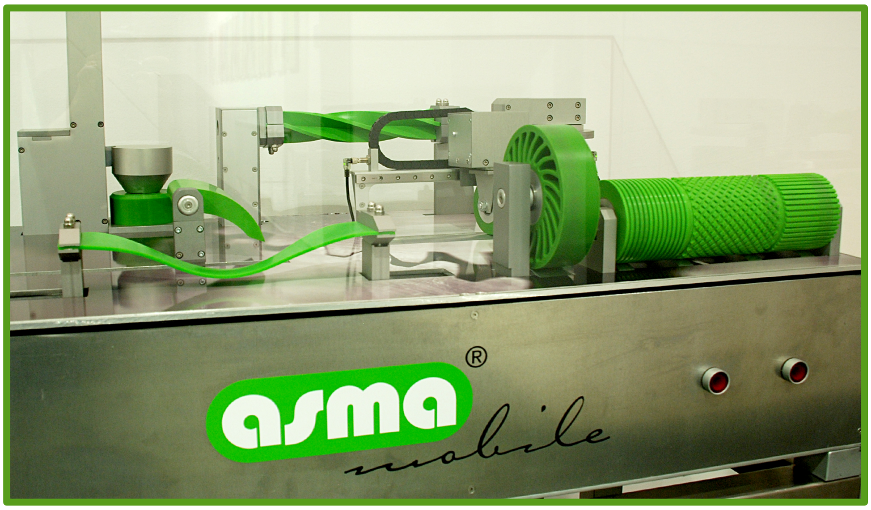
Physical test values

The quality management uses a range of different physical test values, which are essential to ensure a consistent quality of our products.
These values are:

- The hardness (Shore A, Shore D)
- The tensile strength, the elongation at break and tear resistance using an appropriate test device
- The abrasion
- The rebound resilience
- The compression set
- The surface resistance

Moreover, we also assess the deflection of buffer devices using a compression test.



Determination of the hardness

Test according to DIN ISO 48: 2016-09

What should be analysed, is the hardness of samples and products made from elastomers and plastics. The measurements depend on the viscoelastic properties. The test device for hardness is applicable for Shore A values ranging from 10 to 90, whereas harder specimens are analysed using Shore D measurements.
Shore measures the resistance of a material against objects of certain shapes (measuring needle) entering the product with a defined spring force. The scale of hardness comprises a set of units of hardness from 0 to 100, where 0 corresponds to the lowest and 100 to the highest hardness possible.

For the measurement, the hardness tester must be positioned on the sample in a shock-free manner on at least three different points. The measured value can be read after three seconds. The sample should not be thicker than 6 mm, while thinner specimens can also be layered as long as they do not surpass a thickness of 2 mm.

Differing measurement conditions like a missing plane-parallelism, specimens, which are too thin, or a temperature different from the room temperature (23±2 °C) are to be avoided in the test report.

Tensile strength and Elongation at break

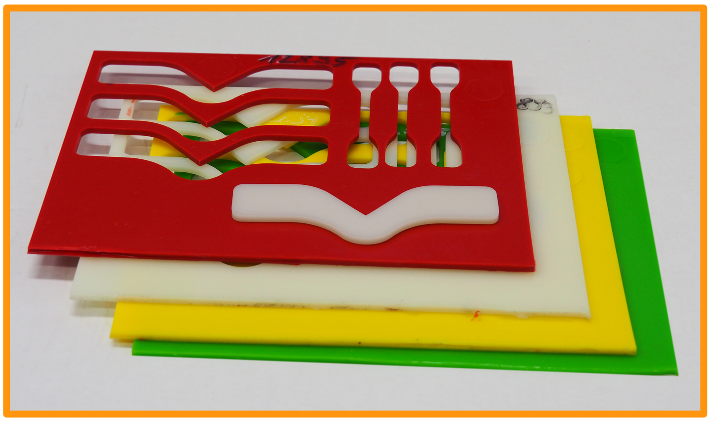
Test according to DIN 53504: 2009-10

The tensile strength σ_{max} is evaluated using a test device. A suitable specimen is put into a holding device and torn apart at a constant velocity until the sample breaks. The tensile strength is the quotient of the highest measured force F_{max} and the initial cross section A_0 of the product. With elastomers, the initially occurring force is usually the maximum force.
The elongation at break ε_R is known as the quotient of the measured change L_R-L_0 in length at the moment of breaking and the initial length L_0.
Our specimen should be the standard bar S2, which is stamped from plates produced especially for the test, paying attention to faultless and smooth edges. At each test, at least three specimens are examined.
The test itself is conducted at room temperature. The specimens should have matured for 3 or 7 days (dependent on the material) by the time it is tested. The sample is put in the testing machine´s holding device vertically and an according computer program needs to be chosen. What can be observed, is the change in force and length when teared. When possible, the force-length change curve is determined, otherwise, the emphasize is on identifying the tensile force at elongation values of 100% and 300%.

Tear propagation resistance with the angle test specimen based on Graves (with cut)

Test according to DIN ISO 34-1:2016-09

The tear propagation resistance test is used with elastomers and serves the purpose of assessing the resistance of a specimen to tear propagation. The ascertained values at certain test conditions can only be used for making relative comparisons and can therefore not be considered indicators for finished construction parts, especially not for their notch behaviour under dynamic stress. The tear propagation resistance depends on the material´s quality, the production impact and the pace of the test.

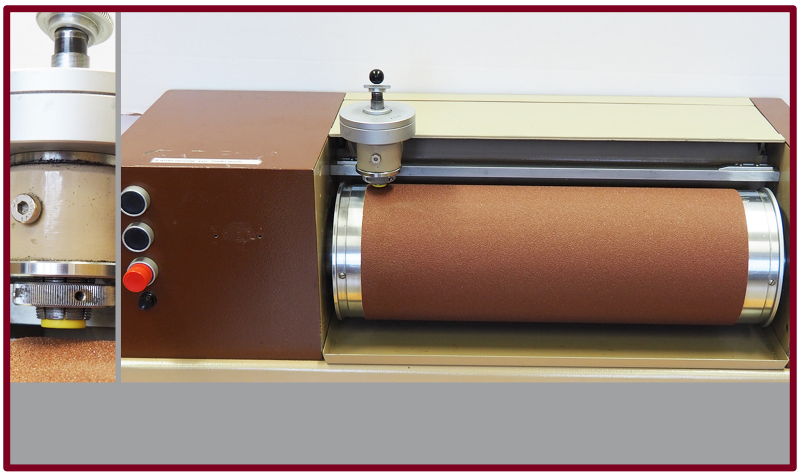


To determine the tear propagation resistance a tensile test machine is used.
Specimens are stamped from plates with a thickness of around 2 mm. Using a razor blade, a cut at the apex of the inner angular reflection of the specimen of 1±0,05 mm should be made. The test should comprise at least three specimens, which should have matured 3 or 7 days (dependent on the material) by the time it is tested. The test takes place at a velocity of around 500 mm/min. The maximum force can be read after three seconds.

Abrasion

Test according to DIN ISO 4649:2014-03

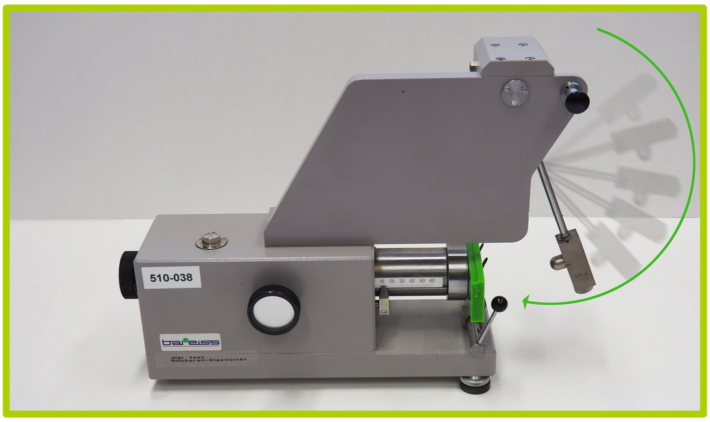
The test procedure serves to determine an elastomer´s abrasive wear. It can be used for comparative tests, to check the regularity of specified products and for specifications. However, the results are not necessarily significant in practice.
The testing device used for the determination of the abrasion consists of a rotatable cylinder with a sheet of test emery paper fixed to it and a laterally adjustable test specimen container.



Discs with a diameter of 16 mm are punched from test plates for the test preparation. Those are usually too thin to be fixed in the holding device, so special plugs with an equal diameter are stuck to the plates using superglue. This plug just serves as a holding device and does not interfere with the result. The specimens are weighted before and after the testing. When fixing the sample in the holding device, the specimen should not protrude from the holding device with more than 2 mm ± 0,2 mm. During the testing, vibrations are to be avoided and adhering burrs should be removed. The difference in weight before and after the test is necessary to assess the abrasion with respect to a control elastomer with a clearly defined abrasion.

Rebound resilience

Test according to DIN 53512:2000-04



This test procedure, which is especially suitable to gain first insights in the dynamic behaviour of the elastomer, analyses the elastic behaviour of elastomers in a hardness range from 30 to 85 Shore A under impact stress. When deforming an elastomer, energy is absorbed and partly regained when the material goes back to its initial shape. The part of the energy that is lost in mechanical energy is translated into heat within the elastomer.

The testing device comprises an anvil, a holding device for the specimen, a pendulum with a peen and a device to display the rebound resilience. The pendulum is suspended so that it moves along a circular path under the effect of gravity. It is important that the pendulum hammer can be hoisted by 90°. Moreover, with a perpendicularly hanging pendulum, the peen should just touch the surface of the specimen.

The device with the anvil must be 100 times as heavy as the mass of the pendulum. To be more, the holding device needs to ensure a tight fit of the specimen. Our instrument possesses a mechanical clamping device.

The sample should have a thickness d of around 12,5± 0,5mm and be casted in one piece or cut out from finished parts. A smooth surface and a plane-parallelism are essentially important.

The test is conducted at 23±1 °C. Furthermore, the specimen is attached to the anvil at the holding device and dropped at the same spot for six times. The first three hits are needed for the conditioning of the system, whereas the median of the hits from 4 to 6 are used to assess the rebound resilience.

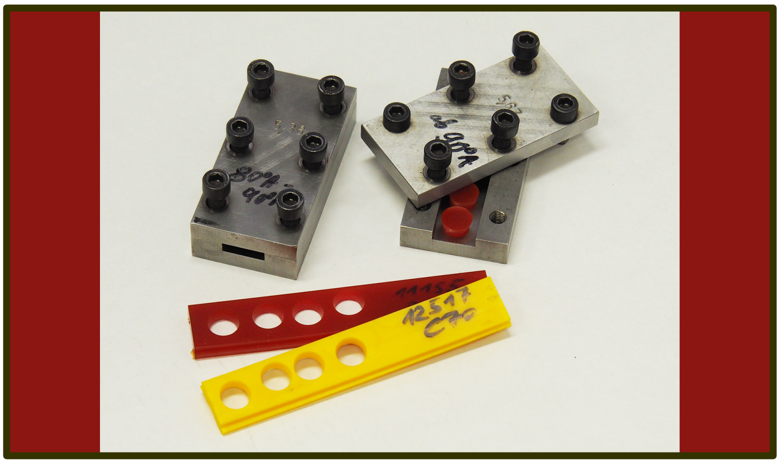
Compression set

Test according to DIN ISO 815-1:2016-09

What is measured when analysing the compression set, is the elastic property of an elastomer when being subject to a long-lasting, constant pressure at a given temperature.

This testing scheme is only applicable to samples with a hardness of 30 to 95 Shore A. The viscoelastic behaviour of sealings, floor coverings, attenuators and buffers of all kinds can be tested. Apart from

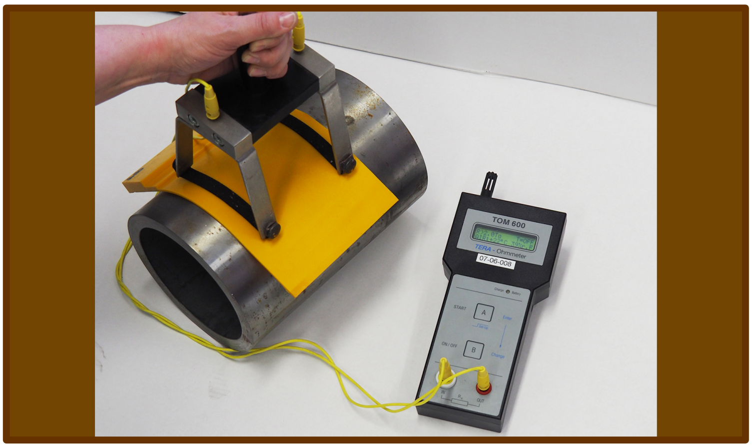
the assessment of the vulcanisation state, this testing method can also be used to measure the freezing and crystallisation behaviour.
The compression set is the deformation of a specimen at a certain point in time after the easing of tension relative to the deformation under tension.
The testing device for the constant deformation consists of at least two even and polished steel plates, which press the two specimens together. The deformations are ranked according to hardness, since there are different spacers (with varying thickness) for certain levels of hardness.



For the test, two different specimens of each material are used and cut out in a cylindric form. A sufficient maturing of the material is essential. Afterwards, the thickness of the layered specimens needs to be assessed, which are then put on the plate. Later, the second plate is added and pressed together, until the pre-determined gap is achieved, and fixed.
We use three prefabricated moulds with a fixed gap respective to the hardness and no spacers. The test device is stored under the predefined conditions (room temperature, high or low temperature). When the test duration is over, the test specimens, one of which was exposed to room temperature, whereas the other was subject to a high (low) temperature, are removed from the holding devices and put on a wooden board, where they should rest for 30 minutes. Afterwards, the thickness is assessed once again. When the assessment takes place under low temperatures, the thickness is evaluated immediately after opening of the test device. The specimen can only be touched using a tweezer, so that the test result is not distorted by any rises in temperature.
Using the measurements before and after the testing, the compression set can be determined.

Electrical resistance

Plastics in general do not possess a high electrical resistance. This leads to electric charge on the surface due to friction, which can result in films sticking together or electronic devices breaking. High electric charge can cause personal injuries, fire or explosions. However, additives can prevent the accumulation of electrical charge.
To assess the electrical resistance, asma uses an ohmmeter with roller measuring brackets fixed on leather straps, which need to be kept moist to enable a current flow. Three seconds after the positioning of the measuring brackets, the resistance can be read on the device. With mini-rollers, we must conduct at least two tests, large rollers (>500 mm) require at least three.
When assessing the volume resistance, the brackets are used without the plugs and are directly connected to the roller shafts.
Instead of brackets, we use a SilverCoating solution, which is applied in two thin layers at a distance of approximately 10 mm. After the solution has vanished (at least 15 min., more would be better), the measurement plugs are put onto the SilverCoating strip and the surface resistance is evaluated.



To discharge electrical charge, two kinds of electrical resistance are important:
The volume resistance (Rv) is measured between the measuring brackets and the roller core.
The surface resistance is assessed between the two poles of the bracket.

Pressure test

The pressure test plays a less important role than the other mechanic testing methods which are conducted by us. It serves the assessment of the material behaviour when exposed to uniaxial compression load.

Generally, the pressure test is not as important as the tensile test, for instance. The reason for this is the relatively little relevance of compression load in practice. Therefore, this test is only conducted in the case of special applications or selected materials such as buffer elements.
The material to be tested is inserted between two pressure plates in a centred manner and subsequently loaded. Most commonly, the nominal compression, which results from the movement of the pressure plates and corresponds to the crosshead displacement, is used. Usually, we define a maximum force, which the specimen is exposed to, or a maximum deflection (e.g. 20 mm or 40%).