Motor Test Rig

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03/30/2017

OUTLINE

- Project overview
- Approved design
- Design progress
- Schedule
- Conclusion

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PROJECT OVERVIEW

THE PROBLEM

Danfoss Turbocor manufactures compressors but don't have a mechanism to determine the torque load and power efficiency of the compressors.

GOAL STATEMENT

To improve on the design of a motor test rig to determine the torque load and power efficiency of Danfoss Turbocor's compressors.

WHAT IS A MOTOR TEST RIG?

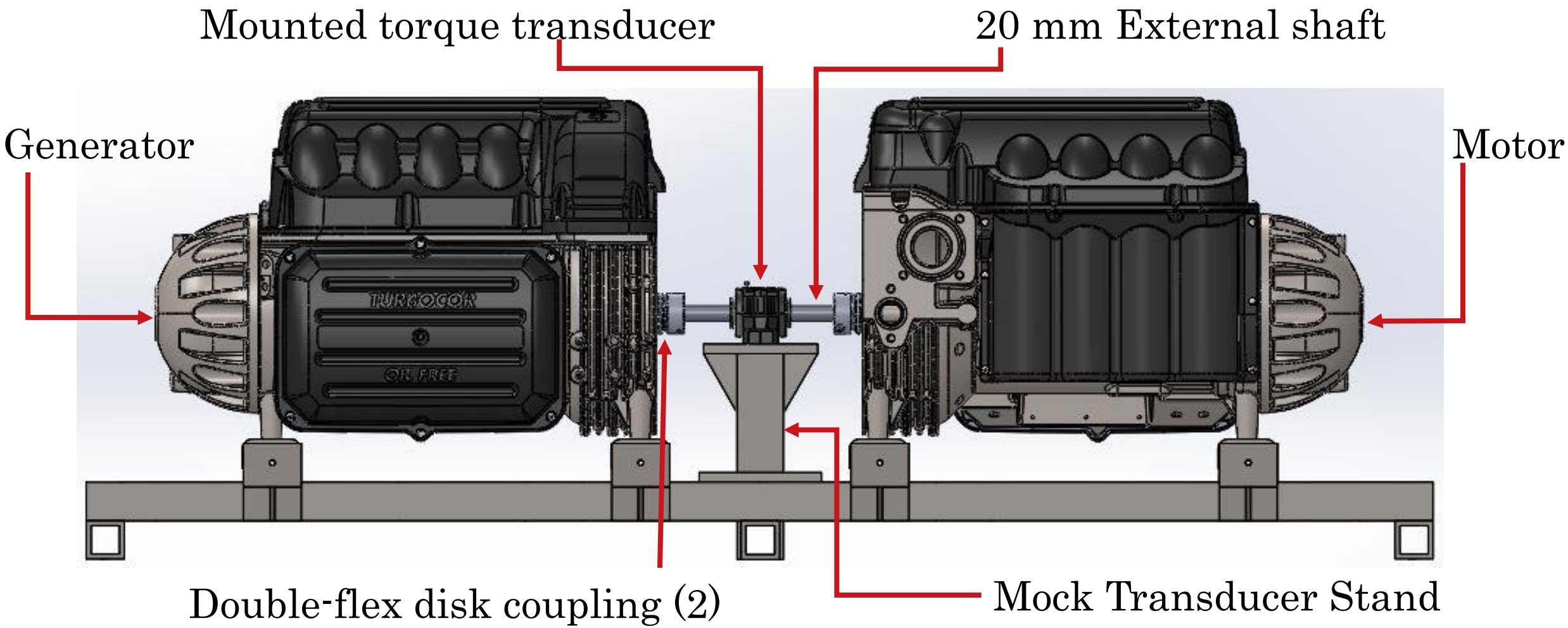

Fig. 1. Motor Test Rig

PROJECT OVERVIEW

OUR OBJECTIVES

1. Incorporating a stand in the base frame for a torque transducer
2. Purchasing appropriate couplings, torque transducer and alignment tool for the system
3. Aligning the compressors and the components between them
4. Achieving levitation of the compressors' shafts
5. Achieving up to 10,000 rpm speed (limited for safety)

DESIGN PROGRESS

DOUBLE-FLEX DISC COUPLINGS

Fig. 2. Zero-Max double-flex disc coupling

- Price: Approximately $400 a piece (not including tax/shipping)
- Quantity: 2
- Adjustable Collar (not keyway)
- 25mm shaft connecting to 20h6 mm shaft
- Up to 9,500 rpm
- **Status: Has been purchased and is being delivered**

DESIGN PROGRESS

LASER ALIGNMENT TOOL

Fig. 3. SKF Shaft Alignment Tool TKSA 31

- Price: Approximately $4,192
- Quantity: 1
- Accurate up to 5 microns
- Live position-correction feed
- **Status: Has been purchased and is being delivered**

DESIGN PROGRESS

LASER ALIGNMENT TOOL

Fig. 4. SKF Shaft Alignment Tool TKSA 31

- Each dimension input box can be clicked at any time
- The units English or Metric can be selected from the settings menu before the alignment is started

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DESIGN PROGRESS

LASER ALIGNMENT TOOL

Fig. 5. SKF Shaft Alignment Tool TKSA 31

- The measurement type can be selected before starting the alignment
- The first position for measurement is the 9 o'clock position
- Measurements are to be taken successively in (9 (-90°)-12 (0°)-3 (+90°))
- A triangular wedge will indicate the required position of the measuring units during each step

DESIGN PROGRESS

LASER ALIGNMENT TOOL

Fig. 6. SKF Shaft Alignment Tool TKSA 31

- Turn the shafts to the blue wedge at the 9 o'clock position. (-90°)
- When positioned within blue wedge the wedge becomes green
- Turn the shafts to the blue wedge at the 12 o'clock position. (0°)
- Turn the shafts to the blue wedge at the 3 o'clock position. (+90°)

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DESIGN PROGRESS

LASER ALIGNMENT TOOL

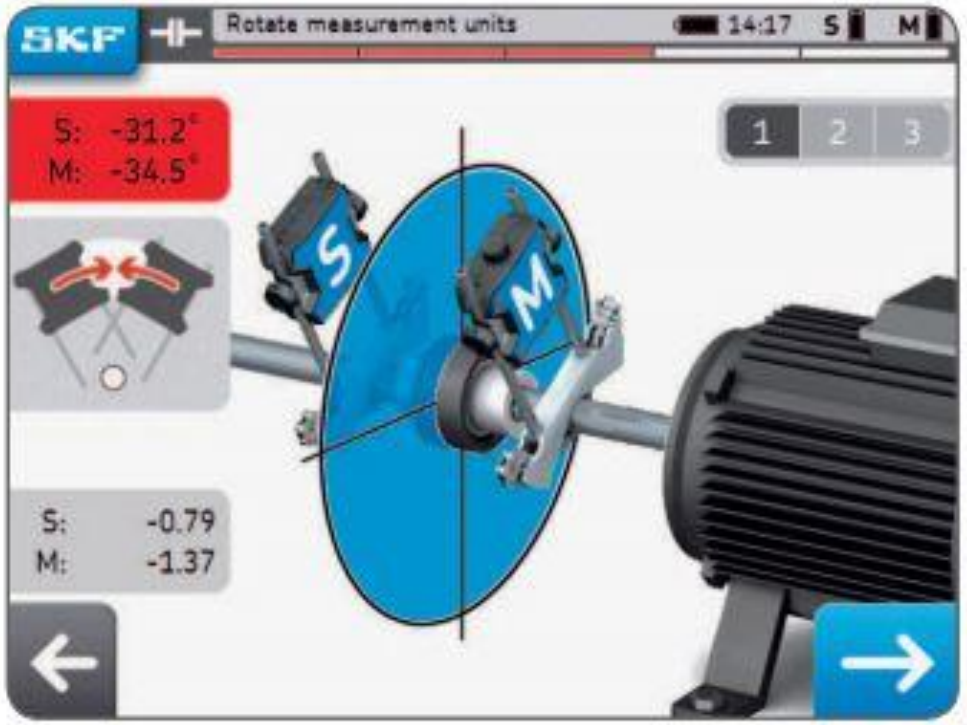

Fig. 7. SKF Shaft Alignment Tool TKSA 31

- The measuring units should not be separated by more than 2° from each other
- When the MUs are more than 2° apart, this condition is called backlash
- Backlash warnings are enabled only when the MU are within a blue wedge

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DESIGN PROGRESS

LASER ALIGNMENT TOOL

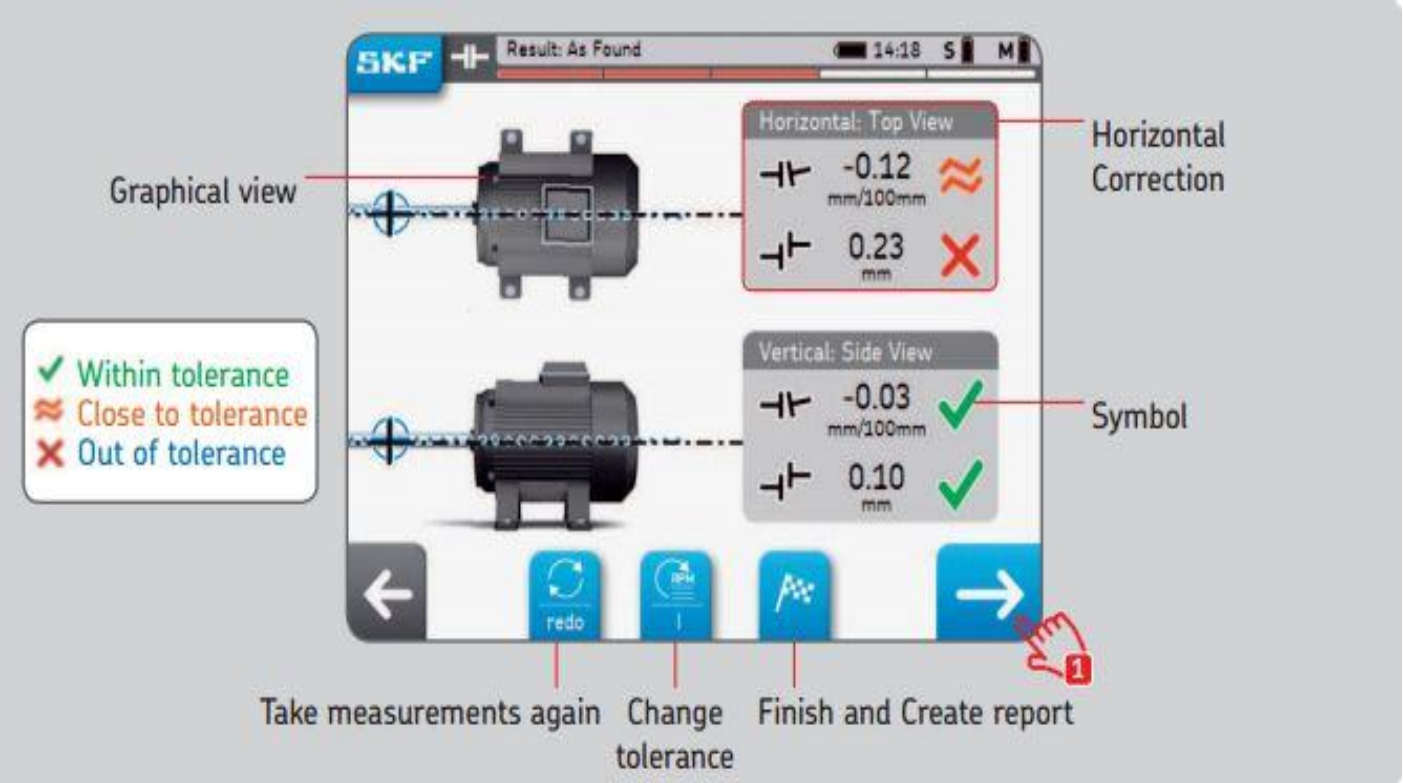


Fig. 8. SKF Shaft Alignment Tool TKSA 31

- The results page shows the coupling and feet adjustment values. The symbols compare the results to the selected tolerance.
- The black line being where the motor should be, the blue line being where the motor currently is.

DESIGN PROGRESS

LASER ALIGNMENT TOOL

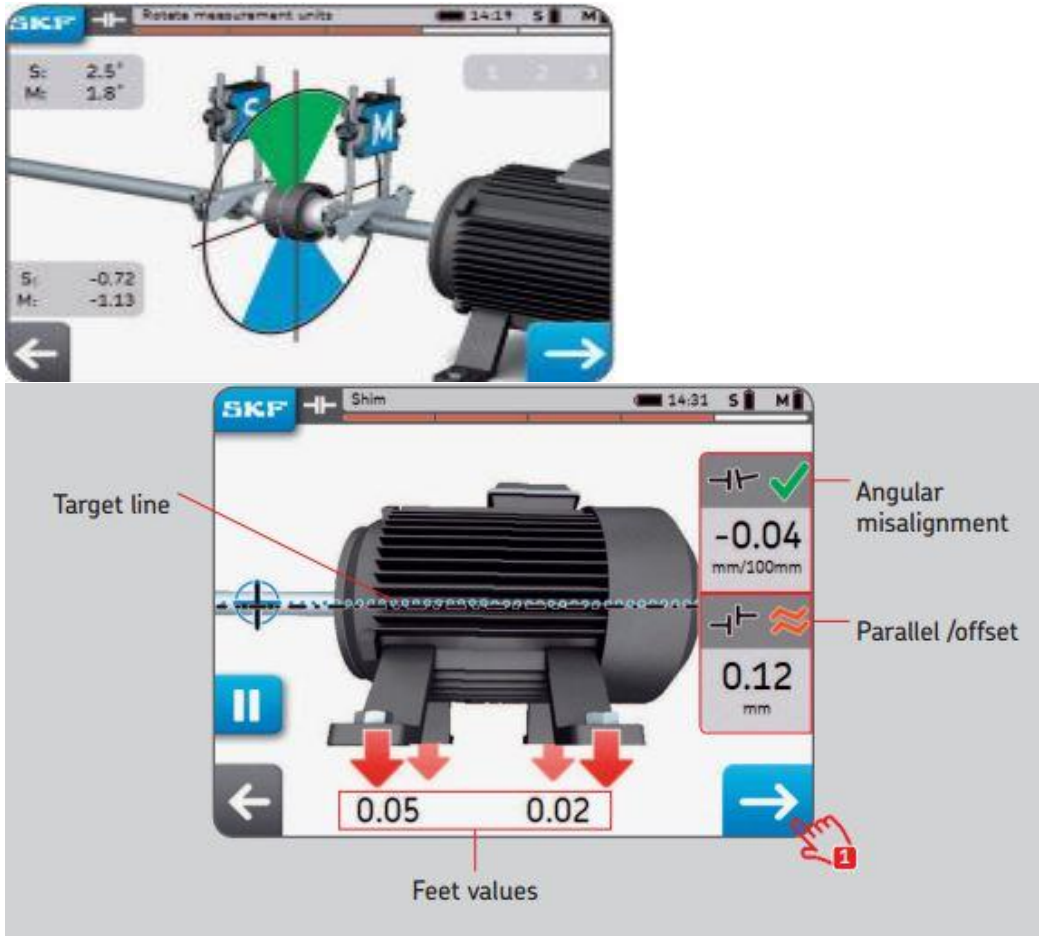


Fig. 9. SKF Shaft Alignment Tool TKSA 31

- Start by rotating the MU at the 12 o'clock (0°) or 6 o'clock (180°) position and validate
- The arrows show in which direction the motor has to be moved.
- STOP when the coupling values are within tolerance and both Green marks are shown.

DESIGN PROGRESS

LASER ALIGNMENT TOOL

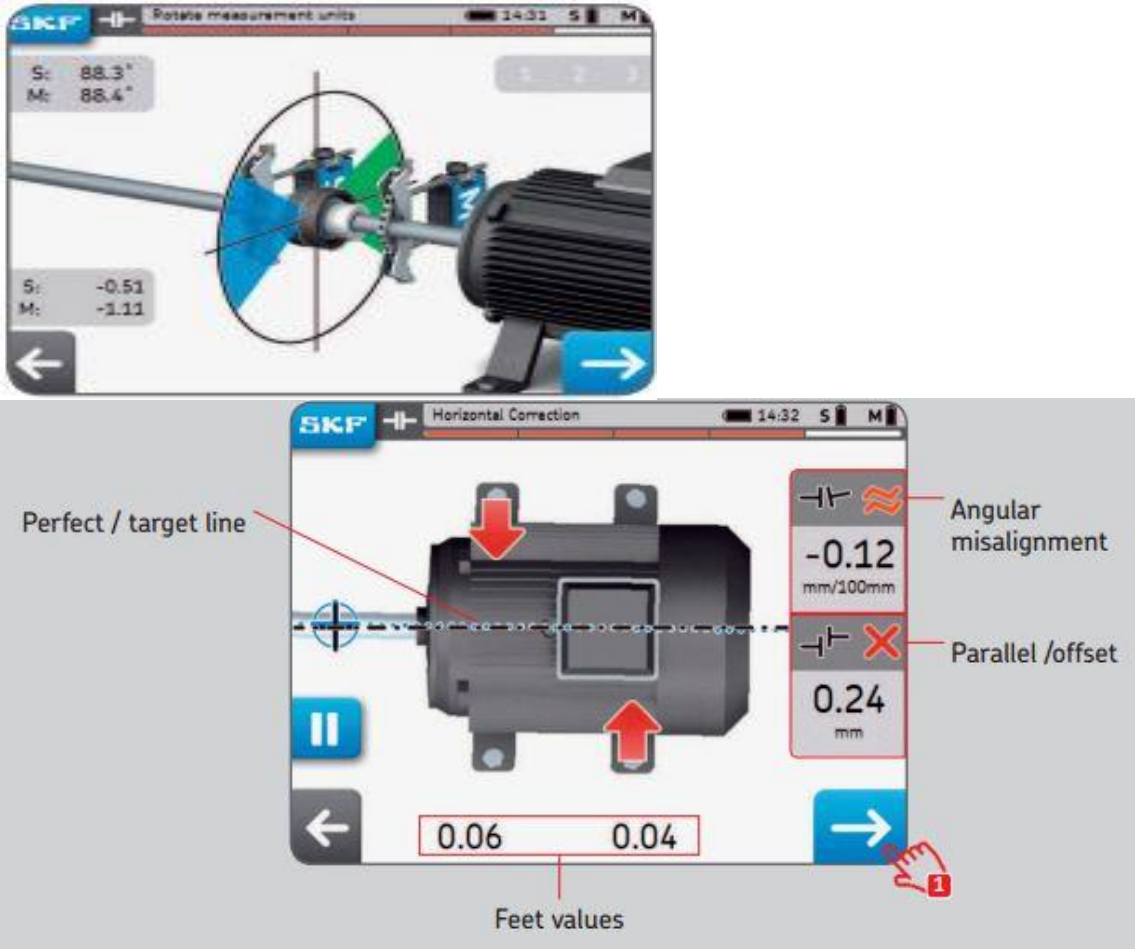


Fig. 10. SKF Shaft Alignment Tool TKSA 31

- Start by rotating the MU at the 3 o'clock (+90°) or 9 o'clock (-90°) position and validate
- The arrows show in which direction the motor has to be moved
- STOP when the coupling values are within tolerance and both Green marks are shown.

DESIGN PROGRESS

ALIGNMENT METHODS

Fig. 11. Jack

- The test rig will be aligned vertically by using a car jack
- This will allow a much easier way to lift the compressor at each point to put in shims.
- No need for a crowbar anymore
- Max lifting capacity is 2 tons
- Lowest clearance is 4" so the entire stand will need to be lifted in order for the car jack to slide through

DESIGN PROGRESS

TORQUE TRANSDUCER

Fig. 12. Magtrol TMHS 310 Torque Transducer

- Total Price: $10,861
  - Transducer: $8,250
  - Power Supply: $2,380
  - ER 113 Signal Cable: $231
- Quantity: 1
- Torque Rating: 50Nm nominal; 100Nm over range
- High Speed Applications: up to 32,000 rpm
- Stainless Steel Shaft Diameter: 20h6 mm
- **Status: Denied due to price and lead time**

APPROVED DESIGN

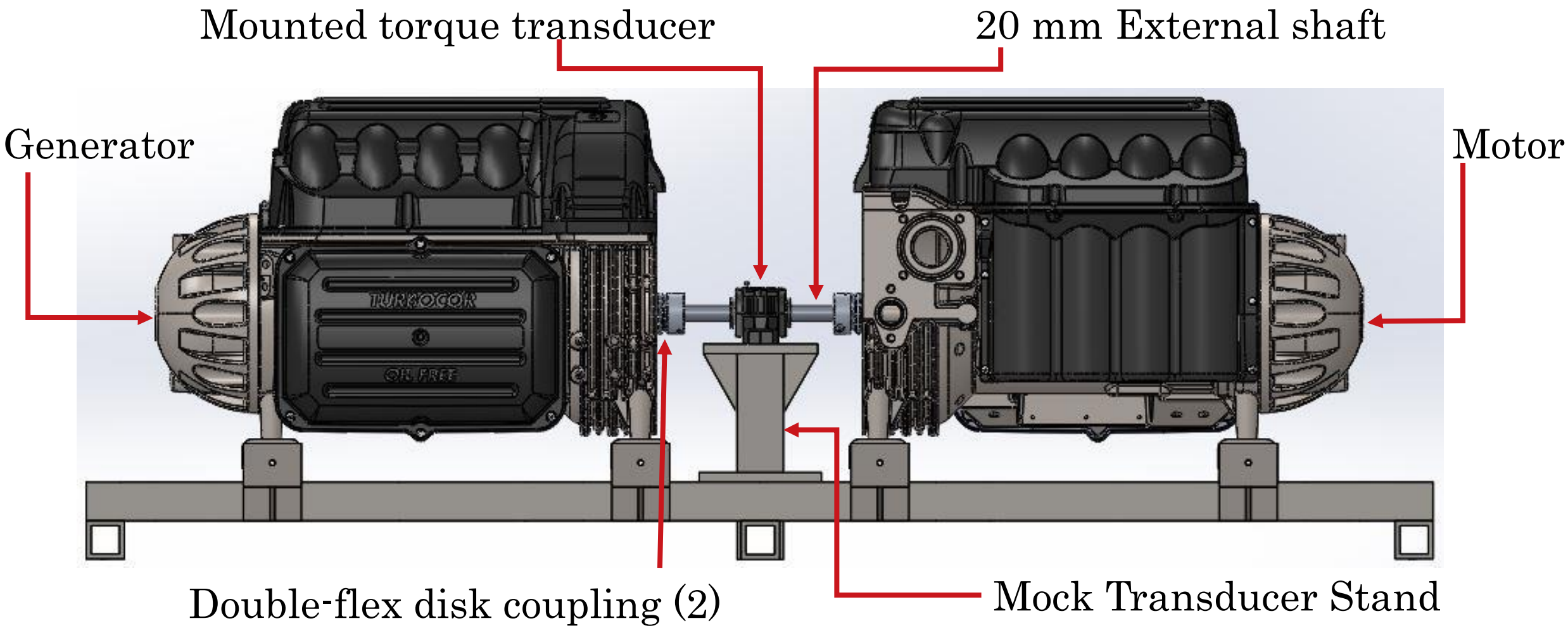


Fig. 13. Motor Test Rig

DESIGN PROGRESS

MOCK TRANSDUCER (BEARING HOUSING)

Fig. 14. SNL 505 bearing housing

- Total Price: Roughly $200-300
- Quantity: 1
- Roller Bearing in Housing
- High Speed Applications: up to 17,000 rpm
- Diameter: 31.5 mm (Compatible with desired bearing)

DESIGN PROGRESS

MOCK TRANSDUCER (BEARING AND ADAPTER SLEEVE)

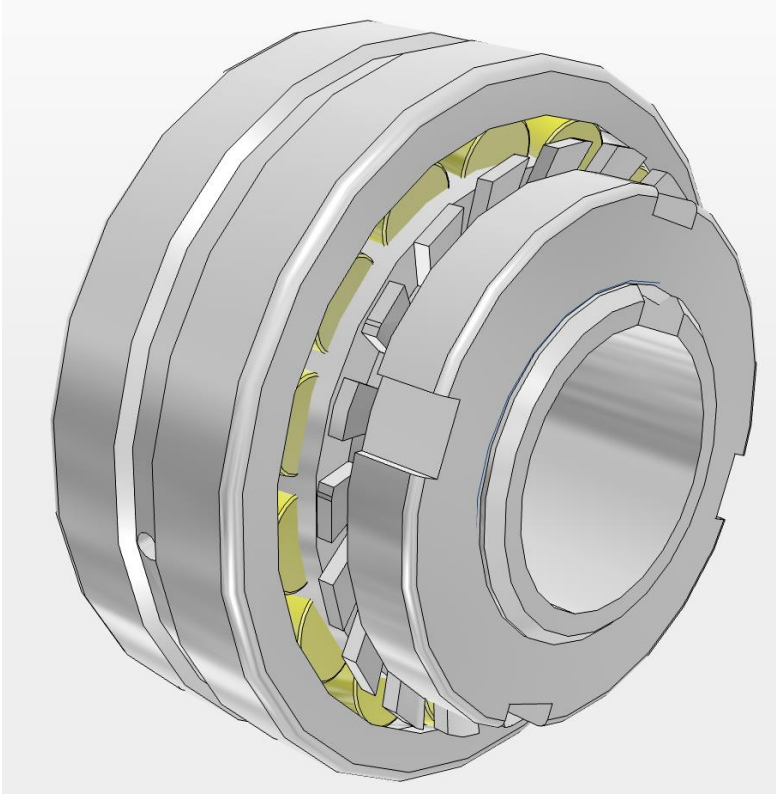


Fig. 15. Spherical Bearing with Adapter Sleeve

- Total Price: Roughly $50
- Quantity: 1
- Roller bearing
- 2 x FRB 6/62 Locating rings
- High Speed Applications: up to 17,000 rpm
- Bearing outer diameter: 31.3 mm
- Stainless Steel Shaft Diameter: 20 mm (Compatible with couplings ordered)

DESIGN PROGRESS

MOCK TRANSDUCER (BEARING AND ADAPTER SLEEVE)

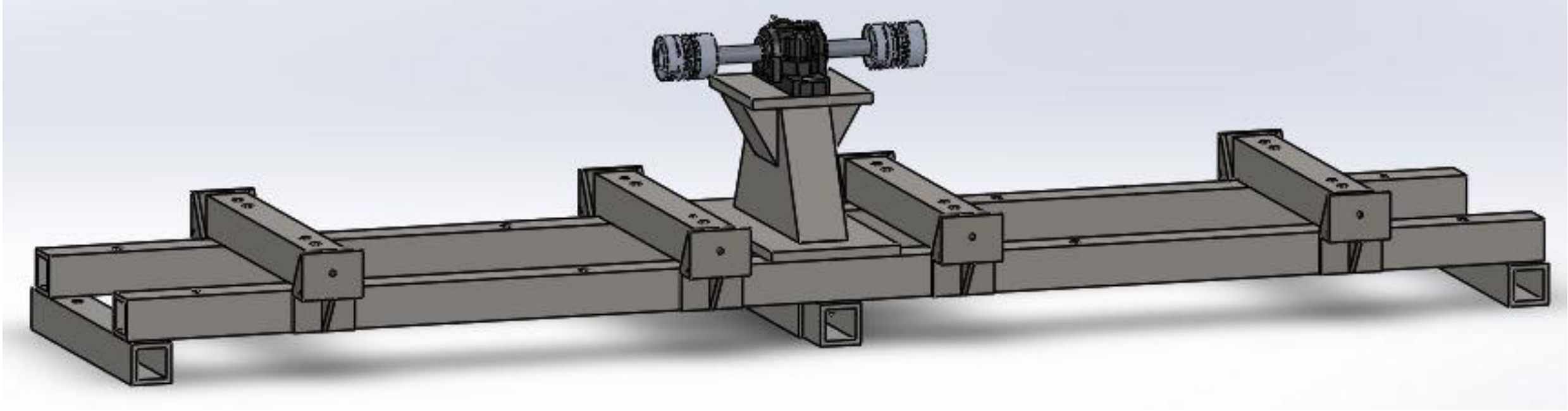


Fig. 16. Test Rig with focus on Components

DESIGN PROGRESS

SAFETY SHIELD

- The housing will be made out of Aluminum or Steel
- Will be using Lexan Polycarbonate as windows
  - Exceptional Impact Strength: 600–850 J/m (or N) (IZOD impact strength)
  - Easily Fabricated
  - Outstanding Clarity
  - Flame Retardancy
  - Wide Temperature Range: -40 °C to 130 °C
- Dimensions for the three windows are as follows:
  - Top and Side Windows: 7 in x 12in x 3/8 in (177.80 mm x 304.80 mm x 9.525 mm)

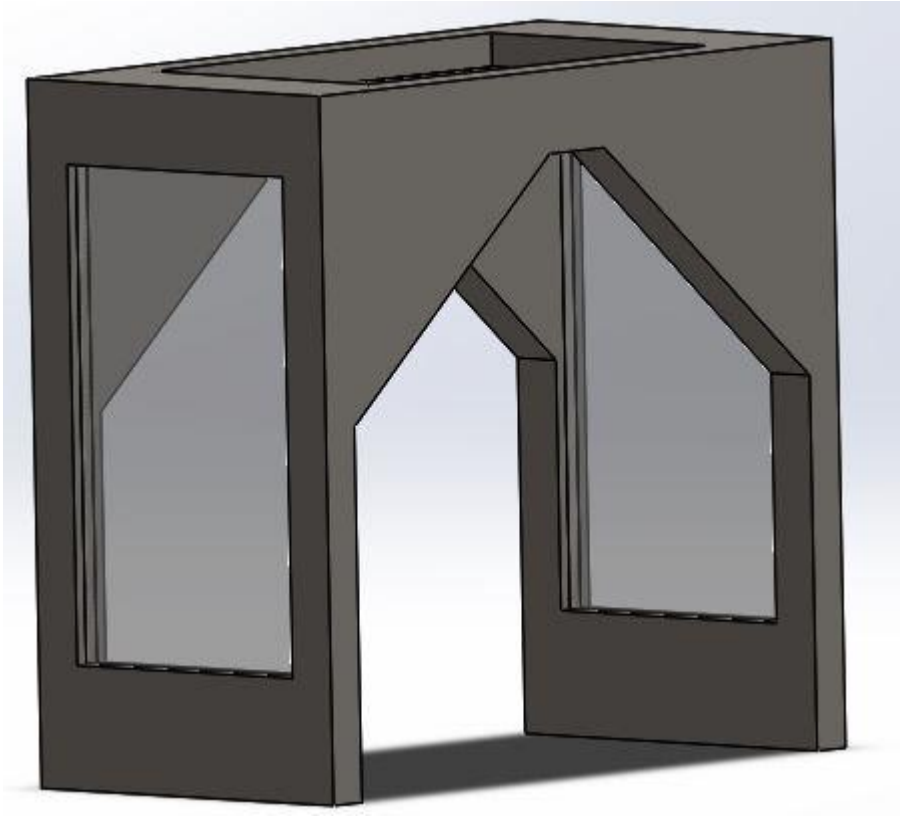


Fig. 17. Safety Shield with Lexan Polycarbonate Windows

DESIGN PROGRESS

SAFETY SHIELD HOUSING PARAMETERS

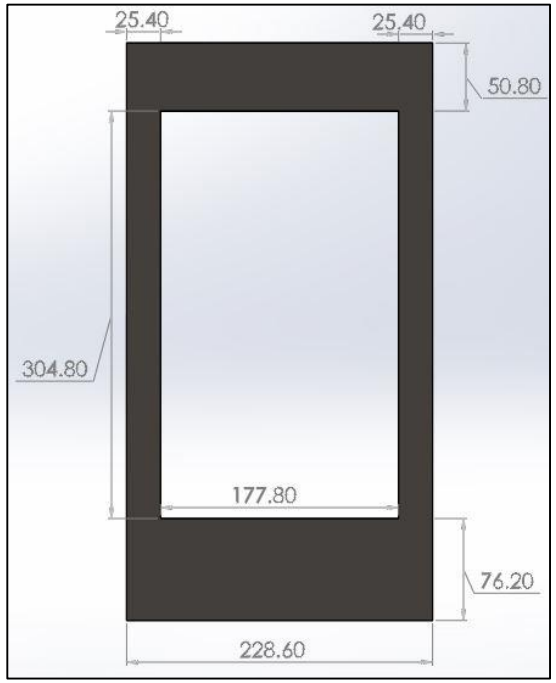


Fig. 18. Safety Shield Front Parameters (mm)

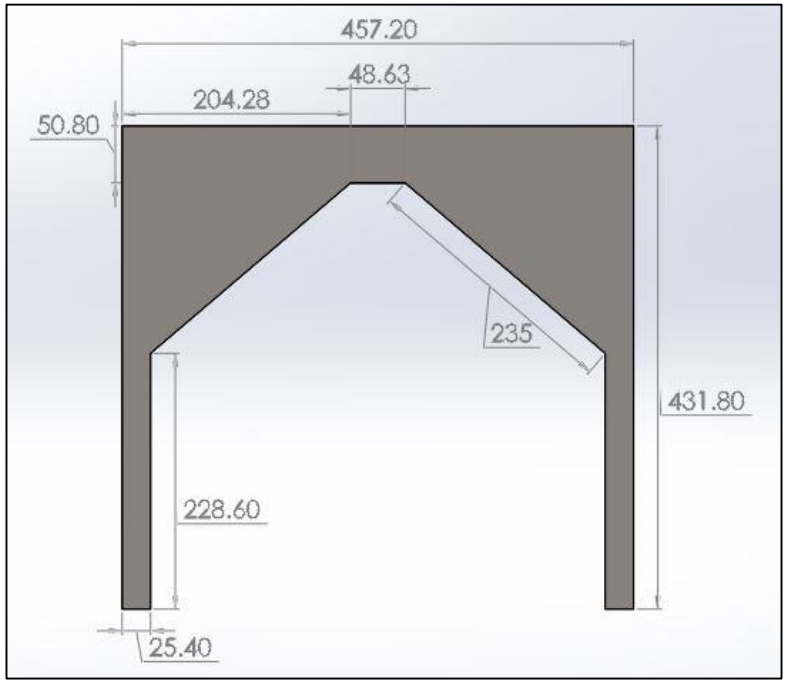


Fig. 19. Safety Shield Side Parameters (mm)

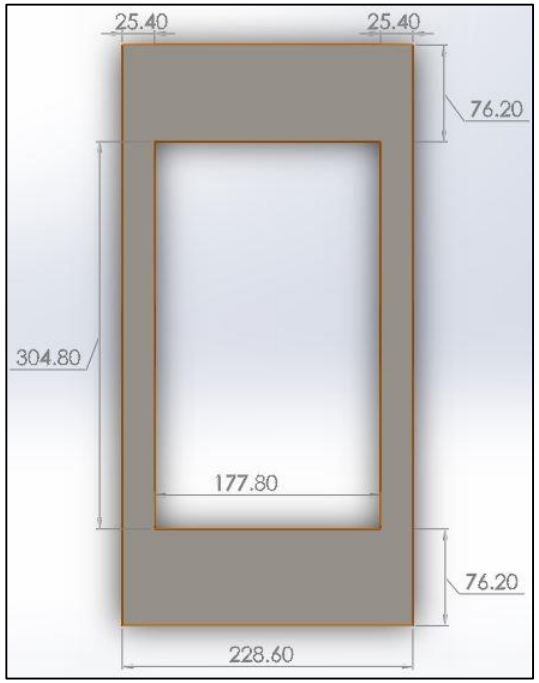


Fig. 20. Safety Shield Top Parameters (mm)

DESIGN PROGRESS

DESIGN WITH SAFETY SHIELD INCORPORATED

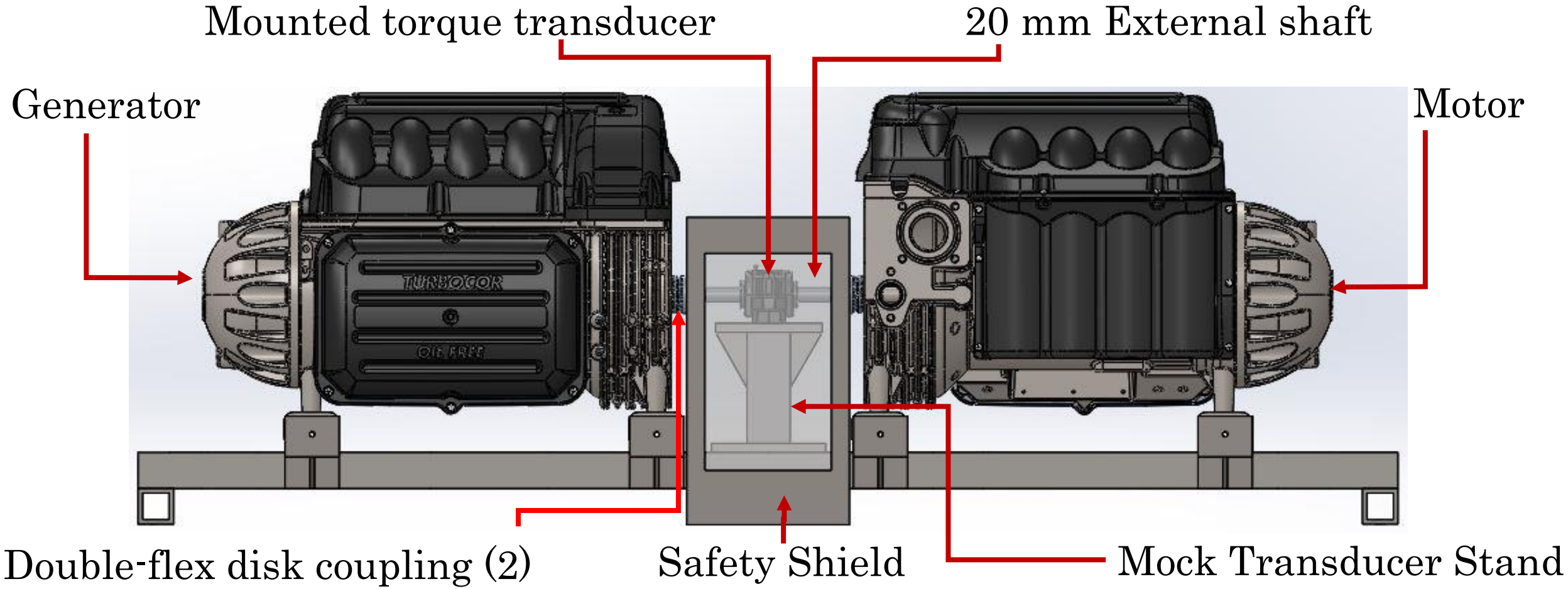
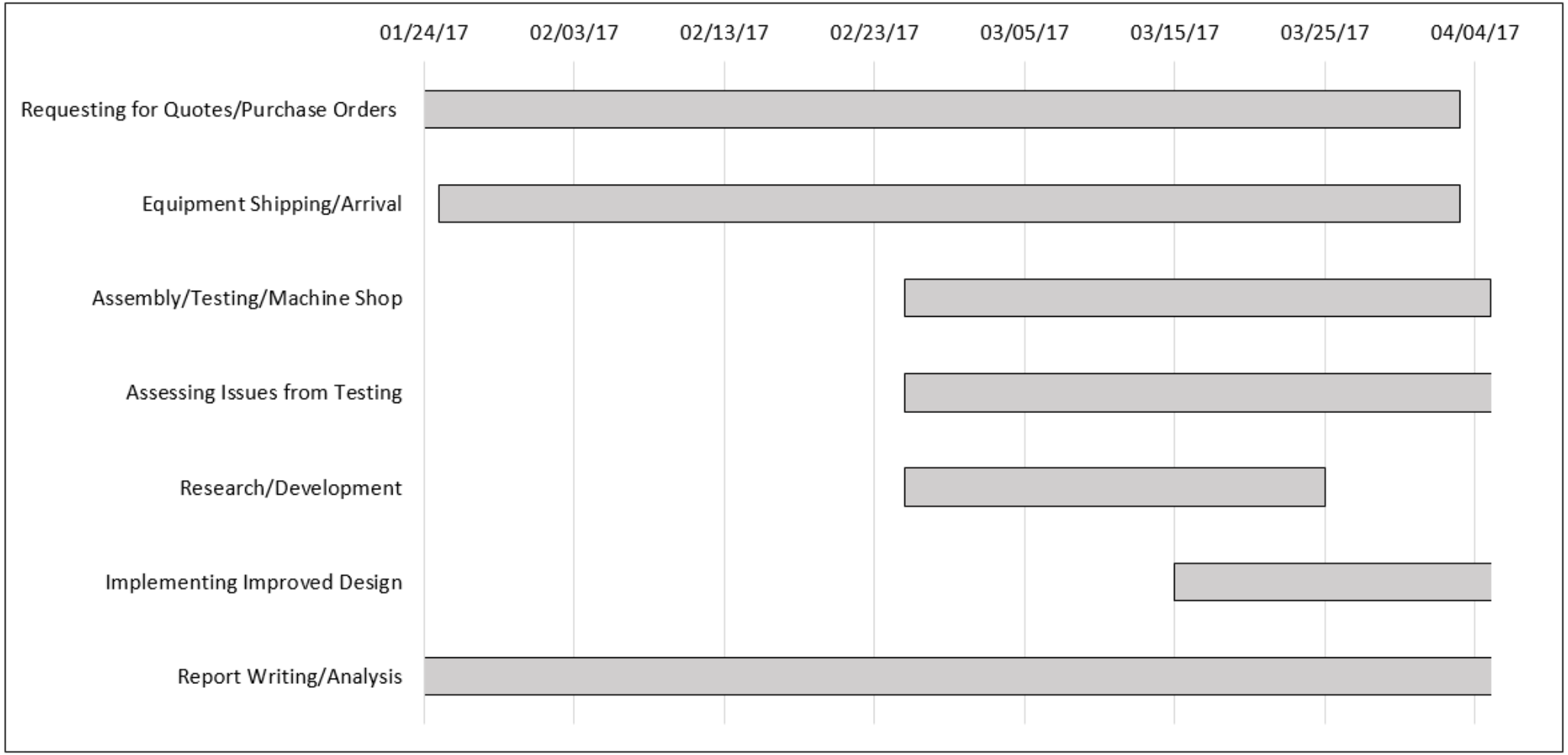


Fig. 21. Motor Test Rig with Safety Shield

SCHEDULE

Table 1. Gantt Chart



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CONCLUSION

FURTHER WORK

- Machining attachment for mock transducer
- Machining the safety shield
- Aligning the compressors and the components between them
- Achieving levitation of the compressors' shafts
- Improving rpm from last year

REFERENCES

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- http://3.imimg.com/data3/FW/MO/MY-5715853/bearing-housing-500x500.jpg
- http://www.aetnaplastics.com/products/d/makrolon
- https://www.youtube.com/watch?v=GtYlNY8hHDc&t=2s

QUESTIONS?