STRESS ENGINEERING SERVICES INC.
an employee-owned company

Upstream: Oil & Gas

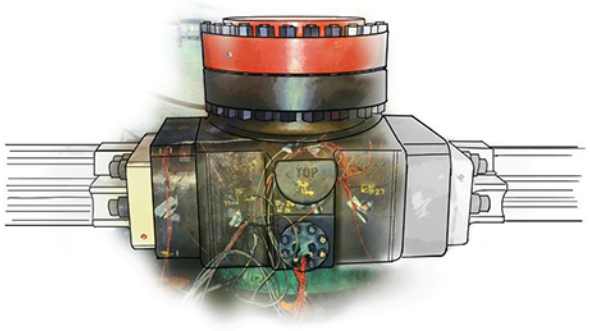
Addressing the Challenge of Elastomers and Polymers in HPHT Service

Making Service Life Predictions for Elastomer Seals

There is a very bright light shining on elastomer performance when used in critical oilfield applications. Upstream high pressure, high temperature elastomer sealing applications are marked by harsh service conditions; high pressures (10,000 psi to 20,000 psi), high temperatures (300°F to 400°F), contact with hydrogen sulfide, carbon dioxide and a plethora of engineered, particle-laden fluids that also include aggressive chemistry. The demand to understand true in-service performance has never been greater. Stress Engineering Services® (SES) has expanded conventional environmental compatibility testing methodology to include testing protocols that enable service life estimates.

ISO 9001 and ISO 13485 Certified

As a result, the focus of most HPHT elastomer testing is compatibility-focused, “Can I use a specific elastomer in a particular environment with these fluids?” Leveraging testing and analysis strategies SES developed for the medical and surgical products industry, SES has focused its attention on answering the more useful question regarding elastomer performance in HPHT service, **“How long will the elastomer of choice satisfy its functional performance requirements in the specific environment in which it will be deployed?”**



The intent of most compatibility testing programs is to impose in-situ environmental conditions in a laboratory setting and characterize changes in baseline attributes like; hardness, volumetric swelling, mass and ductility. The tests are typically run at worst case temperatures, with property changes monitored over the duration of the testing and judged against a set limit of change

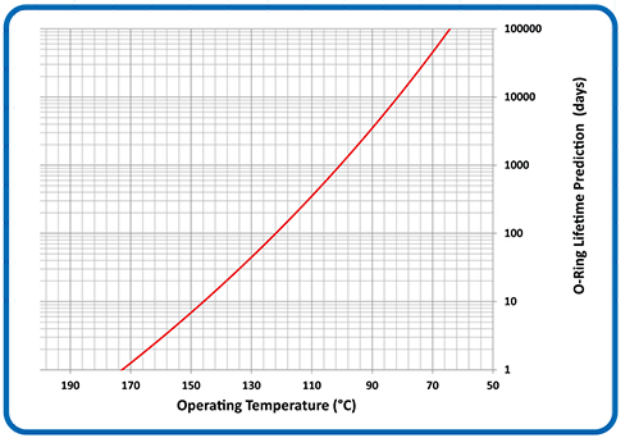
with a pass/fail condition. This enables rankings of materials and an estimate of degradation rate for the environment under the tested conditions. For many applications this is sufficient and provides a basis for making a seal selection. However, if you need a better understanding of how the seal is going to preform over time, SES offers an additional level of service.

WHEN YOU NEED TO ESTIMATE ELASTOMER SEAL SERVICE LIFE

For critical applications, elastomer seal life predictions can be made. SES’s testing approach not only includes the environmental conditions but also addresses the unique structural/mechanical loading experienced by the elastomer material for its specific intended application.

This approach includes:

1) Definition of the environmental conditions (pressure, temperature and fluids)
2) Calculation of stresses and strains for the range of imposed mechanical loading
3) Completion of screening tests
4) Design and execution of component life testing
5) Statistical analysis of data



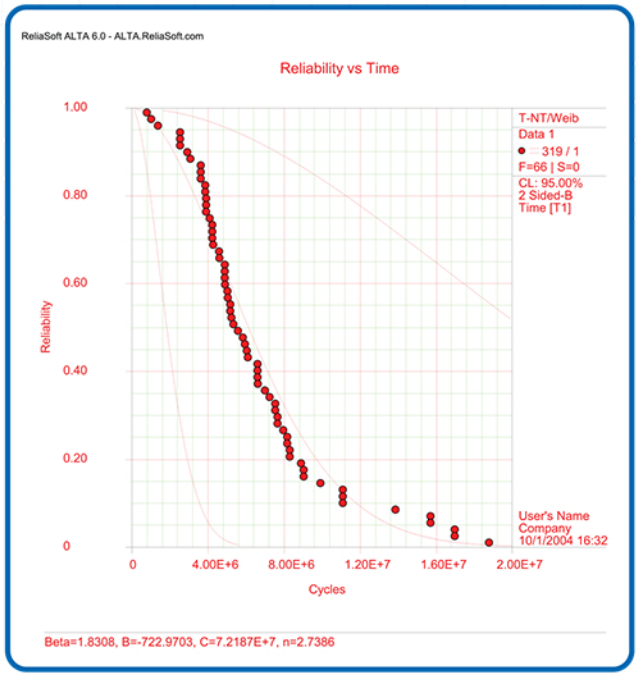
In these test programs multiple samples are conditioned over a broad range of environmental conditions and stress or deformation states for predetermined periods of time. The understanding of interactions between environmental accelerations allows a statistical estimate of elastomer seal life to be made for different conditions or for far longer periods of time. The basic approach can be leveraged for most all elastomer and polymer applications.

ELASTOMER SEAL MECHANICAL SCREENING TESTS WHEN SERVICE LIFE IS NOT NEEDED

There are several good reasons to conduct short term screening tests as part of the selection/evaluation process:

1) There is a range of material choices currently available. Screening can narrow the field.
2) New materials are always being developed and should be considered.
3) Counterfeit components are known to exist. Sub-performing articles can be identified.

SES has developed a method for rapidly screening candidate designs/products/ formulations. Screening testing is focused on quickly evaluating the propensity for candidate materials/products to degrade under accelerated aging conditions. During this testing, samples of the materials are exposed to elevated temperature and stress/strain levels in an environment reasonably representative of the service environment. The mechanical properties of the samples are evaluated after a prescribed time and degradation, if any, is quantified. These data are used to rank and reduce the number of candidate products/materials as well as help define parameters for the Tier 2 testing program. It is not uncommon for Tier 1 testing to be completed in 2-3 weeks.



Stress Engineering Services HPHT Testing Capabilities

Temperature Range	Pressure Range
-60°C (-76°F) to 500°C (932°F)	0 psi to 5,000 psi
23°C (73°F) to 350°C (662°F)	0 psi to 30,000 psi

Sample Geometry

Standard O-rings: 02-325 or similar sized O-ring

Standard Tensile Bars: ASTM D638 type 1-5 dog bones, ASTM D412 Type 1 or 2.

Custom Tensile Bars: Client-Defined/Modified geometry coupons.

Extracted Coupons: Coupon extracted from large components (i.e. BOP seal, pipe liner, etc.)

Full Components: Seal assemblies, full sized product, pipe, rod, etc.

Custom Testing

Additional application-based test setups are developed based on client needs.

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POST-TESTING CHARACTERIZATION

Stress Engineering offers the full suite of mechanical, thermo-mechanical, analytical, and physical characterization post-aging. The critical nature of testing of these properties immediately upon removal from the aging environment provides tremendous value for clients as all testing equipment is co-located for efficient testing.

The development of new technology has allowed for drilling into formations that were inaccessible, which in part, has helped drive the need for unique sealing solutions that can operate in the high-pressure, high-temperature (HPHT) regime. Understanding the behavior of these non-metallic materials when exposed to such conditions is critical for the success in a given application. Determining and tracking the physical damage mechanisms is critical in order to predict long-term life expectancy and suitability in an application.

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