LockStep™ Rotary Shaft Seal Validation

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Department of Mechanical Engineering

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ATLAS SEALS™

Project Background

Atlas Seals is a Salt Lake City seal manufacturer specializing in fabricating custom seals for the medical, oil, gas, and food industries.
They have revolutionized rotary seals with their LockStep™ technology. It utilizes barbs to act as cams against the seal housing, removing the requirement for retaining hardware or press fittings.
Atlas Seals wants to test the limits of their LockStep™ retaining technology and the performance of their Teflon compounds in application.

Objective

The rotary seal testing bench must be capable of:

- Testing different combinations of seal types, shaft finishes, and sizes
- Using automated data collection for temperature, rpm, torque, and time
- Controlling motor rpm and shaft-to-bore misalignment

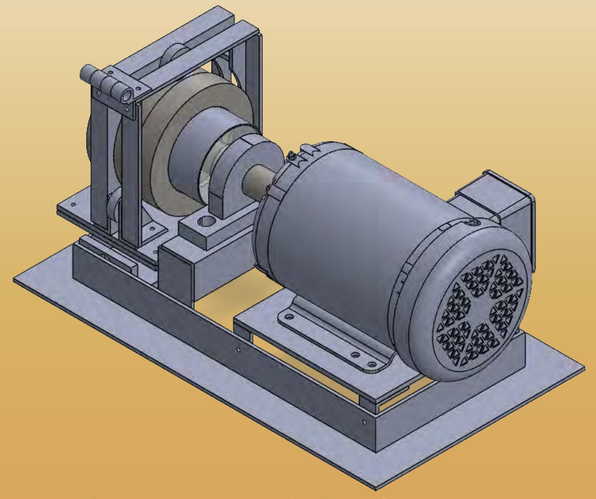

Figure 1: CAD rendering of prototype

Design

A 2-hp motor drives the rotating shaft running through the fluid catch into the seal and tank assembly.
Bearings hold the tank and allow a load cell to measure the torque transmitted by the shaft-seal interface.
An RTD sensor measures the temperature of the fluid.
The PLC controls the rpm of the motor shaft using a VFD, the shaft-to-bore misalignment using a stepper motor, and records all testing parameters.

Design Metrics

Table 1: Specified critical design metrics

Metric	Unit	Value
Load cell resolution	lbs	≤ 0.26
Mount shafts within range	in	$1 \leq D_i \leq 4$
Mount seals within range	in	$1.5 \leq D_o \leq 5.5$
Shaft-to-bore misalignment range	in	$.001 \leq x \leq .1$
Total indicated runout range	in	$.001 \leq x \leq .01$
Shaft rotation speed	rpm	$100 \leq x \leq 4000$

Modal Analysis

The natural frequency of the testing bench must be higher than the motor at maximum rpm (68.77 Hz) to prevent failure.
Analysis was validated experimentally using an accelerometer.

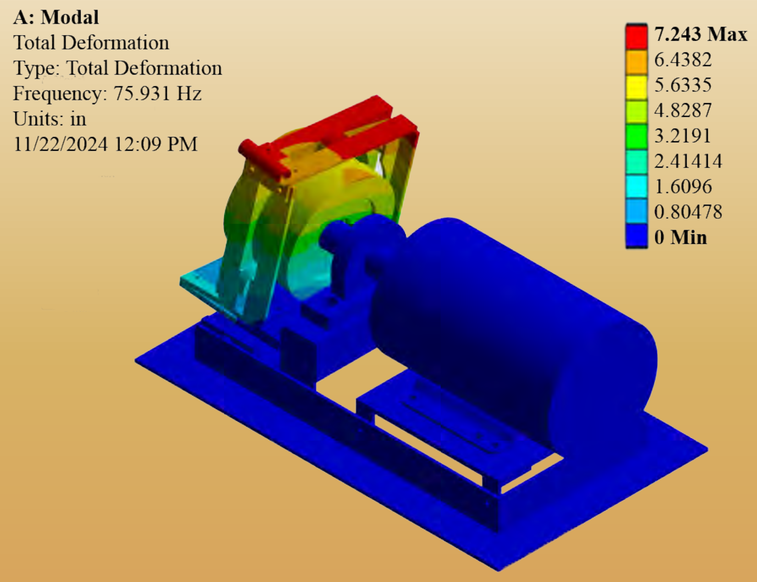

Figure 2: Modal analysis results

Table 2: Modal analysis frequency and calculated safety factor

Mode	1	2	3	4	5	6
Frequency (Hz)	75.931	96.879	138.47	149.27	244.74	288.18
Safety Factor (%)	10.413	40.874	101.353	117.060	255.883	319.049

Physical Prototype

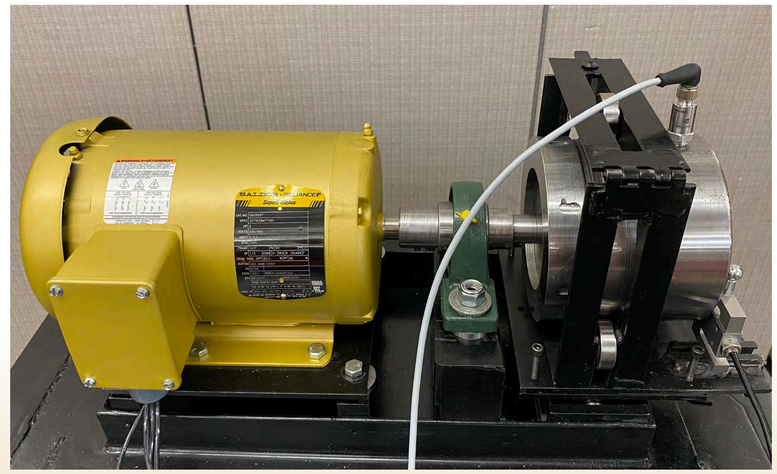

Figure 3: Manufactured test bench with tank, steady rest, shaft seal interface, purchased motor, and all sensors

Live Data Acquisition

Automated data collection for all design parameters occurs through a custom human-machine interface into a single file with live plotting during testing.

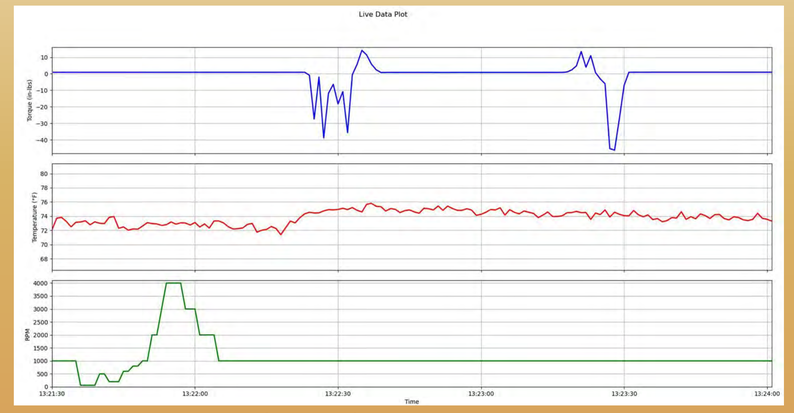

Figure 4: Live Data Plotting (torque, temperature, rpm vs. time)

Conclusion

The rotary seal testing bench met all critical design specifications

- The physical prototype has a modular design to test the required seal types, shaft finishes, and sizes
- A custom human-machine interface (HMI) automates data collection for temperature, rpm, torque, and time
- An HMI and PLC control motor rpm and shaft-to-bore misalignment during testing