Cellasto®

The NVH Solution

# Cellasto®

## A microcellular polyurethane elastomer

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# When NVH

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# is critical

## Cellasto®

Cellasto is the trade name for BASF Polyurethanes' high performance, microcellular polyurethane elastomer. Cellasto components have been used successfully for over 35 years as the NVH (Noise, Vibration, Harshness) solution for automotive chassis and suspension applications such as jounce bumpers, shock absorber top mounts and coil spring isolators. Cellasto is also used in many other applications outside of automotive such as: elevator safety buffers; paper conveying components; friction dampers; sub-frame, motor & body mounts; and more.

The outstanding features are:

- Low compression set
- High volume compressibility with minimum lateral expansion
- Excellent mechanical properties & durability
- Highly versatile - noise isolation at small amplitude & high frequency; vibration isolation at large amplitude & low frequency
- Abrasion resistant
- Resistant to ozone, oils, greases and other aliphatic hydrocarbons

# Progressive load deflection behavior

Cellasto components are based on a microcellular polyurethane elastomer. The molded components are produced in a closed-mold foaming process. Depending on the amount of the material used, the molded components have densities of 350 to 650 kg/m³. The pore volume accounts for 50 – 63% of the molded volume.

The pore diameters are in the range of a tenth of a millimeter and are partially closed.

During compression loading, the pore volume is the first to compress followed by material compression. As compression increases, the material gains rigidity and transitions from flexible/soft to rigid/stiff. This non-linear or progressive load-deflection behavior is depicted in Figure A.

The maximum compression of a Cellasto molded component depends on its density. The spring deflection increases with decreasing density, and can reach up to 80% of the original length of the component.

Large spring deflection and low block height characterize molded components made from Cellasto material.

For Cellasto components, a compressive stress of 4 MPa represents the dynamic continuous load limit. However, the material is not destroyed by a single impact generating stresses of up to 20 MPa.

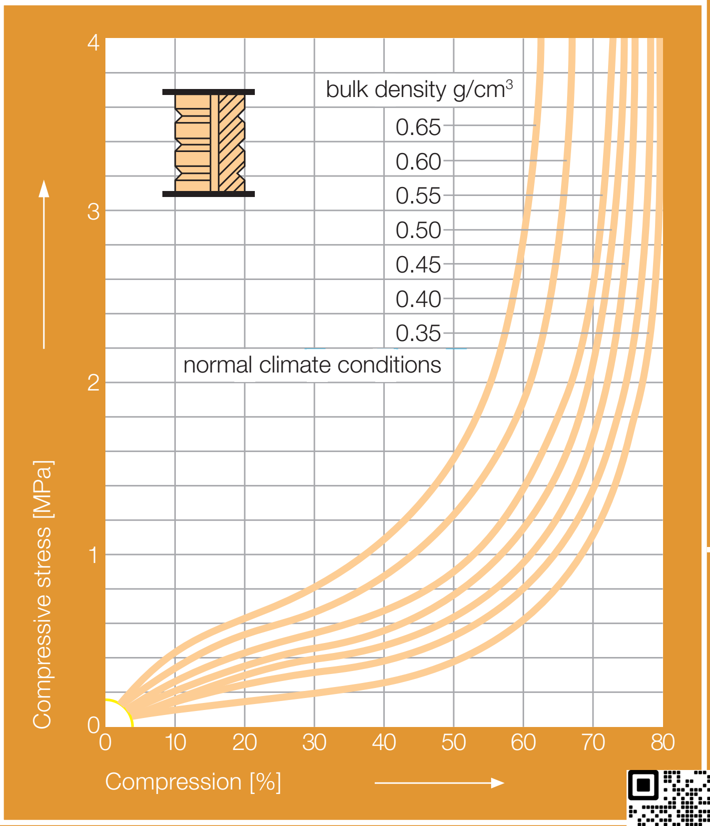
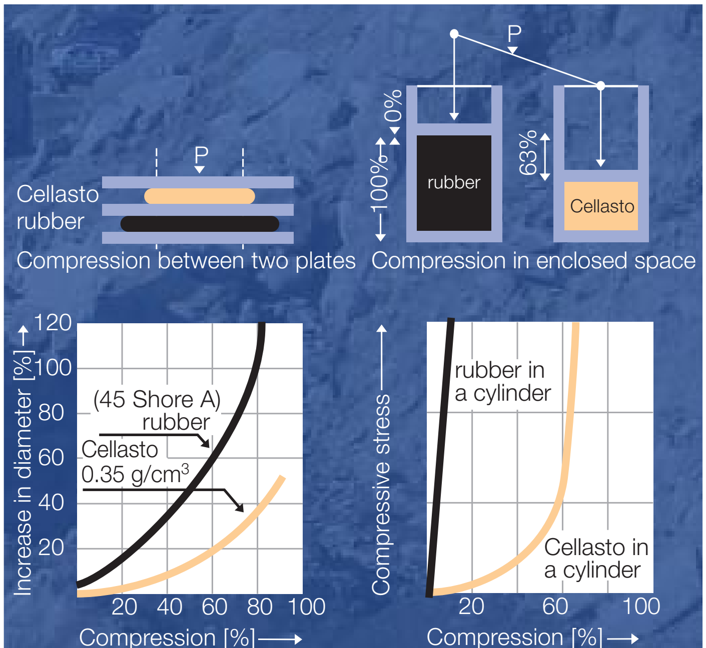



*Figure A. Progressive pressure-compression behavior*

# Low lateral expansion and high volume compressibility

Compact elastomers show large lateral expansion when compressed. However, this is not the case with cellular polyurethane elastomers. They are characterized by low lateral expansion. Cellasto spring elements are therefore suitable for applications where the surrounding structural space is confined or where the spring is located within an enclosure.

***Figure B.***
*Low lateral expansion and high volume compressibility*




Scale representation of the compression (compressive deformation of Cellasto and rubber between two plates)

Material grades:
Cellasto and rubber in the initial compression range (rubber 45 Shore A. 1.18 g/cm$^3$; Cellasto: 0.35 g/c

# Characteristic curves as a function of temperature

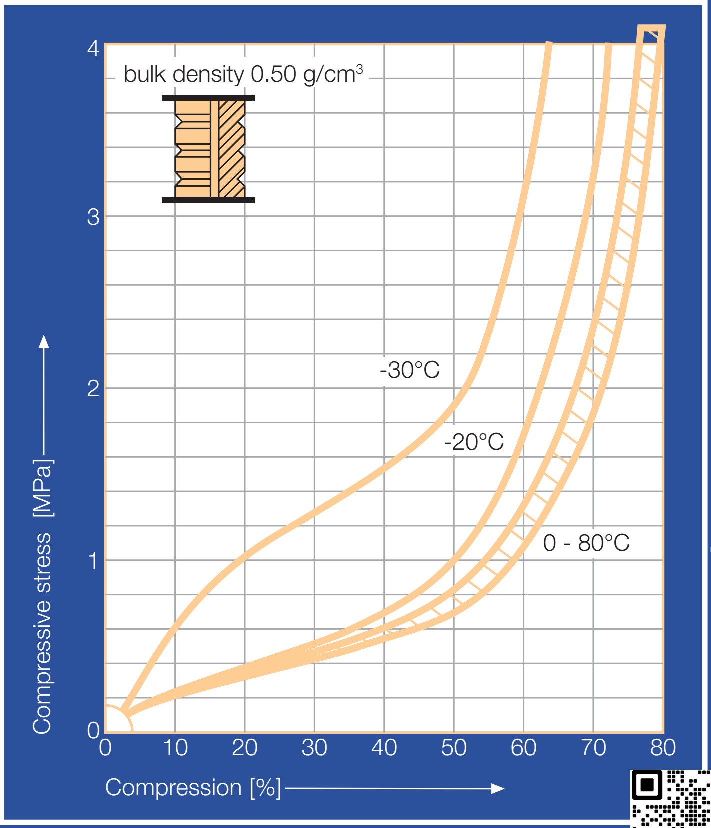
The mechanical properties of plastics are temperature dependent, and are also subject to temperature limits.

Cellasto components gradually stiffen with decreasing temperature and are suitable for applications to about -30°C (-22°F).

Cellasto components that must maintain their elasticity at low temperatures can be manufactured from Cellasto specially formulated for cold flexibility. They are then suitable for applications to approximately -40°C (-40°F).

Cellasto components gradually soften with increasing temperature. As demonstrated in Figure C, the characteristic curve for Cellasto components changes only slightly up to a temperature of approximately 80°C (176°F), making Cellasto suitable for use in ambient temperatures of up to 80°C (176°F) without loss in elasticity performance.

*Figure C. Characteristic curves as a function of temperature*



# Temperature increase caused by damping

The material dampens a portion of the mechanical energy input and converts it to heat. The dissipating heat thereby increases the temperature in the stressed molded component. This temperature should not exceed 110°C (230°F).

An equilibrium temperature is reached for molded components subjected to stresses of constant frequency and constant spring deflection. The family of curves depicted in Figure D is an example of the molded component temperature as a function of spring deflection and frequency. These conditions are taken into consideration in the development phase to determine if the critical temperature may be reached for a particular application.

Cellasto components which become stiffer at low temperatures regain their elastic properties as the mechanical energy is converted to heat and the part temperature increases.

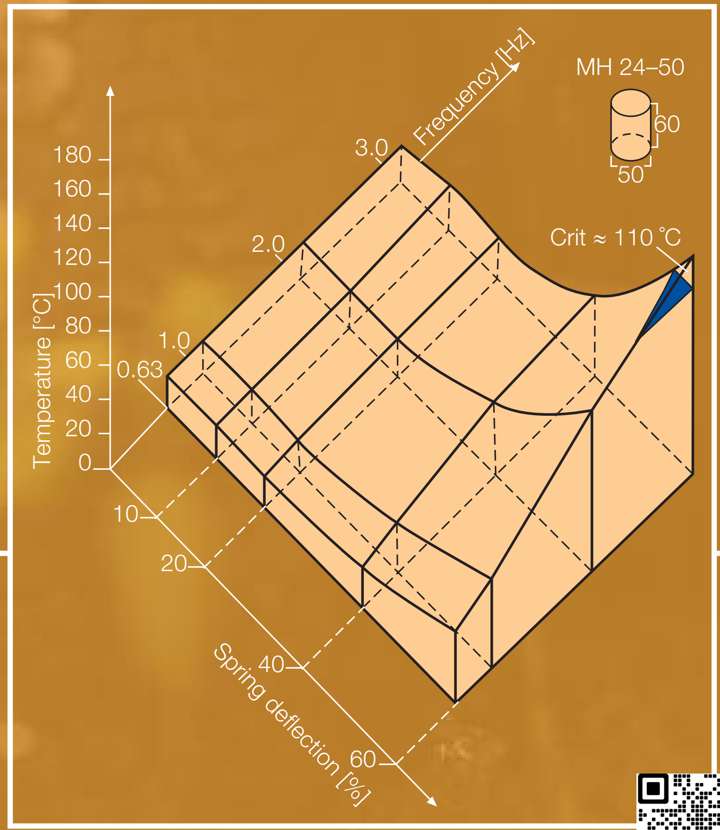



***Figure D.*** *Temperature increase caused by damping*

# Static load-related creep

When designing molded Cellasto components, the increased compression over time at constant load, or creep, must be considered from the outset. The scale of creep, in comparison with reversible compression, is extremely low and can generally be disregarded in standard applications.

The creep measurements shown in Figure E were carried out over a period of years, and in this example, demonstrate the small change in compression under constant load. In addition, the linearity of the curves allow for extrapolation beyond the measurement period.

# Dynamic load-related creep

Under dynamic loading, deformation or compression is determined by the load frequency and number of load cycles. Compression increases with increasing load frequency. The increasing frequency raises the temperature of the Cellasto test specimen causing the material to become softer and more flexible.

The curve in Figure F flattens out in the load controlled test. The low increase in compression equals the permanent set. At the end of the test, the sample virtually recovers to its original height.

***Figure E.*** *Static load-related creep*

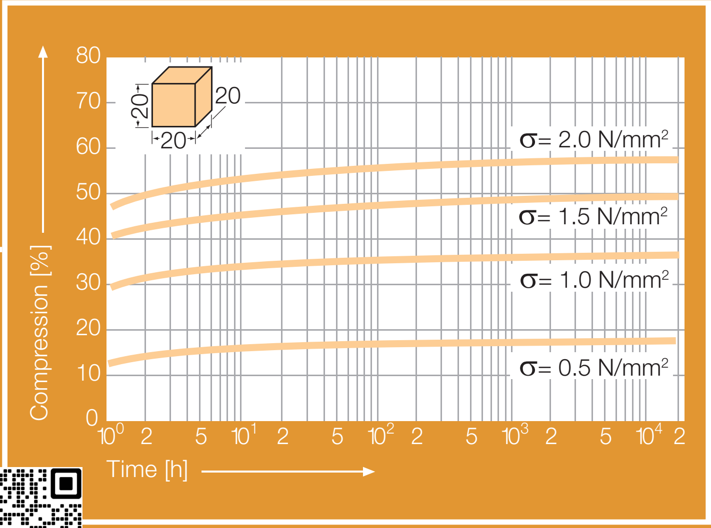
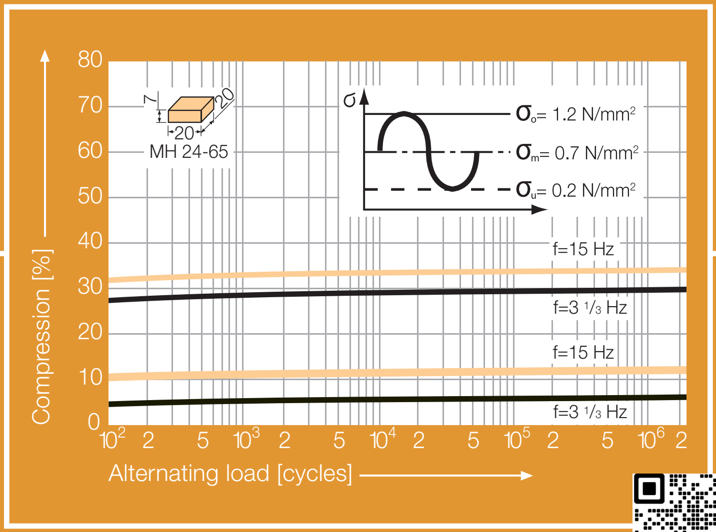



***Figure F.*** *Dynamic load-related creep*



# Amplitude dependent damping

In order to provide optimum isolation performance in the field of Noise, Vibration and Harshness (NVH), materials need to have low damping properties at high frequencies. At those frequencies the amplitudes are usually small. This is the opposite of large movements at low frequencies where the material requirement is rapid damping for dynamic and safe driving purposes. These seemingly contrasting requirements are met equally well with the use of Cellasto.

Figure G clearly shows the steep rise in “loss angle” (a measurement of damping), with the increasing amplitudes for all material densities.

# Dynamic stiffening

Cellasto exhibits a very low dynamic rate ratio even at high frequencies. Figure H shows the dynamic modulus values to a basis of 1 Hz. The data was obtained by statically precompressing a cylinder by 30% of its original height. A sinusoidal load with an amplitude of 0.1 mm is then applied. The dynamic rate ratio decreases with increasing density.

This quality makes Cellasto an ideal material for mounting elements to isolate noise and vibrations.

***Figure G.*** *Amplitude dependent damping*

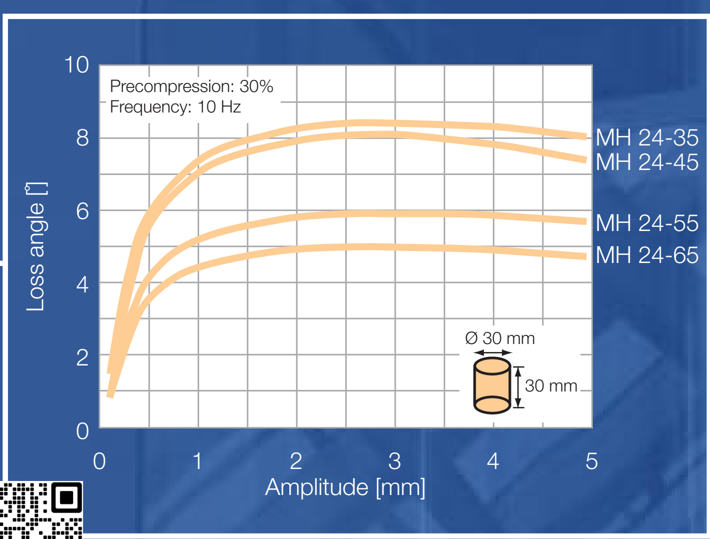
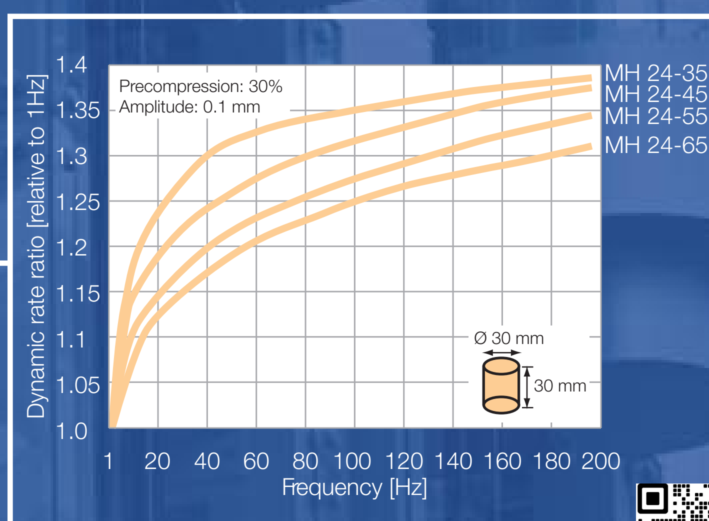



***Figure H.*** *Low dynamic rate ratio*



## Material characteristics

| Property | Tested in accordance with | Material designation: Cellasto MH24 | | | | | | | Dimension |
|---|---|---|---|---|---|---|---|---|---|
| | | -35 | -40 | -45 | -50 | -55 | -60 | -65 | |
| Bulk density | ASTM D3574, A | 350 | 400 | 450 | 500 | 550 | 600 | 650 | kg/m$^3$ |
| Tensile strength | ASTM D3574, E | 3.0 | 3.5 | 4.0 | 4.5 | 5.5 | 6.5 | 7.0 | MPa |
| Elongation at break | ASTM D3574, E | 350 | 350 | 400 | 400 | 400 | 400 | 400 | % |
| Tear Strength | | 8.0 | 10.0 | 12.0 | 14.0 | 16.0 | 18.0 | 20.0 | N/mm |
| Compression set | | | | | | | | | |
| deformation at 50%/70h/20°C | ASTM D3574, D | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | % |
| deformation at 50%/22h/70°C | ASTM D3574, D | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.5 | 5.5 | % |

***Cellasto is the NVH***

## Our Commitment

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- In-house technical expertise
- Customized solutions
- Collaboration between your engineering teams and BASF experts
- Value added products through increased driving comfort, light weighting and noise reduction

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