Project Profile	
Customer:	Trelleborg Sealing Solutions
Industry:	Polymer technology; specialist in seals and sealing systems
Project:	Test benches for linear and rotary seals
Task:	Flexible test cycles for functional and endurance testing; measurement of friction forces, friction torques, temperature, wear, and leakage
Solution:	Measurement technology; modular test and control software
Software:	Custom-developed based on LabVIEW RT
Hardware:	Measurement and control cabinets with - NI cRIO-9035 real-time controller - NI-9205 analog input, 32 channels - NI-9264 analog output, 16 channels - NI-9403 digital I/O, 32 channels
Key Figures:	4 test benches with 1-2 test chambers; maximum pressure of 50 MPa; minimum 5 pressure cycles per second (5 Hz); up to 32 measurement points; linear stroke speeds from 0.001 to 2 m/s; rotary speeds from 0 to 40,000 rpm

„measX test software is an indispensable tool for our dynamic seal tests. Its precise control enables us to simulate customer-specific applications and analyze changes in key parameters reliably..“

Markus Hammeley, Manager Testing, Technology Center Stuttgart

Designed for Harsh Conditions

Trelleborg Sealing Solutions – Measurement and Test System for Fluid Seals

Versatile Test and Control Software Enables Comprehensive Seal Evaluations

Initial Situation

Trelleborg Sealing Solutions – a business area of Sweden's Trelleborg Group – is a leading global developer, manufacturer, and supplier of precision polymer seals, bearings, and custom polymer components. Their innovative solutions address demanding requirements in aerospace, automotive, medical, and general industries. Within Manufacturing & Automation, a core focus is seals for hydraulic and lubricating oils, utilizing advanced elastomers, polyurethanes, and high-performance plastics for optimal sealing and longevity. Trelleborg not only produces these products but also customizes sealing systems. The company operates global R&D centers, equipped with over 200 test benches, to deliver tailored solutions for every application.

Project Task

At the Trelleborg Innovation Center in Stuttgart, two test benches for hydraulic rod and piston seals, and two for rotary seals, required complete renewal. The role of hydraulic seals is to retain pressure media and exclude contaminants during linear, rotary, and oscillatory motion – often under extreme pressure, temperature, and lateral loads.

These test benches are designed to assess the sealing characteristics of individual seals and complete systems under realistic conditions. Test specimens are exposed to tailored motion, temperature, and pressure profiles over defined periods, required to seal one or more pressurized chambers. Performance metrics include leakage volume and wear of both the seal element and mating surfaces. During tests, systems record key parameters such as friction forces, torques, pressure, and temperature.

For instrumentation and controller development, Trelleborg partnered with measX at the Stuttgart site; project collaborators handled mechanical engineering and construction of benches and actuator control cabinets. measX was responsible for sensor integration, overall test design, and software development for all four benches.

Solution

Each test bench varies slightly in dimensions and configuration according to seal type and test objectives. Rod and piston seal benches utilize a hydraulically driven actuator executing linear motion, precisely controlled for speed and stroke. Rotary benches feature integrated drive systems imposing controlled rotation on test samples, with programmable position, speed, and direction.

Test chambers can be filled with diverse media – mineral oils, synthetics, water-based hydraulic fluids, water, air, gases – and are independently regulated. A temperature unit maintains conditions between +20 °C and +140 °C, while pressure modules can apply between 0 MPa and 50 MPa, with up to five pressure changes per second. Rotary bench actuation uses frequency converters housed within the power control cabinets; linear motion is achieved by precisely controlled hydraulic valves.

Measurement, Control, and Regulation

Each test bench is equipped with temperature, pressure, fluid level, and additional analog sensors for fast, highly accurate control and parameter logging. Numerous digital signals are also monitored for status, interlocks, valve positions, and switches.

The system inspects rod seals with diameters ranging from 17 mm to 70 mm for wear, leakage, and friction.

Complete Measurement and Control Solution

The control and measurement software acquires all sensor data from the test benches, manages monitoring, calculations, and control routines, and executes all test procedures as specified.

The sealing system in hydraulics is exposed to high loads.

The interface to both sensors and power cabinet is a measurement/control cabinet with an NI cRIO-9035 real-time controller. All measurement and control software, developed in LabVIEW RT, runs on this platform to meet demanding real-time response needs. The modular software architecture is consistent across all four benches; only the test procedure modules differ by bench.

Flexible, Realistic Test Sequences

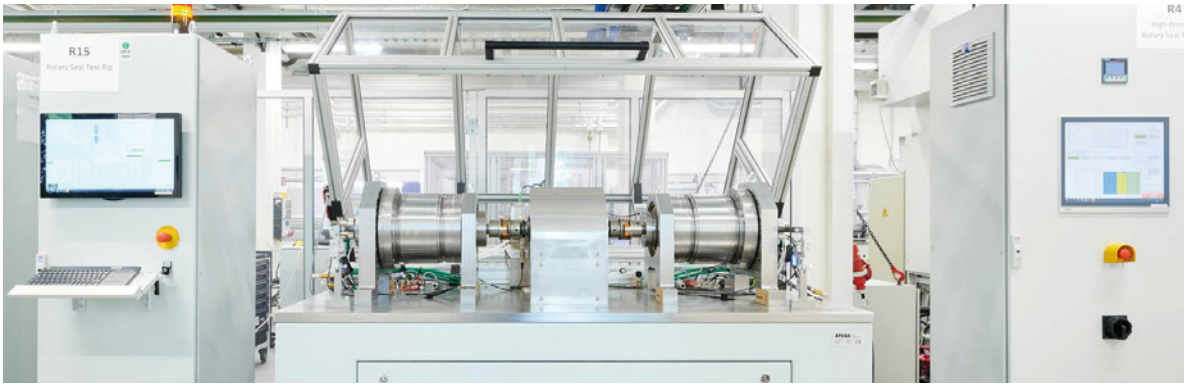
A core function of each bench is simulation of real-world stresses. Technicians define temperature profiles, motion, and pressure patterns in cycle tables, detailing speeds, stroke lengths, rotational speed, revolutions, angles, pressures, and temperatures. Predefined test sequences can be loaded and executed automatically, with manual operation mode available for setup and component verification.

Calibration Function with Alarm System

A dedicated calibration dialogue supports sensor adjustment, ensuring reliable measurement even after extended use. The system allows each channel to be equipped with threshold values and response times for conditional monitoring and emergency shutdown. Warnings, faults, and system alerts are provided in real time, ensuring swift intervention capability.

Monitoring of Measurement Data

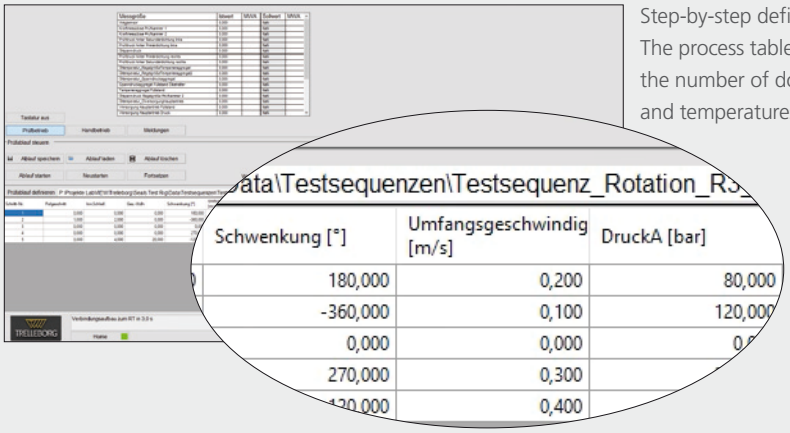
Upon startup, the test bench computer communicates with the RT-system controller that handles all time-critical algorithms and equipment control. Measurement data flows back for real-time processing and online visualization. An integrated oscilloscope assists in evaluating friction metrics. All measurement and computed results are saved for subsequent analysis.



Rotational test bench with test bench computer in the measurement cabinet (left) and power switch cabinet.

Field Success

Trelleborg has effectively employed these seal test benches for functional and endurance testing during product development for years. Realistic test scenarios deliver transparency and assure the highest standards of performance and quality to customers. As a development partner, Trelleborg demonstrates that solutions are validated against bespoke criteria for tightness and safety. measX software controls all critical test and measurement functions, delivering reliable output for key parameters such as friction, wear, and leakage. The acquired measurement data answers pivotal development questions: How do characteristic values change over time? Under which conditions do deviations occur? How do sealing properties vary between fluids? The resulting database supports the development of new materials, geometries, and seal combinations for demanding applications. The modular software architecture enables further test capabilities to be added at any time. With updated test benches, Trelleborg is well equipped for future challenges.



Step-by-step defined test sequence:
The process table specifies test parameters such as the number of double strokes, speed, pressures, and temperatures.

Users can already view custom measurement data at reduced resolution during the measurement by using the integrated oscilloscope.

Key Advantages at a Glance

- ***x*** Realistic testing environments
- ***x*** Seal performance metrics
- ***x*** Reliable operation (alarm functionality)
- ***x*** Comprehensive data pool for analysis
- ***x*** Modular, service-friendly software

measX GmbH & Co. KG
Trompeterallee 110
41189 Mönchengladbach

Telefon: +49 (0) 2166 9520-0
info@measx.com
www.measx.com

measX . Messtechnik . FS Trellborg . D . 8.25