



VIP | TUNNEL SEGMENT GASKETS





GLOBALLY APPROVED SEALING GASKETS

VIP Polymers Ltd was founded in 1923 specialising in seals and gaskets for high pressure potable water applications. The company has developed its specialist knowledge and expertise, to become recognised as one of the world's leading manufacturers of gaskets for potable and drainage water applications.

VIP's extensive manufacturing capability has quality systems certified by BSI to ISO 9001 which includes our own laboratories where we design, develop and test rubber formulations, on-site mixing facilities that create a wide range of rubber compounds, and moulding and extrusion equipment that converts the uncured compound into the final product.

VIP is a global supplier with its head office in Cambridgeshire, UK where all VIP tunnel segment gaskets are manufactured.

VIP's tunnel segment gaskets are being used successfully in tunnels and shafts used for transport and water applications around the world.



PIPELINES

For the transportation of drinking and dirty water



TUNNELS

Ensuring they remain watertight



RAIL

Noise suppression & anti-vibration components

ELASTOMERIC TUNNEL SEGMENT GASKETS (TSGS)

The Benefits of VIP's Tunnel Segment Gaskets

- Easy to install
- Available in a variety of compounds, profiles and types
- Can be manufactured to fit any segment profile
- Create an effective seal once segments have been installed
- Designed to work even with fluctuating water levels or ground movement
- Have a long service life which is underpinned by resistance to microbiological or chemical environments

Elastomeric (rubber) gaskets are one of the most effective waterproofing systems for segmentally lined tunnels and shafts where protection is required against water ingress or for retention in tunnels used for fluid transport or storage.

The gaskets are manufactured from high-grade rubber compounds, which meet many internationally recognised standards including EN681-1 (the material requirements standard for pipe and joint seals used in water and drainage applications). The complex section of the gaskets is designed to provide the energy within the seal, generating the sealing function once the segments have been assembled, whilst minimising closure forces.

VIP's gaskets are typically designed to collapse into the segment groove once the segments have been fully closed. Each profile manufactured by VIP has been specifically designed so that the volume of rubber does not exceed that of its corresponding groove.

VIP offers a range of gaskets to suit various applications and specifications. In addition, its team of technical engineers have the experience and detailed knowledge to design bespoke gaskets for unique conditions. VIP can also prove the gasket in our dedicated test facility, to simulate the segment assembly, build conditions and sealing pressures as specified by the design.



EN 681-1



CAST-IN GASKETS



Cast-in gaskets are integrated with the segment during the casting process as opposed to being glued into a pre-made groove once the segments have been cast. Cast-in gaskets are cleaner to work with and are rapidly becoming the preferred choice of designers and pre-casters by eliminating the need for applying adhesive while providing cost and time savings by removing extra installation processes.



Cast-in seals 'anchor' themselves to the segment as the concrete surrounds the legs at the base of the seal. This process ensures a consistent positioning of the gasket around the segment.

The design of the legs ensures that the seal is secure in the segment and will not move during or after the segment is cast. This is especially important during installation of the tunnel segments.

UNIQUE CORNER JOINTING SYSTEM

Cracked or damaged segments caused by corner point loading has traditionally been a problem faced by tunnelling engineers and designers. VIP's Cast-in gaskets are designed specifically to eliminate this due to the unique way the corners are manufactured.

This has allowed us to dramatically reduce the volume of rubber at the corners, thus ensuring the gasket can collapse into the groove.



CAST-IN GASKETS

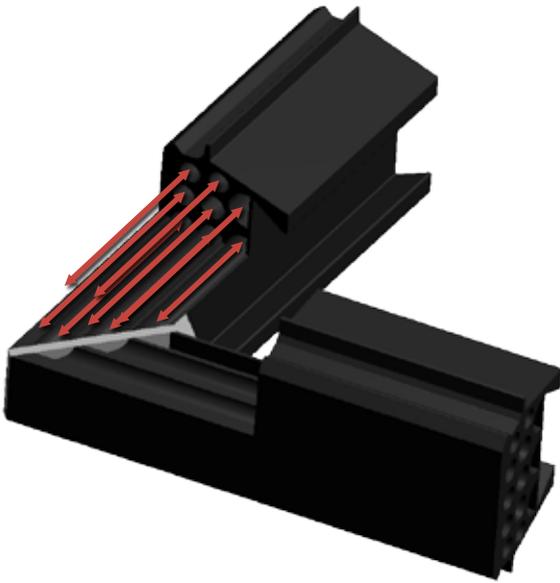


MINIMISING RUBBER VOLUME AT THE CORNER JOINT

VIP's unique jointing process results in the profile of the gasket being maintained up to the corner edge.

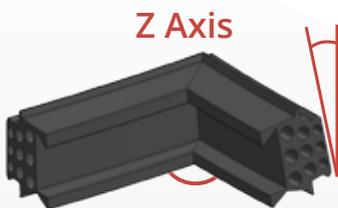
This differs to a traditional shot-joint corner which results in excess rubber travelling along the gasket voids during the moulding process. This results in making the gasket unable to compress at the corners due to the voids being full of rubber, creating a 'solid' corner.

The energy exerted at these points during closure of the segments can lead to cracks and spalling as it dissipates through the segment, finding the path of least resistance.



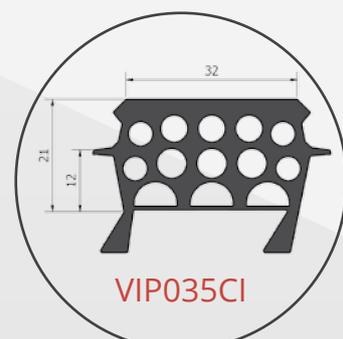
CORNER ANGLES THAT PERFECTLY MATCH THE SEGMENT

VIP can manufacture corners for Cast-in gaskets to obtuse, acute and 90° angles, therefore matching the profile of the segment design perfectly.



Segment design can differ with each project. Recognising this and the importance of the gasket matching the exact shape of the segment, VIP can also vary the profile orientation along the Z axis.

The following profiles comprise VIP's Cast-in core range. Further profiles are available or can be developed on request.

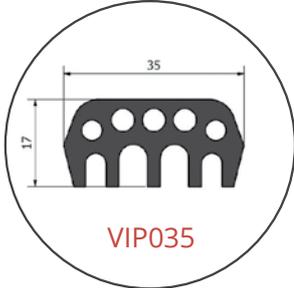
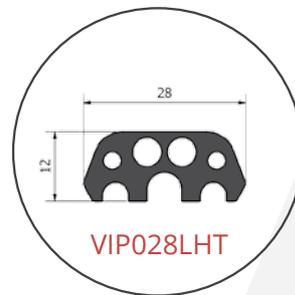
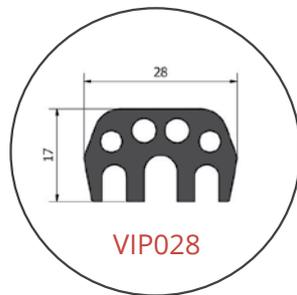
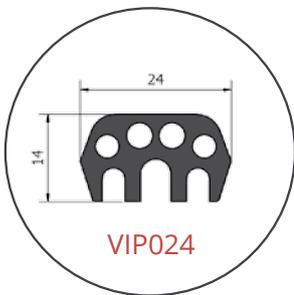


GLUED-IN & GASKETS



Traditionally the industry has used elastomeric gaskets that are glued into grooves cast into concrete segments which have a groove in place to accommodate the gasket. VIP manufacture a range of profiles which are compatible with many pre-existing segment moulds.

The following profiles comprise VIP's Glued-in core range. Further profiles are available or can be developed on request.

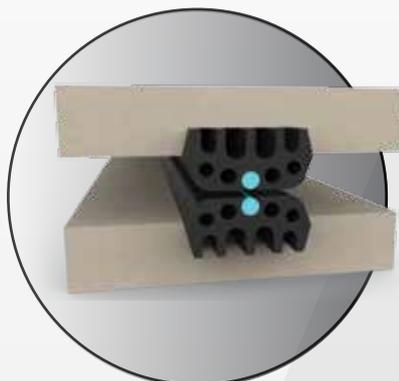


As per VIP's Cast-in gaskets, the Glued-in profiles have corner joints that can be manufactured to match the angles of the segment design. The corners are formed using an injection process using moulds that match the exact profile of the extruded gasket, ensuring that when the segments are joined together, the gasket can collapse into the groove and the load on the corners is equal to the rest of the gasket.

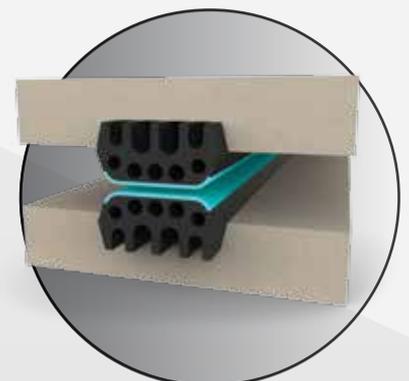
HYDROPHILIC GASKETS

VIP also manufacture hydrophilic gaskets for both our Cast-In and Glued-In profiles. Hydrophilic compounds are designed to swell when they come into contact with water which can close the gap between the gasket faces. VIP supply hydrophilic gaskets in 2 main formats:

Hydrophilic cord inserted into a slot in a TSG prior to installation



Hydrophilic strip integrally bonded onto an elastomeric TSG



VIP's tunnel segment gaskets are being used successfully in numerous tunnels and shafts used for transport and water applications around the world.



RUBBER COMPOUNDING AND MANUFACTURE



VIP's tunnel segment gaskets are manufactured in our Cambridgeshire headquarters in the UK, which is approved by The British Standards Institute to ISO 9001 using the latest manufacturing equipment and processes.



RUBBER COMPOUND

VIP compounds its own rubber at our on-site mixing facility to proven formulations developed by VIP's rubber technologists. The compounds used meets WRAS and other internationally recognised standards where required.

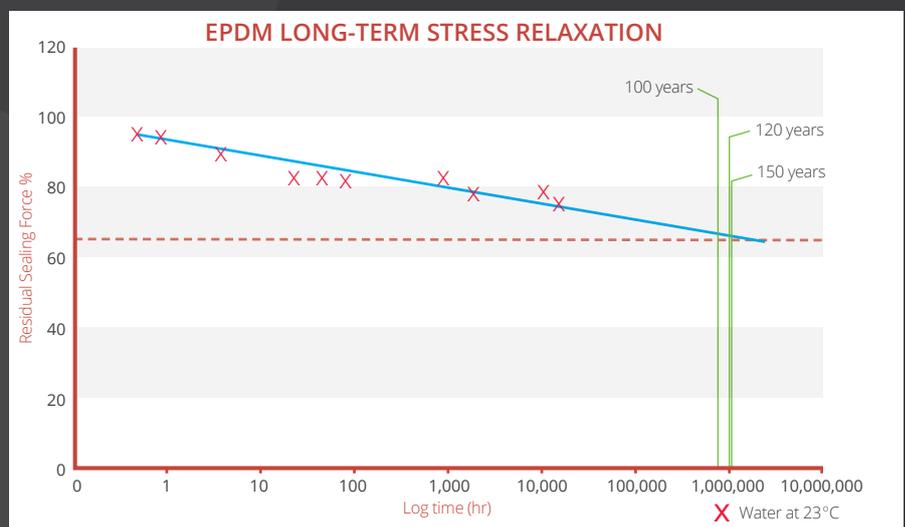
Predominantly EPDM is the rubber of choice for tunnel segment gaskets as it provides both the sealing and material qualities required. However in instances where resistance to more aggressive chemicals is required, VIP can compound and manufacture from NBR (Nitrile).



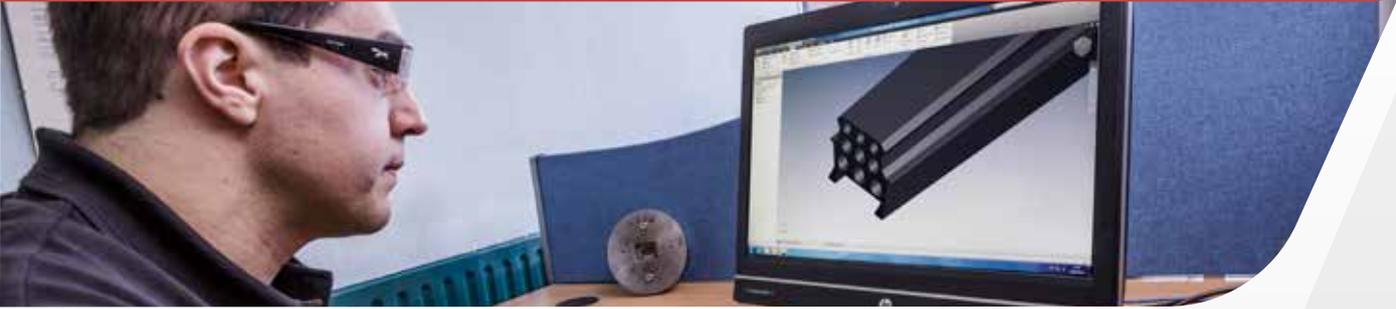
LIFE EXPECTANCY

A study carried out by Loughborough University in the UK on behalf of VIP concludes that one of the major elements affecting the gaskets' long term sealing ability is 'Stress-Relaxation'. This is the measurement of the force that a compressed gasket exerts over time which is crucial to the sealing performance.

The research also revealed that with correctly formulated and processed rubber, as supplied by VIP, the life expectancy of our gaskets is in excess of 120 years.



Extracted from 'Stress Relaxation in Compression' by Professor A.W.Birley, Loughborough University of Technology



EXTRUSION

VIP's gasket profiles are extruded through one of the most modern microwave curing lines. This manufacturing technique creates the profile length by forcing the rubber through a die prior to curing. This is then cut to lengths determined by the segment requirements.



CORNER JOINTS

All VIP's corner joints can be manufactured in obtuse, acute and 90° angles to perfectly fit with the corresponding segments. Using the latest laser guided cutting technology enables virtually any joint angle to be achieved and their design ensures that the sealing properties and closure forces match the extruded gasket section.



QUALITY INSPECTIONS

In order to ensure the final product meets the high standards set by VIP, physical checks are made by our quality team both during the manufacture process and on final completed gaskets against:

- Profile Size - to ensure a consistent profile shape during the extrusion process
- Joint Integrity - to check the strength of moulded joints
- Geometric Requirements - to check the shape of the finished gasket meets the segment design requirements.

IN-HOUSE TESTING

VIP's laboratory and quality team undertake various tests throughout the manufacturing process of our TSGs, ensuring that our products are produced to the highest standard and perform as expected. Tests are undertaken on both the uncured rubber compound prior to manufacture with further tests on the final extruded product which check for:

- Hardness
- Tensile strength
- Elongation
- Compression set
- Dimensional checks
- Stress relaxation

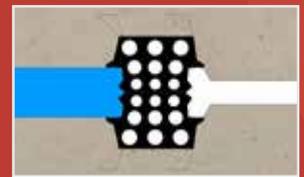
Completed gaskets are finally checked on specially designed jigs to ensure they are the correct dimensions for the corresponding segment shape.



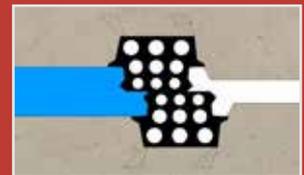
Gaskets are also tested at our UK headquarters in specially designed test rigs, which replicate the build of a segment ring in order to measure their performance.

VIP undertake a range of tests using T & X rig testing in order to replicate closure forces and pressures experienced both during the tunnel build and throughout the service life of a tunnel.

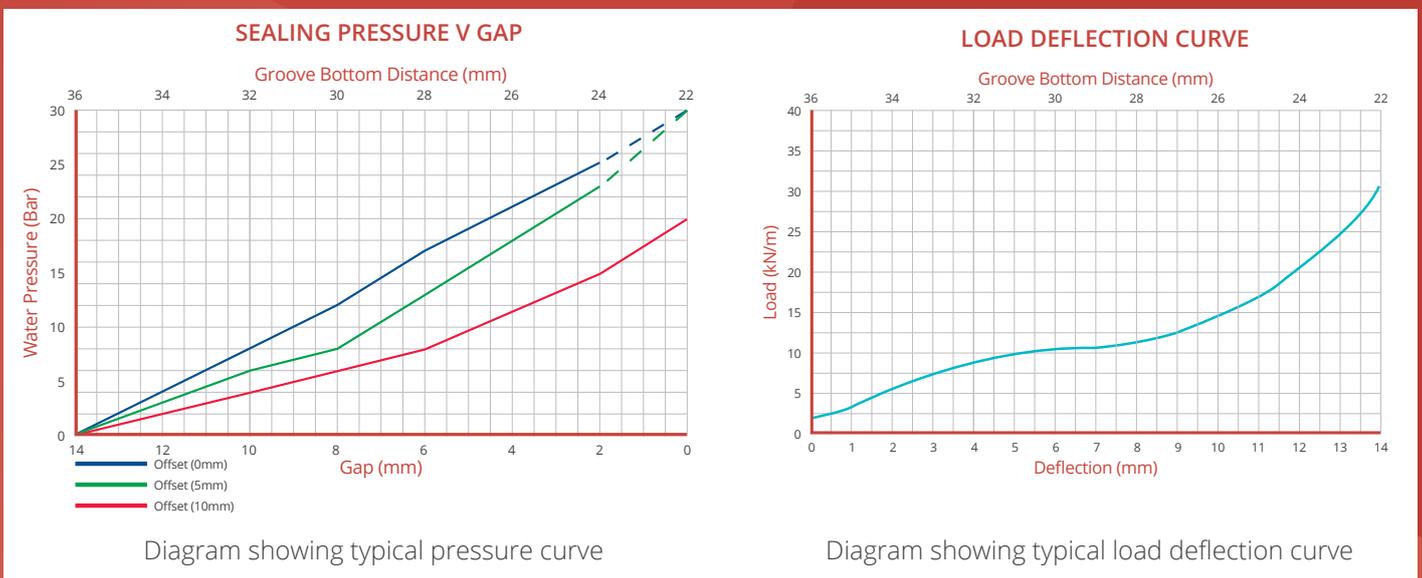
Pressure testing is undertaken at maximum and minimum gaps, and zero-to-maximum offset/ deflection. This replicates the gaps and displacements that occur between segments either as a result of building tolerances, changes in direction of the tunnel or due to the effects of ground movement.



Pressure Test With No Offset



Pressure Test With Offset





ADHESIVE

VIP can recommend a number of approved adhesive suppliers for the application of Glued-in gaskets onto the segment. If required, we can also arrange the supply of the adhesive.

LUBRICANTS

VIP recommends applying lubricant to the surface of the gasket during segment installation to assist the segments sliding into place. This process reduces the risk of gaskets moving or pinching during installation which can potentially affect their performance. We can recommend and supply an appropriate WRC-approved lubricant.

STORAGE

TSGs should be stored in the same conditions as for most elastomeric products and ideally in accordance with ISO 2230:2002 (rubber products guidelines for storage). VIP can supply details upon request.

QUALITY

VIP operates a quality system, which is approved to ISO 9001 standard and certified by BSi. We are renowned in the seal and gasket industry for the high quality of all of our products, and our approach to quality extends to TSGs.





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