SYMBRIUM: YOUR ONE-STOP SHOP FOR GEAR MATERIAL TESTING

Symbrium

Testing and Services Group

Symbrium is pleased to announce that our **Gear Material Testing Lab** is now taking on additional clients after establishing ourselves by working with a few major powertrain corporations over the past years. We present this lab as a first-of-its-kind non-institutional commercial gear testing facility in the US. We are uniquely set up to provide both test machines and testing services to perform the following:

- Static Bending Strength (Yield and Ultimate)
- Dynamic Bending Fatigue Life (S-N Curves)
- Pitting and Wear Resistance
- Scoring Index

We offer the following support services including:

- Advanced Gear Design and Analysis
- Full Dimensional Inspection
- Full Metallurgical Analysis
- Prototype and Test Gear Manufacturing: hobbing, shaping, milling, grinding, other
- Material sourcing including steel alloys and highly engineered polymers
- Heat treatment and post-processing including shot peening, isotropic surface finishing and coatings



Symbrium STB-140 single tooth bending machines with advanced controls automatically stop upon crack detection.

Symbrium offers all of the above and more on an as needed basis or as part of bundled service packages with turnkey pricing. Whether your company lacks the capital resources to invest in specialized test equipment, does not have the technical resources to perform certain types of testing in-house or simply does not have the capacity to complete a test program per schedule demands, you can trust Symbrium to provide full service program management and test execution delivering timely and reliable data for product development, process validation or research. Many of our clients provide bar stock, and we manage the production, heat treatment, certification and testing of gears to your specifications.

The **Symbrium Gear Material Testing Lab** is a climate controlled, fully monitored, testing facility active 24/7 laser focused on providing unquestionable data and insightful analysis. Using high-speed purpose-built test machines that we developed in-house and have supplied to some of the leading powertrain testing facilities in the world, Symbrium is able to produce full S-N curves for new materials in a fraction of the time normally required. Our clients receive exclusive access to an online data repository that includes real-time test status, updated files and data, and a live feed of their testing being performed on our machines. We also have capacity to test bearings, rollers, gearboxes, transmissions and other powertrain components and systems in house.





Above: Symbrium GTA-750 Four-Square gear testing machines have become the new standard for evaluating gear materials, processes, and lubrication.

Left: Symbrium can generate a 36 point SN curve with 20M cycle suspensions in as little as 6 weeks using our high-speed STB-140 single tooth bending servo-hydraulic machines.

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STB-140 test machine configured for automotive and aerospace gears up to 200 mm in diameter with 140 kN static or cyclic loading up to 100 Hz.

Symbrium has designed and built a series of purpose-built, high-speed, servo- hydraulic load frames optimized for **single tooth bending testing** of gears.

Our **STB-140** single tooth bending machine is ideally suited to test steel gears up to 200 mm in diameter at loads up to 140 kN and frequencies up to 100 Hz. Sinusoidal loading accuracy is +/- 1 N with R values of 0.01 and Total Harmonic Distortion of less than 0.1%. Tooth deflection is measured in real time to a resolution of less than 2 microns using a non-contact sensor.

Our customers are using these exact machines to test SAE 1619 and other Standardized Test Gears as well as proprietary and production gear designs in their labs to determine yield and ultimate strength and generate partial or fully populated S-N curves. By **popular demand**, Symbrium has installed STB-140 machines in our lab and created the supporting infrastructure to conduct gear material testing programs. Our most popular package is a 36 test profile consisting of six trials at five finite life load levels with at least six tests to 10M or 20 Million cycle suspension. Turn around is from 3 to 5 weeks per material variant!

Symbrium has developed advanced statistical analysis techniques to process gear fatigue data and estimate an endurance limit within a desired confidence interval.

Symbrium will work with you to develop **customized test plans** to gather real-life performance data for your materials or applications and supply you with static material property data and dynamic S-N-P diagrams along with **in-depth metallurgical and failure analyses**.

PITTING - WEAR - SCORING

BENDING



GTA-750 test machine configured for standard 91.5 mm center distance automotive and aerospace test gear pairs up to 235 kW (315 HP) with speeds up to 3,000 RPM and Torque up to 750 Nm. Higher speeds, torque levels and custom center distances can be accommodated using other GTA series machines or available dynamometer test beds. Symbrium has also developed the GTA family of computer controlled four-square gear test machines that are used to evaluate pitting fatigue, wear, scoring and fully reversed bending of gear pairs ranging in operating center distance from 60 to 200 mm at speeds up to 16,000 rpm. Load can be set on these machines using either dead weights and a removable torque arm or by using an optional servo-hydraulic actuator that is capable of changing load during the execution of a test profile without stopping.

Lubrication is a key factor in functional gear testing. Symbrium foursquare machines are capable of supplying lubrication in many different ways ranging from partially submerged static fills to dry sump recirculating filtered sprays into or out of gear mesh. Temperature is precisely controlled over a range from ambient to 200C. Flowrate and application can be controlled as required. Lubrication systems contain no yellow metals and are compatible with all types of petroleum, mineral and synthetic oils, and transmission fluids as well as turbine grade engine oils. Tests have even been performed using dirty oil collected from the field and calibrated oil-debris mixtures.

The Symbrium lab is equipped with GTA-750 four-square test rigs set at 91.5 mm center distance that are capable of providing up to 750 Nm of torque at speeds up to 3,000 rpm. This configuration is ideally suited for most generic automotive and aerospace gear material property testing programs. The lab is also equipped with several smaller GTA-050 machines that are used primarily for testing automotive engine accessory gears and polymer gears. Symbrium can quickly configure other GTA machines or dynamometer test beds for testing gears of different center distances and power levels.

Symbrium[®] (Testing and Services Group

SYMBRIUM: YOUR TRUSTED GEAR TESTING LABORATORY

Symbrium provides data processing, test reports, and in-depth analysis services that support our gear material testing activities. Progressive inspections of gear flank surface distress such as wear, pitting, spalling or scoring are performed on all tested gears by trained technicians. Oil samples are also collected and analyzed as appropriate.

Testing is supported by **full metallurgical analysis** including SEM, XRD, and optical microscopy methods:

- Chemical composition
- Hardness
- Micro-hardness
- Effective case depth
- Retained austenite
- Residual stress
- Fracture surface topography



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Symbrium conducts advanced statistical analysis on all load cycle data and can provide comprehensive **Wohler Diagrams** with confidence intervals (SNP Curves). Yield, ultimate and endurance limits are estimated from static and cyclic bending tests. Pitting and wear data are analyzed using a variety of statistical methods depending upon test protocol and sample size. Fracture surface analysis can be provided that includes **highly detailed micrographs** and SEM/EDS analysis that provides valuable insights into inclusions, manufacturing defects, and microstructural effects.

Test gears of standard and customer supplied or production designs can be used for testing to determine the following:

- Fundamental Material Property Data for Design
- Material Screening and Selection
- Material Supplier Accreditation
- Heat Treat or Shot Peening Process Evaluation
- Manufacturing Process Change Validation
- Lubrication and Temperature Studies

Symbrium maintains a CNC machine shop capable of producing gear test fixtures to meet your needs. Custom test rigs can be configured for non-standard gear and other powertrain related testing. Symbrium can manage the production of test gears using your supplied materials to exact process specifications. Critical heat treatment and other post-processing operations can be performed by our affiliates or at your own plant with dimensional and metallurgical analysis conducted by Symbrium. This saves you time and money and ensures that your test gears are of the highest quality.



For more information, contact Symbrium Testing and Services Group at (919) 241 7886 or via email at lab@symbrium.com to talk about a customized test plan today.