Sealing Design Guide

ROGERS CORPORATION

PORON® Urethane &
BISCO® Silicone Materials

Successful enclosures rely on a gasket's ability to make a seal.

This guide, further supported by the Technical Sealing Guide, presents comparison test data on sealing materials while highlighting essential criteria for long-term sealing solutions in many enclosure applications. The accompanying research acts as a reference for material selection, while serving to better educate the market on Rogers' materials.

Enclosure Specifications

Seals are used in industrial, electrical, and/or electronic applications to keep in what's meant to be in and keep out what's meant to be out.

Four types of gaskets – strip, form-in-place, die-cut, extrusion – help to seal according to the requirements of four of the most common standards:

- Underwriters Laboratories® (UL): Ratings are similar to NEMA
- National Electrical Manufacturer's Association (NEMA): Ratings are numbered. Most common for indoor applications are 12 and 13 while 3, 4, 4x, 6 and 6P are most common for outdoor applications.
- International Electrotechnical Commission (IEC): IP-XX (ingress protection) codes specify protection required.
- Canadian Standards Association (CSA)

*Note: NEMA only provides guidelines, not certification

Multiple factors, including enclosure and gasket design, contribute to successful sealing, but material selection is also critical. If the gasket leaks or must be replaced, the certification will be lost, resulting in lost time and increased expenses in addition to the damage incurred to the components within.

Material Specifications

Many engineers prefer to use gasketing materials like PORON® Urethanes and BISCO® Silicones that are already certified for use under several standards including UL-508 (industrial control equipment), UL-1572 (HID lighting fixtures), and especially UL-50E (electrical enclosures) with testing done to the new periodic recompression standard. These certifications enable designers to design-in gasket material without testing the material itself, effectively simplifying the screening process.

Materials

Common materials used to seal enclosures and devices include:

- Silicone
- Neoprene
- Polyurethane
- Polyethylene
- Vinyl Nitrile
- EPDM
- PVC

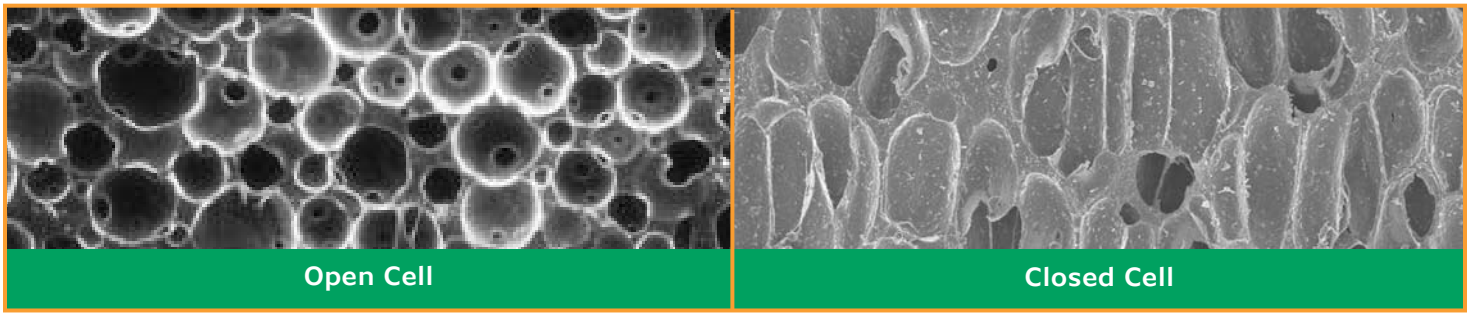
Each chemistry offers different properties that result in different long-term sealing capabilities. Compressibility, environmental exposure, sealing effectiveness, and specifications should be considered when selecting a material.

Cell Structure

Sealing effectiveness is not dependent on an open or closed cell structure. Material selection should be based on performance, not whether a majority of the cells are completely closed.

Open-cell materials typically resist compression set and force relaxation better than close-cell materials, but are not as effective at resisting water absorption in an uncompressed state. However, at a certain level of compression the small openings in the cell walls of an open-cell foam will "close off", resulting in an effective seal.

This guide will help to determine the appropriate compression needed for “closure” of these cells while also looking at how other physical properties affect long-term sealing performance.

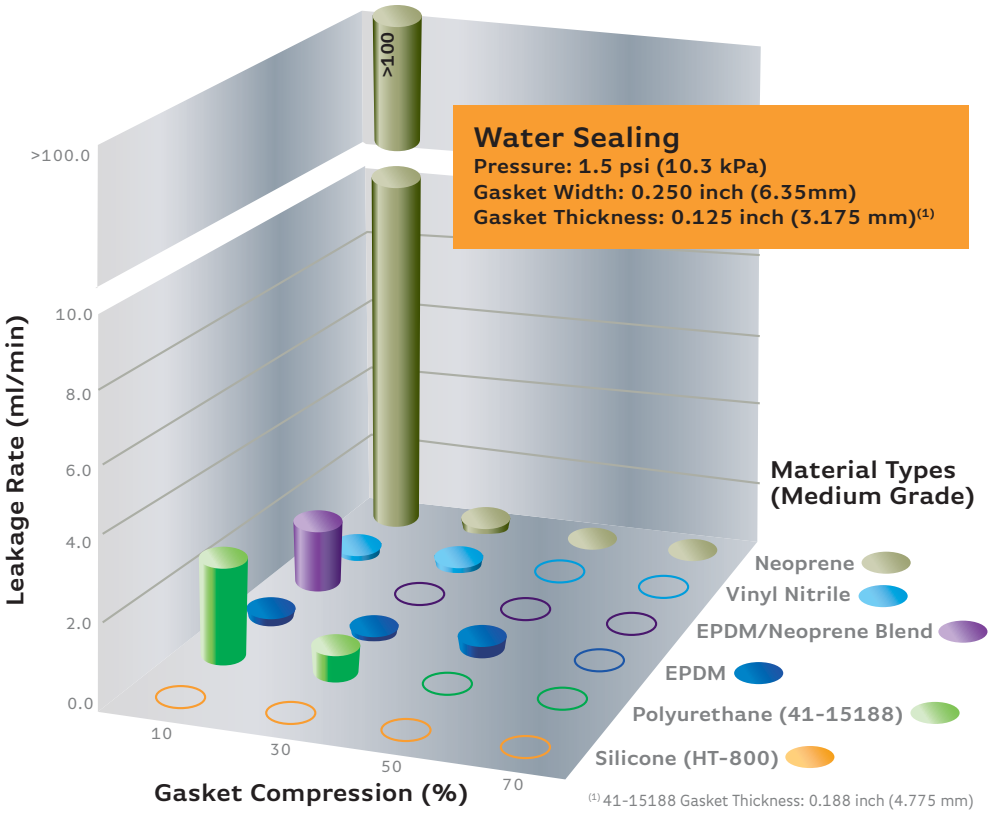


Open Cell | Closed Cell

Sealing

Through an extensive water sealing study, many materials were evaluated for initial sealing effectiveness. A high demand scenario was simulated with 1.5 psi (10 kPa) of water pressure on a 0.250 inch (6.35 mm) wide gasket using materials of medium firmness compressed to various compressions. The following chart shows the results:

At ≥ 50% compression, most materials formed a good seal, but seal quality decreases as compression decreases.



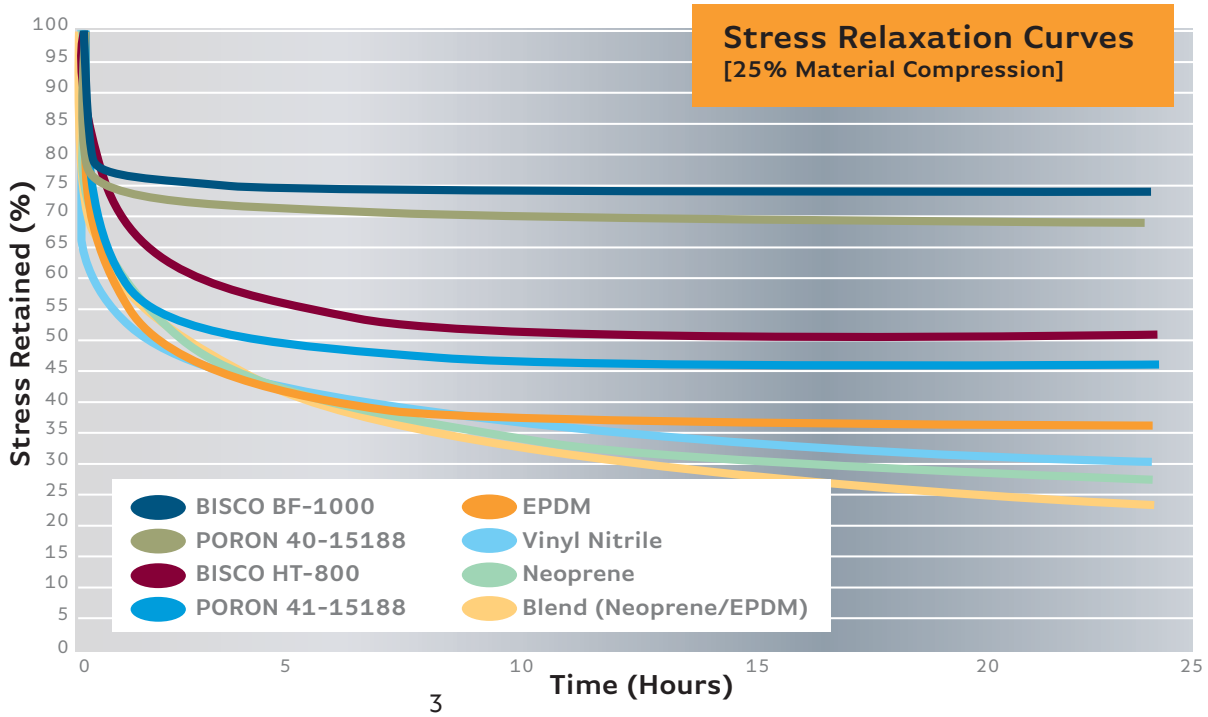
Long-Term Sealing Effectiveness

Stress relaxation and compression set resistance are two key attributes that significantly impact long-term performance.

Stress Relaxation

A material's loss in force resistance over time under continuous compression is exhibited by all cellular materials; however, some lose a greater percentage of their original force than others.

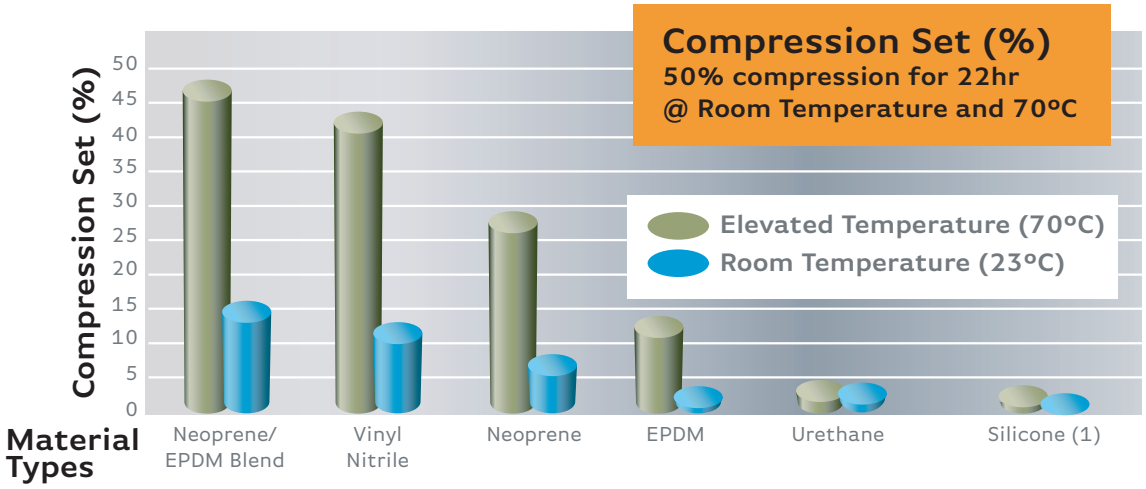
Rogers' materials lose less force and level out quickly unlike other materials tested.



Compression Set Resistance (C-Set)

Material rebound after constant deflection for a specified time and temperature provides a similar conclusion.

Elevated temperature is used to simulate accelerated aging. PORON Urethane and BISCO Silicone exhibit minimal C-Set. All other test materials take a significant C-Set.



(1) Silicone Elevated Temperature: 100ºC

What effect can these properties have on long-term sealing and performance?

Significant stress relaxation could result in compromised sealing if a gasket no longer fills a gap with enough force. Greater force retention can help to keep a consistent closure force on a door or panel. A significant reduction in the closure force may raise concerns about the gasket's performance.

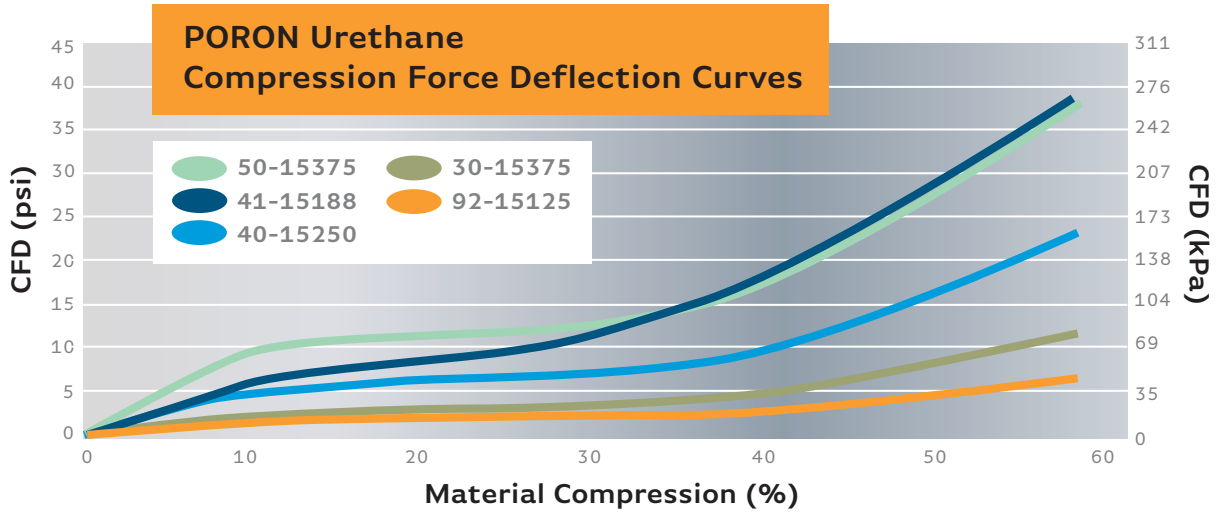
Compression set resistance becomes even more critical when a gasket is exposed to compression cycling. If a gasket takes a significant C-Set, sealing may be compromised as a result of the decreased thickness. This normally takes place over time, and is not always evident during initial testing.

Material Selection

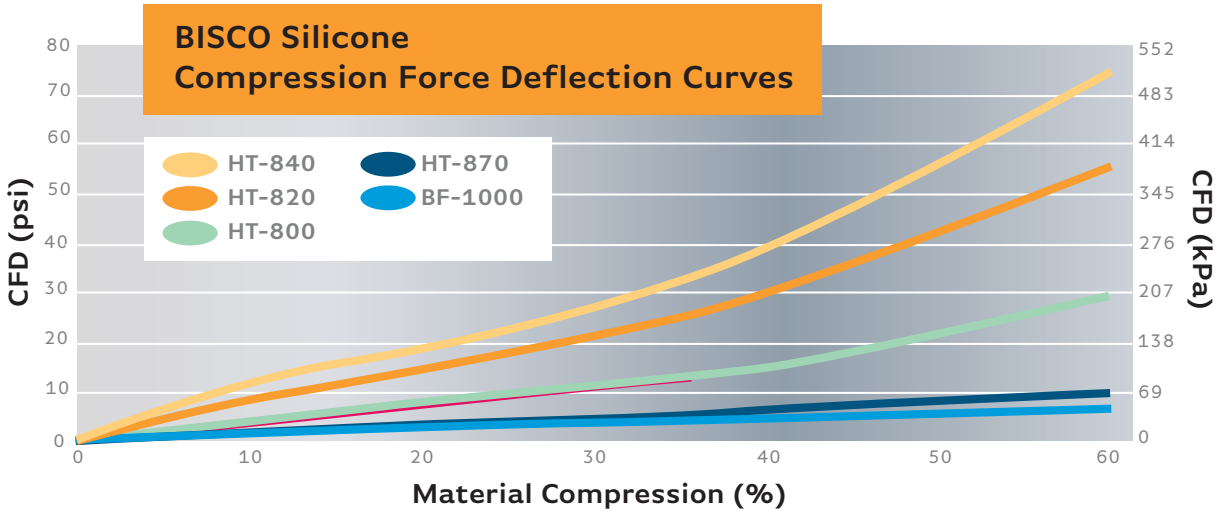
Understanding the key requirements in an application is critical when selecting the right material. When PORON Urethane or BISCO Silicone is determined to be the best material for the application, the optimal grade and thickness must be selected.

Compression Force

Compression Force Deflection (CFD) curves show the force of each material at various compressions which helps identify at what point the compression resistance may become unmanageable.

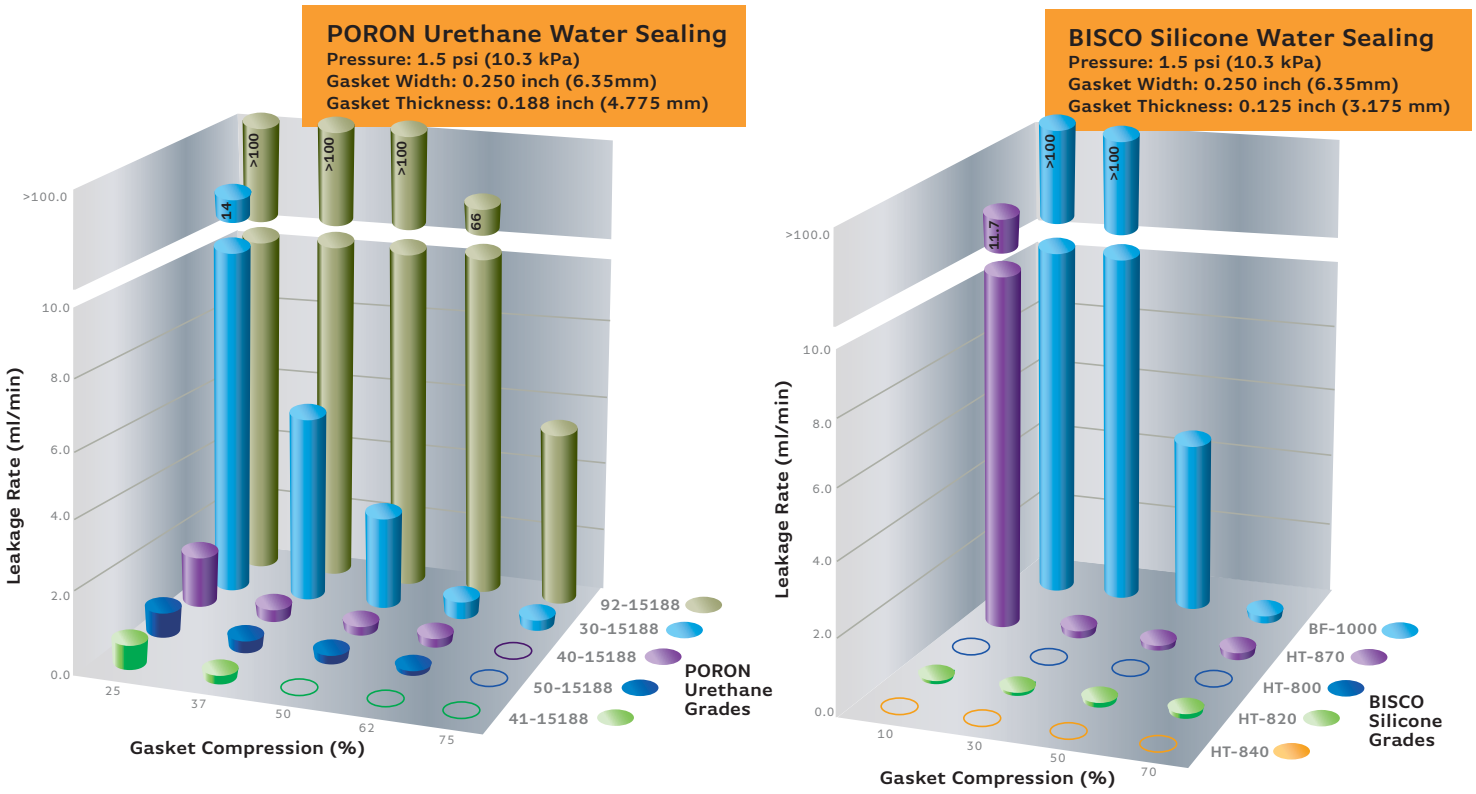


PORON Urethane and BISCO Silicone material offerings are available with a wide range of compression force deflection values and grades ranging from very soft to very firm making the material selection process much easier.



PORON Urethane / BISCO Silicone Sealing Data

Rogers' water sealing graphs indicate the minimum tested compression required to achieve an effective seal at the specified conditions. Sealing results shown are based on a stringent water pressure of 1.5 psi. With sealing correlating to pressure, results become more favorable as water pressure is decreased. The following graphs show comparisons between the various grades of PORON Urethane and BISCO Silicone.



General Sealing Conclusions

a) Sealing improves as gasket compression increases

b) Sealing improves as gasket width increases

c) Sealing improves as the water pressure decreases

PORON Urethane and BISCO Silicone exhibit superior physical properties, excellent sealing characteristics when compressed, and are certified by UL for gasketing and flammability. Both materials provide effective and dependable long-term sealing solutions.

For additional material selection recommendations, contact your local Rogers' Sales Engineer and/or local Rogers' Preferred Converter. Their expertise across a wide range of materials, markets and applications can prove to be helpful in selecting the right solution. Additional information can be found in the Technical Sealing Guide available on the Rogers Corporation website.

World Class Performance

Rogers Corporation (NYSE:ROG) is a global technology leader in specialty materials and components that enable high performance and reliability of consumer electronics, power electronics, mass transit, clean technology, and telecommunications infrastructure. With more than 178 years of materials science and process engineering knowledge, Rogers provides product designers with solutions to their most demanding challenges. Rogers' products include advanced circuit materials for wireless infrastructure, power amplifiers, radar systems, high speed digital; power electronics for high-voltage rail traction, hybrid-electric vehicles, wind and solar power conversion; and high performance foams for sealing and energy management in smart phones, aircraft and rail interiors, automobiles and apparel; and other advanced materials for diverse markets including defense and consumer products. Headquartered in Connecticut (USA), Rogers operates manufacturing facilities in the United States, Belgium, China, Germany, and South Korea, with joint ventures and sales offices worldwide.

For more information visit www.rogerscorp.com/hpf

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