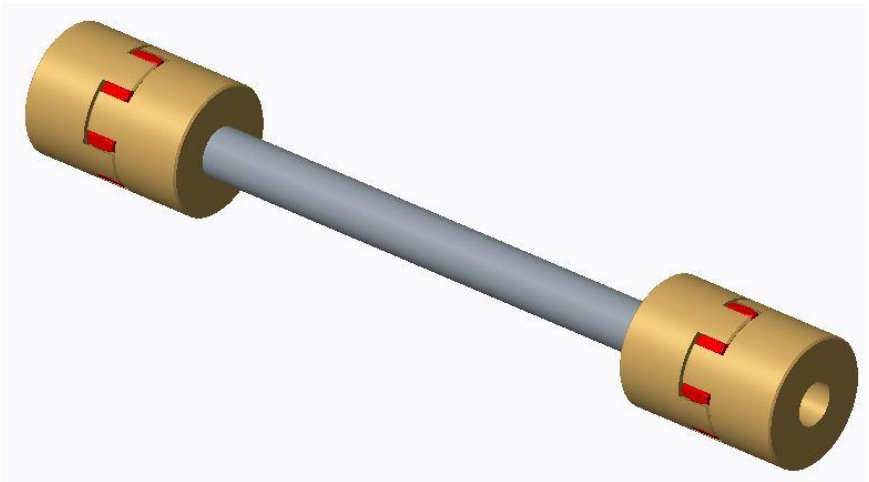


Fig. 14 Design 2

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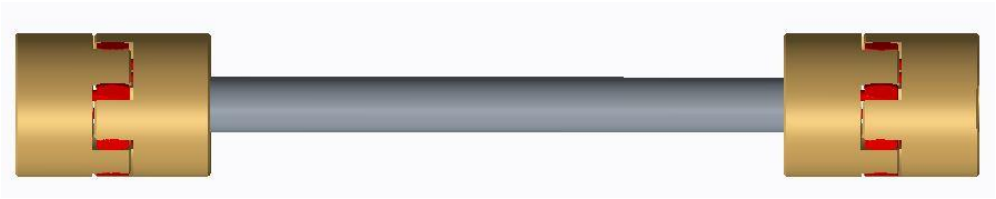

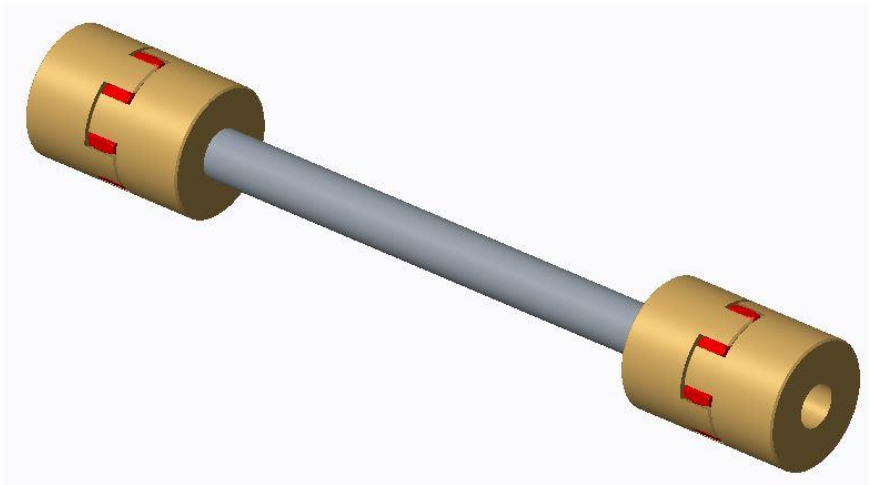

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DESIGN 2 CONCEPT

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Benefits of this design:

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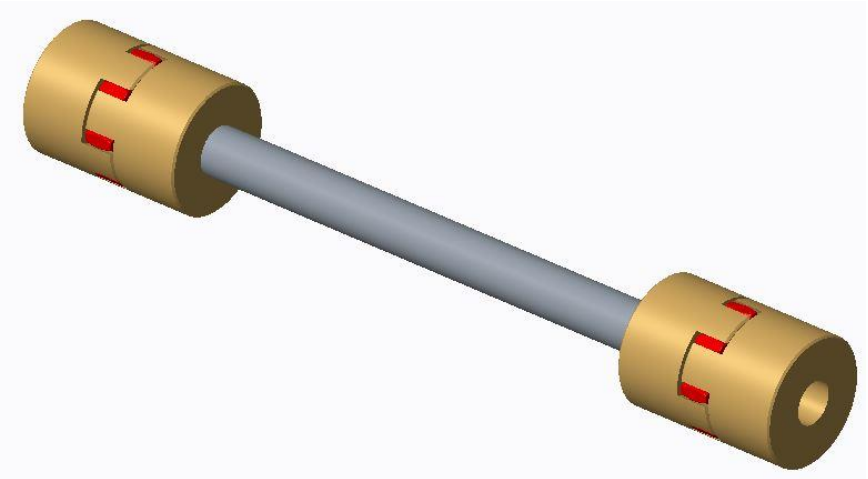

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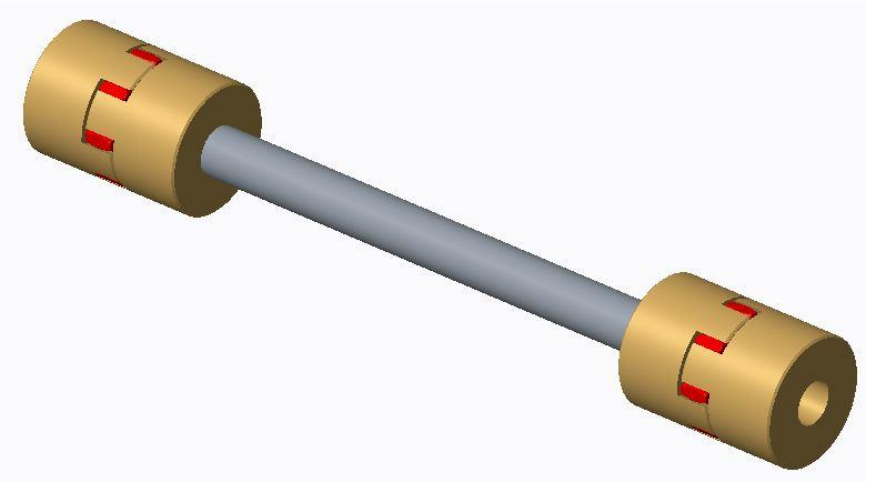
Benefits of this design:

- Curved jaw couplings allow more tolerance for misalignment than flexible couplers
- Makes the overall design less complex
  - Removes rigid couplers with curved jaw couplers while removing one coupler overall



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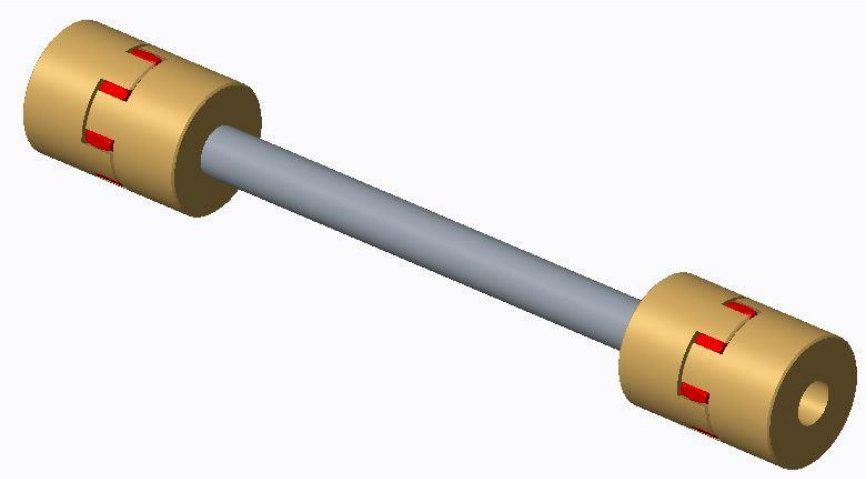

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- Potential to just replace the shaft with the transducer when going into phase two.

TT-500 Danfoss TurboCor Compressor

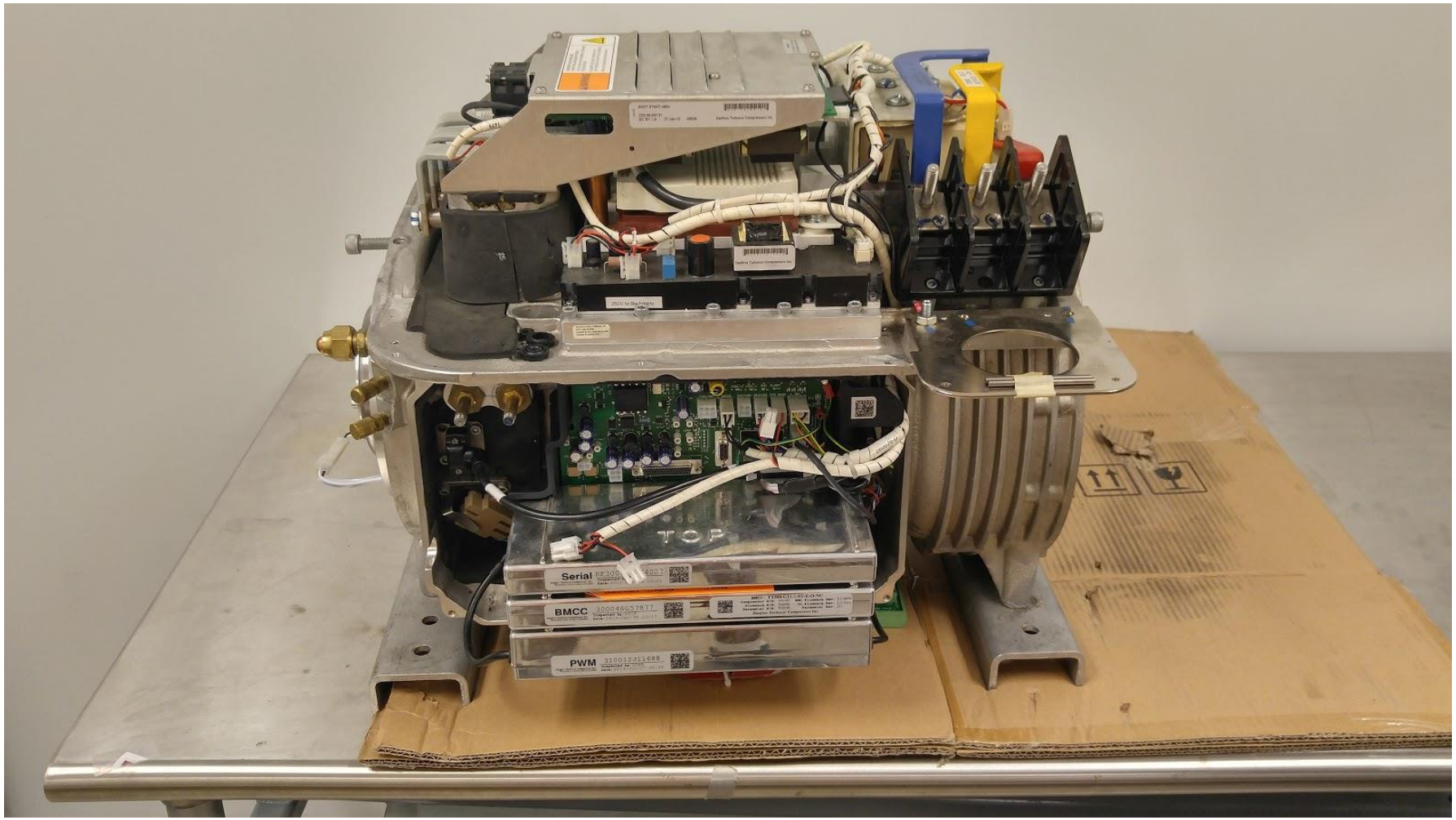


Fig. 15 Compressor

MAGTROL TORQUE TRANSDUCER

- Torque Rating: 20 N·m to 500 N·m
- High Speed Applications: up to 32,000 rpm
- Stainless Steel Shaft

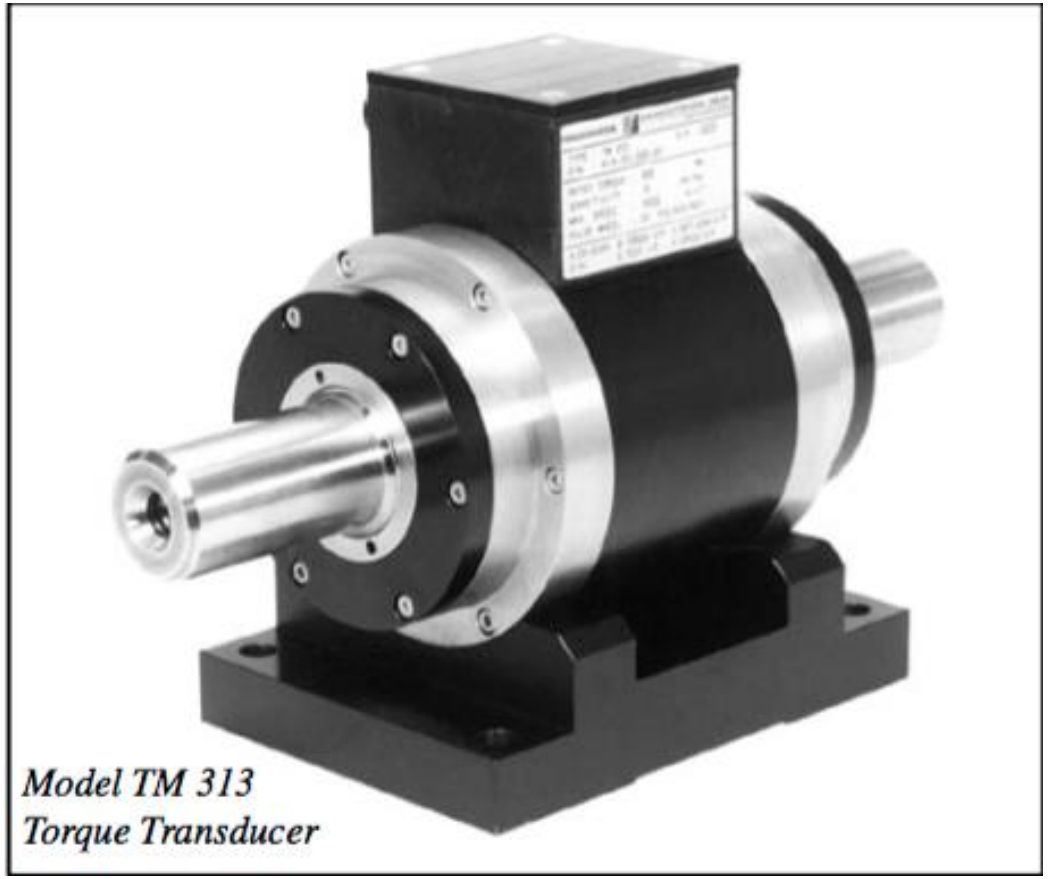


Fig. 16 Torque Transducer

DOUBLE-FLEX DISC COUPLING

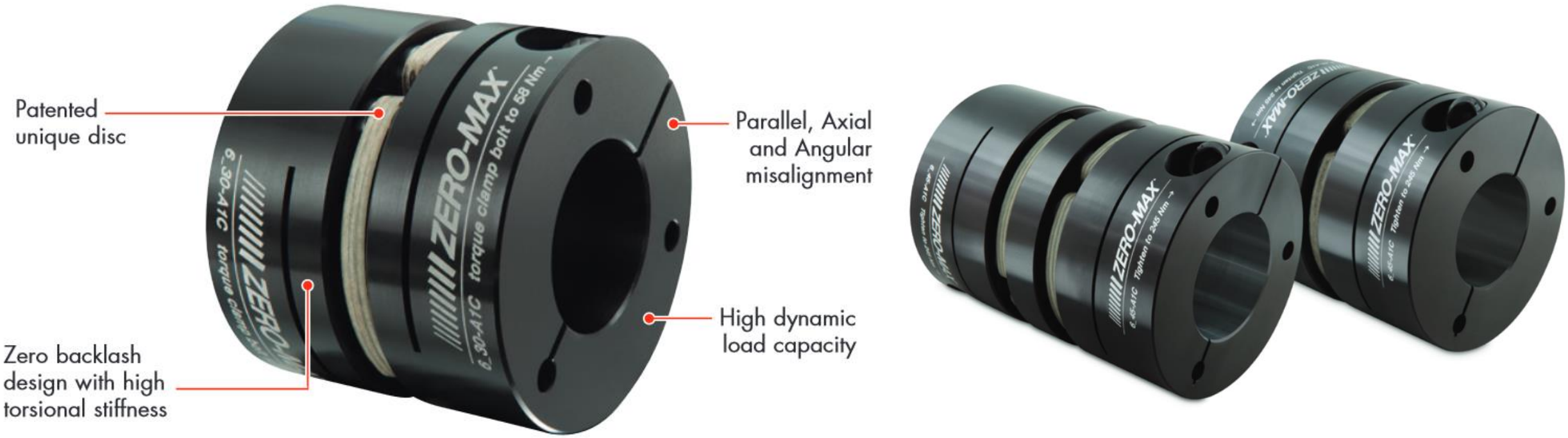
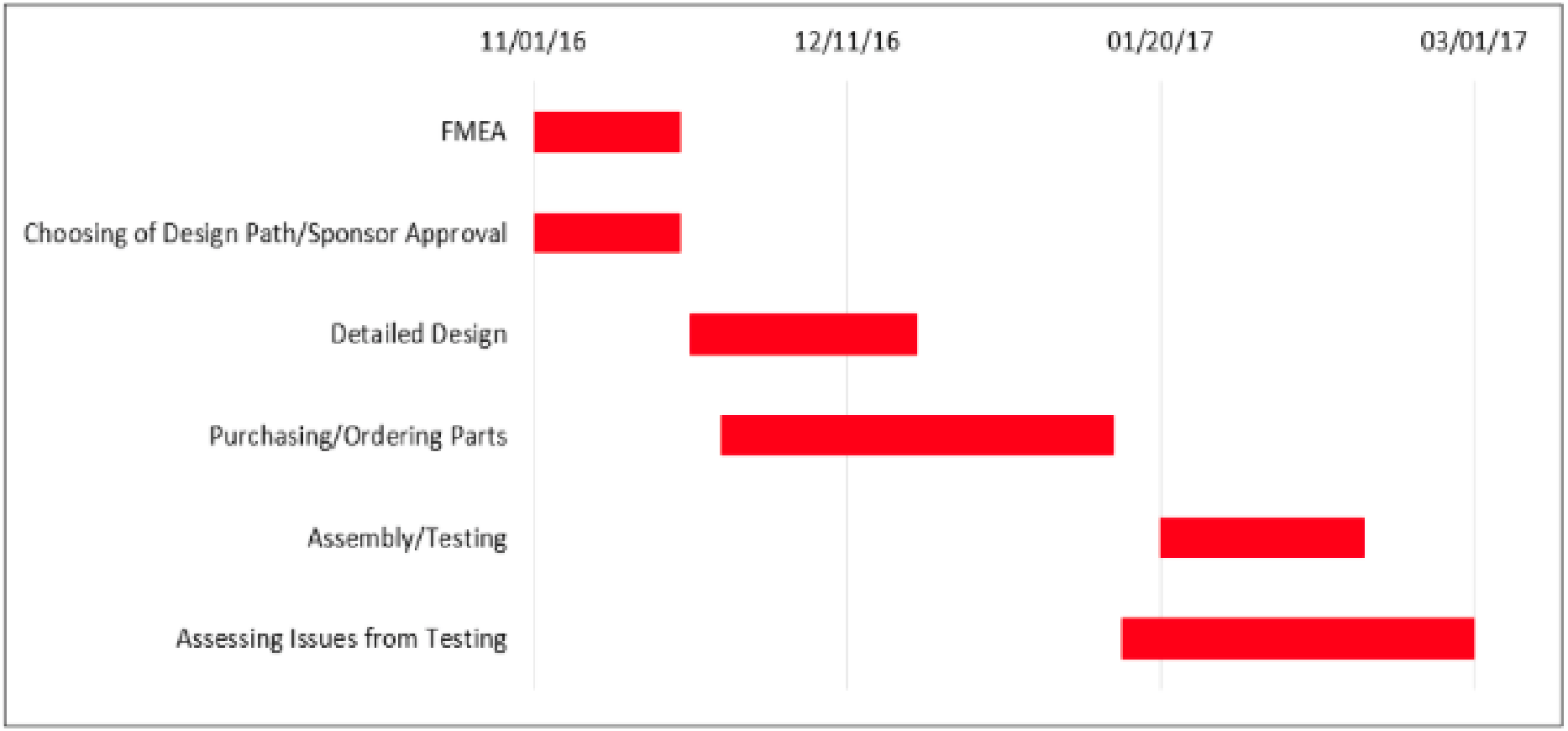


Fig. 17 Double-Flex Disc Coupling

Gantt Chart

Table 1: Future Schedule



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QUESTIONS?