

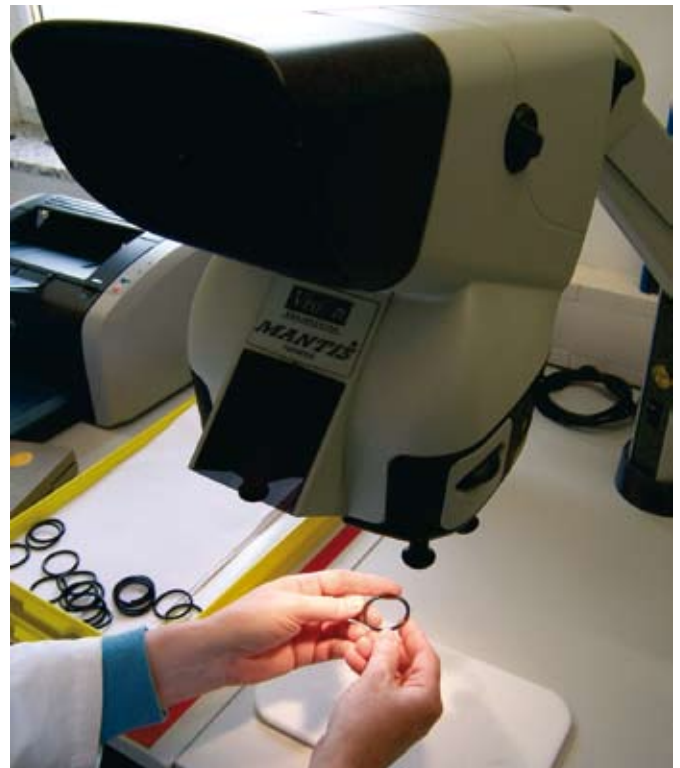


1. O-rings and rubber parts

ERIKS MTC has different capabilities to test and measure following international specifications.

We have capabilities to test and measure:

- Hardness
- Compression Set
- Tensile Strength
- Chemical and Heat ageing
- Ozone Resistance
- Material Composition
- Dimensional Measurements
- Surface Defects
- Material properties at temperatures from -70 °C to 300 °C
- Tests run to ASTM, DIN and ISO standard....
And to customer specific requirements





1. O-rings and rubber parts

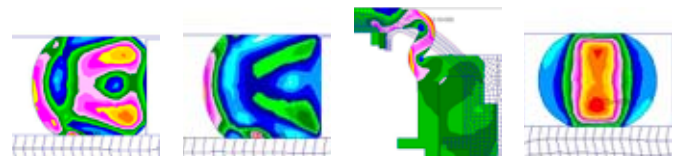
Eriks MTC has the capabilities to measure hardness based on different international norms.

Testing of Hardness

The common method for hardness testing of rubber parts is Shore A. On O-rings or moulded parts the microhardness in IRHD is more specific. The drawing below shows the two methods.



The IRHD is measuring on a 2 mm sheet during 30 seconds. The Shore A is measured on a 6 mm sheet during 3 seconds. The first method is very sensitive for surface imperfections. The second method is difficult for measuring at small cross-sections.





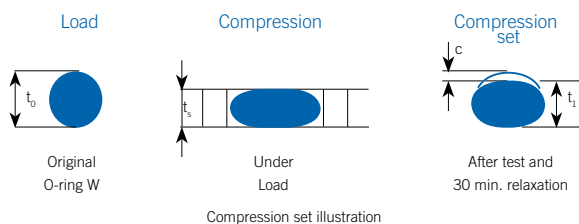
1. O-rings and rubber parts

Compression Set

This chapter discusses the next criteria that must be considered like compression set, hardness, tensile strength, chemical compatibility, thermal effects, pressure, and extrusion. Data and procedures enabling the designer to meet particular requirements or obtain specific performance from the seal will be found in this chapter.

Compression Set

In designing an O ring seal, it is important to determine the compound early, as the compound selected may have an influence on the gland design. The application determines the rubber compound, the primary factor being the fluid to be sealed. But the elastomer must also resist extrusion when exposed to the maximum anticipated pressure and be capable of maintaining good physical properties through the full temperature range expected.



Compression Set and Compression

Compression set is the percentage of deflection that the elastomer fails to recover after a fixed period of time under a specific compression and temperature. Compression set is a very important sealing factor, because it is a measure of the expected loss of resiliency or “memory” of a compound. Compression set is generally determined in air and measured as a percentage of original deflection. Although it is desirable to have a low compression set value, this is not so critical as it might appear because of actual service variables. For instance, an O ring may continue to seal after taking a 100% compression set, provided the temperature and system pressure remain constant and no motion or force causes a break in the line of seal contact. Also, swelling caused by contact with the service fluid, may compensate for compression set. The most severe condition is the combination of high compression set and shrinkage. This will lead to seal failure unless exceptionally high level of compression is employed. Compression set is calculated as follows:

$$C = \frac{t_0 - t_1}{t_0 - t_s} \times 100 \%$$



1. O-rings and rubber parts

Tensile Strength and elongation
Chemical and Heat Aging
Ozone resistance

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Tensile Strength and elongation

We have the highest specification test equipment available that allows us to accurately determine the following properties for any elastomeric material.

- Tensile Strength
- Stress-Strain relationship
- Elongation at Break
- Compressive Strength
- Hysteresis
- Creep

Our Tensometer is a two column design that eliminates any flexing of the test rig that could corrupt test results. We measure elongation using laser technology that allows us to measure true elongation of the test piece without contact issues.

Furthermore we have an environmental chamber that allows us to perform these tests at any temperature from -70 degree C up to 300 degree C and so replicate conditions of the real world application.

In conjunction with chemical and heat ageing we use tensile testing to enable us to better predict the performance of a material over time under real world conditions.

Chemical and Heat Aging

Chemical compatibility tests allow us to identify suitable materials for specific applications. We have the capability to test materials in different liquids at temperature from -40 degree C up to +250 degree C.

As with all our tests we can perform to all recognised international standards or to individual customer specific criteria.

Typical chemical resistance tests include - but are not limited to - changes in hardness, volume, compression set and tensile strength.

Ozon resistance

Often overlooked ozone can have a significant impact on the life of elastomers. Electrical devices (such as electrical motors) produce high concentrations of ozone, and high levels can also be created by climatic conditions.

To identify elastomers with the best Ozone resistance we run tests to recognised international standards such as ISO143-1.



1. O-rings and rubber parts

Material Composition

There are 5 techniques we commonly use for identifying material composition:

- Fourier Transform Infra-red Spectroscopy (FTIR)
- Thermogravimetric analysis (TGA)
- Coupled TGA: FTIR
- Electron Microscopy
- Differential Scanning Calorimetry (DSC)

1. Fourier Transform Infra-red Spectroscopy (FTIR):

Infrared spectroscopy exploits the fact that molecules have specific frequencies at which they rotate or vibrate corresponding to discrete energy level. Therefore by exposing a material sample to a spectrum of infra red frequencies the equipment can detect which frequencies are absorbed by the material and thereby identify which molecules are present.

The benefit of this technique is that it is very quick and requires minimal sample presentation. The limitation of this method is that it is not as sensitive as other techniques. This technique is primarily to identify the base material properties and for batch to batch quality control checks.

2. Thermogravimetric Analysis (TGA):

This test is performed on samples to determine change in weight in relation to change in temperature. As each molecular chain will break down at a specific temperature this equipment is able to accurately determine how much weight loss occurs at a precise temperature and thereby identify the type and percentage of weight of each molecule present in the compound.

This test is used to identify type and percentage weight of molecules in the compound. However as different molecules break down at very similar temperatures it is not always easy to identify specific elements. Therefore it is most usual that we compare the weight loss vs. temperature profile of a sample against a known reference to identify the material composition.



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3. Coupled TGA with FTIR:

To more accurately establish the composition of a unknown material we couple the TGA with an FTIR. In this set up the gas burnt off the material in the TGA is passed through the FTIR.

As the elements in the gas are pure (pyrolised) the sensitivity of the FTIR is enhanced and allows us to make a more accurate identification of what type and quantity of elements make up the compound.

4. Scanning Electronic Microscope (SEM):

This technique involves a high voltage electron beam emitted by a cathode and focused by a group of electrostatic and electromagnetic lenses. As this beam is transmitted through a specimen it carries information about the inner structure of the specimen to the imaging system of the microscope

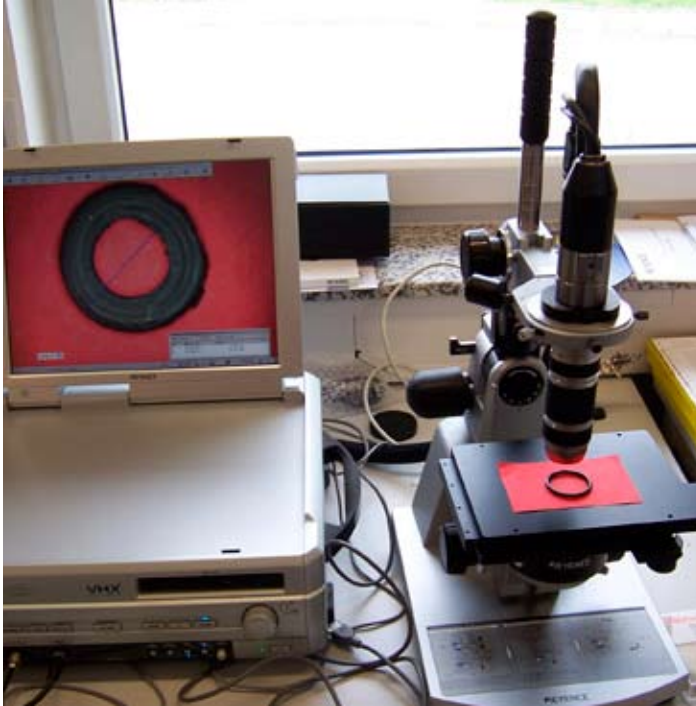
This technique not only allows us to identify specific elements in the material but also allows us to examine the structure and dispersion of elements within the material.

The main benefit of this analysis over the previous techniques is that it allows us to better analyse inorganic elements and to look at the homogeneity of the material. However it is relatively expensive and requires significant sample preparation.

5. Differential Scanning Calorimetry (DSC):

The basic principle underlying this technique is that, when a sample undergoes a physical transformation such as phase transitions, more (or less) heat will need to flow to it than for a reference to maintain both at the same temperature. For example, as a solid sample melts to a liquid it will require more heat flowing in to it to increase its temperature at the same rate as the reference

We mainly use DSC to analyse to establish the low temperature brittleness of elastomers.



1. O-rings and rubber parts

Dimensional Measurement

- Basler Inspection
- Cross-section measurement
- Visual and CMM dimensional measurement
- Surface Defects

Basler inspection machine on surface defects: 100% inspection of O rings:

Via the Basler inspection machine the tolerances and the surface imperfections are controlled by a camera system.

Cross-section measurement:

Via a laser controlled system the cross-section is controlled automatically.

Combined Visual and CMM dimensional Measurement System:

We utilise state of the art computer controlled measurement systems to precisely measure components. Using a combination of visual edge detection and CMM probes we can accurately measure the shape of the most complex mouldings.

This equipment is used for quality control purposes, failure mode analysis and allows us to measure complex shapes and automatically generate engineering drawings for a component.

Surface Defects

Our Finite Element Analysis capability allows us to provide an accurate mathematical prediction of seal performance. This technology allows us to model seal performance on the computer and ensure right first time solutions to sealing applications.

The type of analysis we undertake can be as simple as that of calculating the maximum force required to insert a seal or as complex as predicted a seals performance after many years of service.

We undertake customer specific projects that can combine our material testing and dynamic testing capabilities, in conjunction with FEA prediction, to provide data that provides a high level of confidence the seal will retain its integrity over the designed life of the application.

