

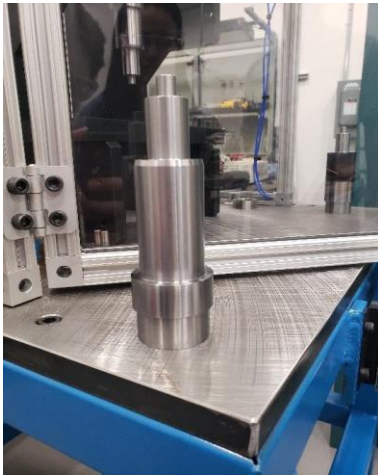
# High Speed Shaft Assembly System: Operations Manual

SD Team 507

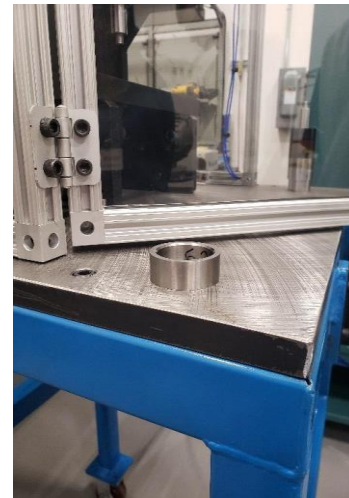
## PROJECT OVERVIEW

The objective of this project is to assemble shafts for Danfoss Turbocor's TT-Series Compressors. A heat-shrinking process is utilized to press a bearing sleeve and a radial sensor onto the shaft stubs. Images of the shaft components are shown below.

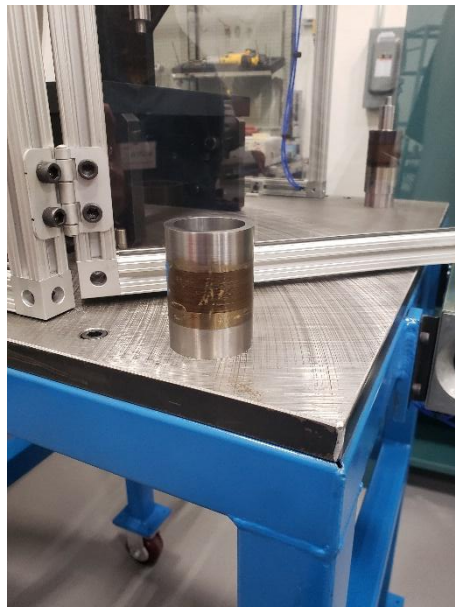
**Shaft Stub**



**Radial Sensor Bearing**



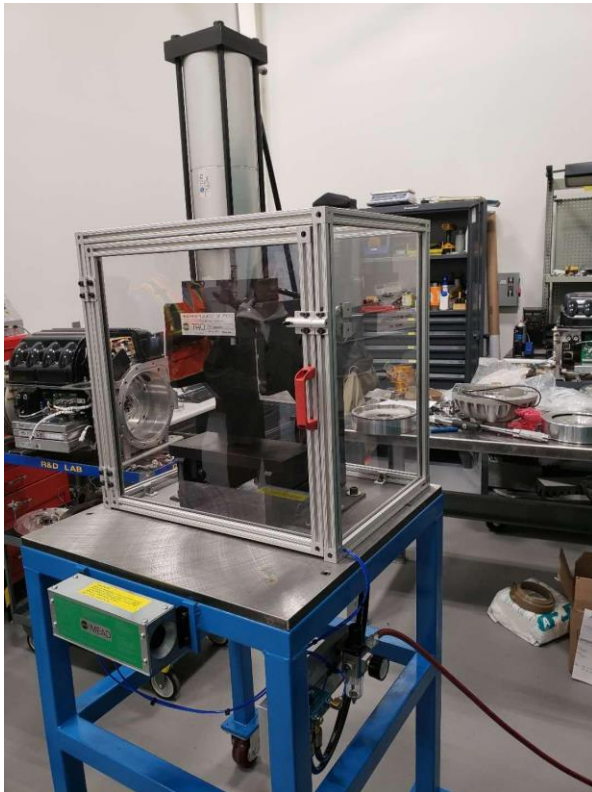
**Bearing Sleeve**



## **OPERATION**

A two-stage pneumatic press is used to press the shaft stub through the preheated bearing sleeve and radial sensor bearing. An oven next to the press will be used to heat the bearing sleeve and radial sensor to a uniform temperature of 605°F (320°C). Images of the pneumatic press and the oven are shown below.

**Two Stage Pneumatic Press**

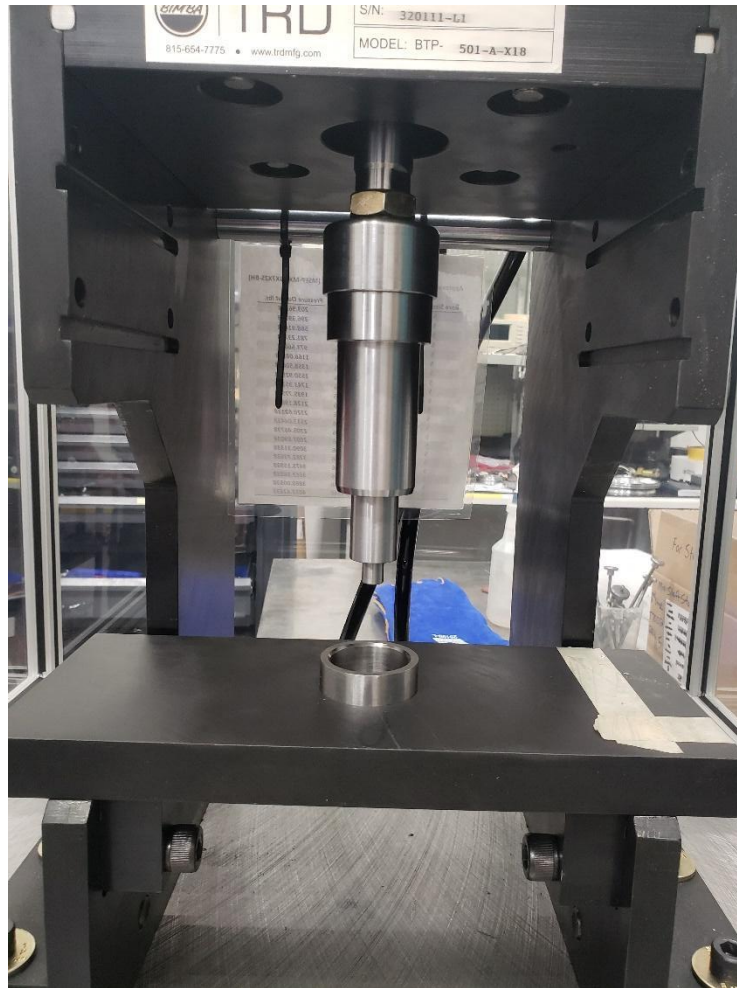


**Oven**



## Shaft Assembly Procedure

1. Preheat the oven to 605°F (320°C) and place the bearing sleeve and radial sensor inside the oven for a minimum of 30 minutes.
2. Open the plexiglass shield and place the bottom of shaft stub into the magnetic holding mechanism attached to the piston of the press. See the figure below.



3. Using a thermal protection glove, remove the radial sensor bearing from the oven and place it in the inset on the base plate of the press. (An image of the shaft and radial sensor bearing loaded into the press is shown previously)

4. After loading the shaft stub and bearing sleeve, close the plexiglass shield by locking the latch. (The press will only operate when the shield's latch is locked.)
5. To activate the press, press and hold the two buttons on the sides of the control box with both hands for a minimum of 10 seconds (If either of the buttons are released during this time the press will retract and the process must be started over with new shaft components). After 10 seconds the shrink fitting process is complete. Remove hands from the press controls and wait for the piston to fully retract with the shaft stub and the now assembled radial sensor. (The radial sensor bearing should be in full contact with the stop on the shaft stub. If there are gaps between the shaft components, remove the shaft components and restart the process with new components.)
6. Open the plexiglass shield and wait 15 minutes for the now assembled shaft stub and radial sensor bearing to cool inside the magnetic holding mechanism.
7. Using an oven mitt remove the bearing sleeve from the oven and place the radial sensor bearing in the inset on the base plate of the press. (Same procedure as the radial sensor bearing)
8. After loading the bearing sleeve in the inset, close the shield and lock the latch.
9. To activate the press, press and hold the two buttons on the sides of the control box with both hands for a minimum of 10 seconds (If either of the buttons are released during this time the press will retract and the process must be started over with new shaft components). After 10 seconds the shrink fitting process is complete. Remove hands from the press controls and wait for the piston to fully retract with the shaft stub and the

now assembled bearing sleeve and radial sensor bearing. (The radial sensor should be in full contact with the bearing sleeve. If there are gaps between the shaft components, remove the shaft components and restart the process.)

10. Open the plexiglass shield and wait 15 minutes for the fully assembled shaft to cool.

Then remove the assembled shaft from the magnetic holding mechanism. (An image of a fully assembled shaft is shown below.)



## **TROUBLESHOOTING**

Troubleshooting should be done with the advice and supervision of technicians at Danfoss. The press manufacturer can be contacted to troubleshoot issues with operation of the press itself. See the included folder for Matlab code including calculations and CAD files and drawings of the press, shaft, sleeves, and safety components.