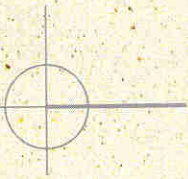





AQUAQUELL

Shield-driven tunnels are currently being used for construction work at ever-greater depths and higher-pressure water environments. The resultant need for improved water sealing characteristics is best met by water-expanding sealant materials which swell on contact with water.



INTRODUCTION

Shield-driven tunnels are common features of such construction works as subways, water supply and sewer systems in cities, and cable-laying. Recent trends in shield-driven tunnels have been toward new applications, increase and decrease in section size, and also construction at greater depths or under the sea bed where measures against high-pressure water are of vital importance.

Accordingly, construction works in sites where underground water is likely to be encountered have resulted in the need for water-expanding sealant materials which swell on contact with water. It is essential that such materials should provide a good watertight seal for long periods of time.

New type of rubber seal

Aquaquell is a new expanding rubber sealing material that is intended mainly for sealing of joints in tunnels and shafts. It has been used successfully in tunnels in pressure conditions up to 10 bars, and sections are available that can resist 20 bars.

Eight-fold Increase in volume

Aquaquell is an extruded rubber compound made from CR/SBR rubber, hydrophilic resin and urethane. On contact with water it is capable of swelling to eight times its own volume, and under conditions of confinement will mould itself to exert pressure evenly on the surrounding surfaces, even when these are rough and the gaps to be filled are of uneven size. This feature assures a good waterproof seal without the need for any sort of high-compression force.

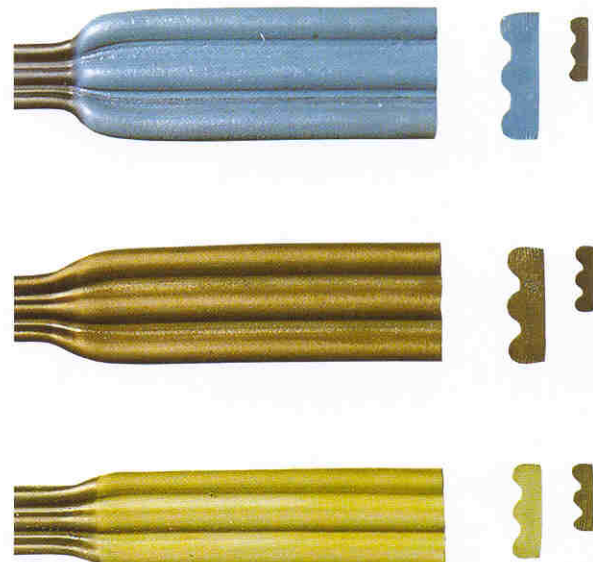
Shape and size according to needs

Aquaquell is available in numerous standard shapes and sizes, and can also be extruded in non-standard shapes to meet clients' special requirements or in combination with ordinary non-expanding rubber. Three main grades are produced: 3V (green), 5V (black), and 8V (blue).

Delay coating option

If required, Aquaquell can be given a delay coating which prevents swelling for several hours even after contact with water. This allows time for the material to be positioned accurately in underwater conditions, while also providing protection against accidental wetting.

Aquaquell is produced in large quantities and delivered worldwide to numerous organizations and enterprises that require an effective and economical waterproof sealing material. Examples of projects making use of Aquaquell include the Channel Tunnel linking England and France, and the Cairo waste water drainage project in Cairo, Egypt.



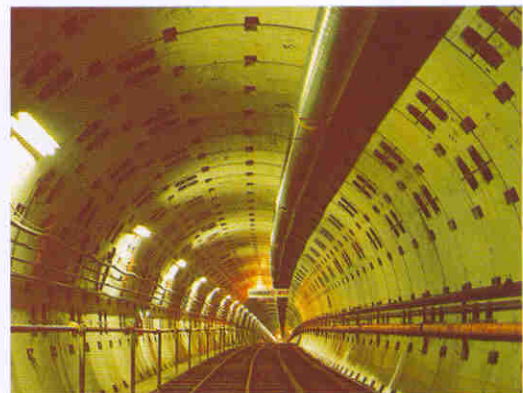
USE IN SHAFTS AND TUNNELS

Provided that Aquaquell is confined within a joint, it can be used with all types of lining, and no mechanical connection is needed. It is suitable for use in manual or mechanical excavation/erection works and for all methods of ground support.

In the case of longitudinal joints using bituminous packing, these packings are modified in size so as to accommodate the Aquaquell. Aquaquell can also withstand the shove ram forces occurring at circumferential joints.

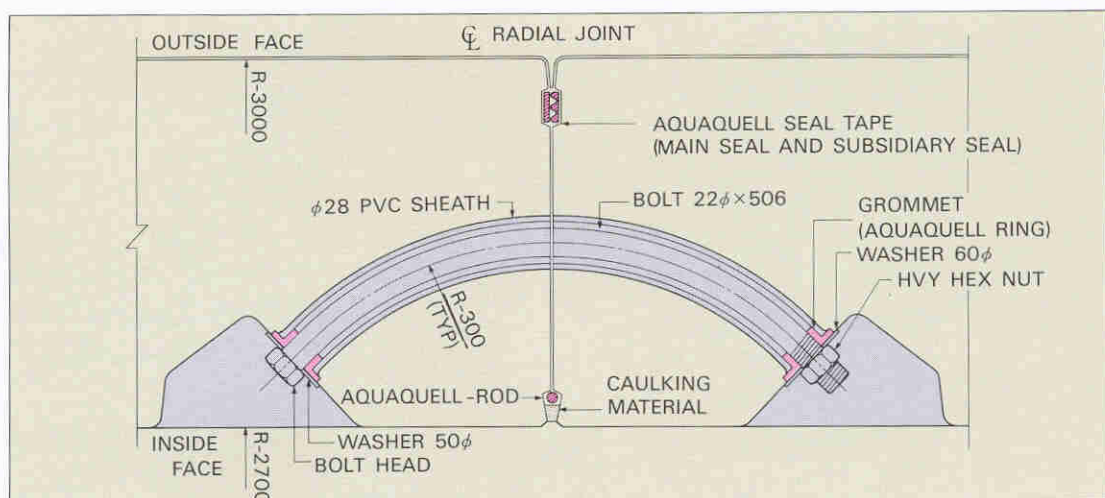
Apart from its excellent sealing qualities, Aquaquell has the additional advantage of requiring no underground work since — unlike conventional caulking and pointing materials — it is applied to the segments at the surface.

This results in numerous benefits including ease of application, efficiency and work safety.



Sealing methods

- (1) Single layer seal: Method applicable to most cases. A single length of standard Aquaquell is applied on the plain face on two joint sides of each segment and key. At each end of the main strip, corner-seal, FC-type, are placed around the corners.
- (2) Double layer seal: Method applicable to cases where grooved segments are used. Aquaquell is applied to all the sides of the groove in each segment. No special corner mouldings are needed, so Aquaquell can be applied straight from the reel.



Aquaquell #100 for construction joints

Aquaquell #100 is also suitable for use when new concrete is being cast against existing construction materials such as concrete, brickwork or steel. It will also form a good seal for secondary concrete coverings of shield-driven tunnels.



The diagram illustrates a cross-section of a concrete repair. A concrete nail is shown driving through a concrete slab. The nail is coated with Aquaquell #100, which is applied to the concrete surface. The nail is then driven through the concrete, and the hole is filled with Aquabond (modified butyl rubber). The diagram is labeled with the following components:

- Concrete nail
- Aquaquell #100
- Aquabond (modified butyl rubber)
- Concrete

PRE-CAST CONCRETE STRUCTURE APPLICATION

Applications with pre-cast concrete include manhole rings, box culverts, cable troughs, bridge decks and slabs, hume-pipes and jacking pipes. Aquaquell BH-1 Type is especially suitable for sealing the joints of hume-pipes.

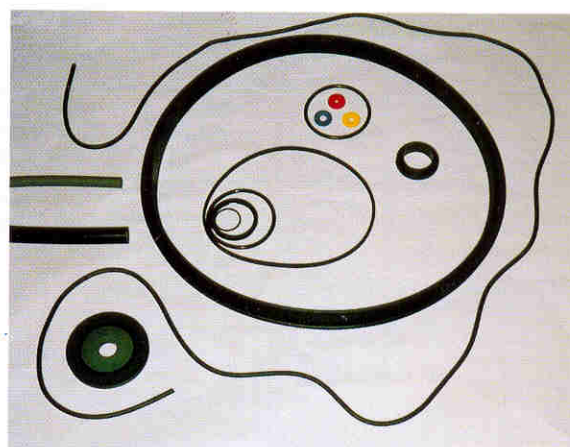
Aquaquell is used for numerous applications on construction sites including construction joint seals with in-situ concrete, and sealing of temporary works, weir boards, diffuser domes and cofferdams. It can also be used as the sealer for shaft base slabs.

The wide range of shapes, sizes and grades available as standard or to order enable Aquaquell to be used in all applications where watertight seals are required — including domestic plumbing, civil engineering, and undersea construction projects.



OTHER APPLICATIONS

Its superior performance and ease of use have resulted in Aquaquell being applied in numerous fields other than that of segmental tunnel linings, for which it was originally developed.



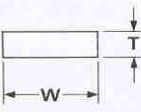
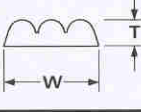
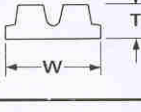
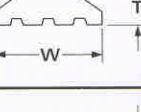
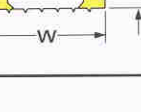
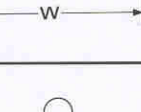



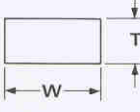
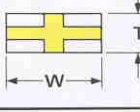
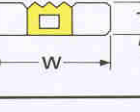
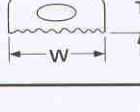
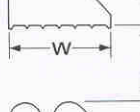
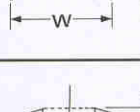
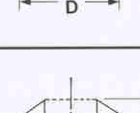
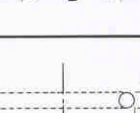
PHYSICAL PROPERTIES

ITEM	AQUAQUELL SEAL TAPE			AQUAQ	AQUAQUELL WJ		SUPER SEAL	AQUAQ RING
	3V	5V	8V	#100	6V	1.5V		
SPECIFIC GRAVITY	1.29	1.23	1.23	1.27	1.22	1.26	1.25	1.28
HARDNESS (Shore A)	40	40	40	45	45	45	55	50
TENSILE STRENGTH (kgf/cm ²)	60	50	40	90	50	100	50	100
ELONGATION (%)	500	500	500	500	500	550	500	500
DEGREE OF VOLUME EXPANSION BY WATER (factor)	3	5	8	2	6	1.5	20	1.8
RESTORABILITY	GOOD	GOOD	GOOD	VERY GOOD	VERY GOOD	VERY GOOD	VERY GOOD	EXCELLENT
TYPICAL APPLICATION	SEGMENT			CONSTRUCT'N JOINT			SPECIAL USES	RUBBER RINGS PIPE

TEST METHOD IN ACCORDANCE WITH JIS K-6301

STANDARD CROSS-SECTIONS

SUPER-LOW EXPANSION RUBBER

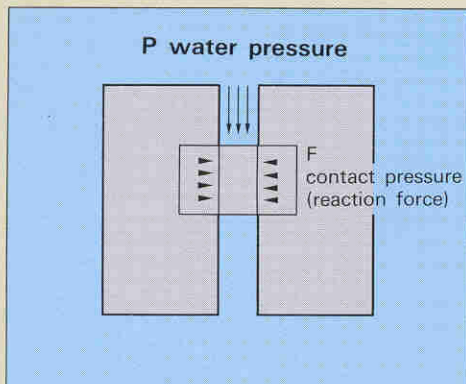
	TYPE	CROSS SECTION	DIMENS'N (mm)	RATE
AQUAQUELL SEAL TAPE	F type		W × T 20 × 2 20 × 3 20 × 5	3V to 8V
	S type		W × T 20 × 4 20 × 5 20 × 6 20 × 7	
	C type		W × T 20 × 5 20 × 6	
	FT type		W × T 18 × 5 18 × 6 20 × 5 20 × 6	
	SW type (Dual)		W × T 20 × 4 20 × 5 20 × 6 20 × 7	
	FC type		W × T 60 × 1	5V
SUPER SEAL	O type		D 5 10 12 14	20V
	Q type		D × B 10 × 7 12 × 9 14 × 12	
	QW type (Dual)		D × B 10 × 4 12 × 6 14 × 8	
AQUAQUELL WJ	AQ #100		W × T 20 × 10 20 × 20 20 × 30	2V
	CJX type (Dual)		W × T 20 × 10	2V
	CJQ type (Dual)		W × T 20 × 7	6V
	DQ type		W × T 26 × 13 30 × 19 34 × 22.5	2V
AQUAQUELL RING	BH-1 type		W × T 20 × 10.5 22 × 12 24 × 12 28 × 15.5 31 × 18.5	2V
	B-1		W × T 41 × 12 44 × 12 51 × 14 54 × 14	2V
	B-2			
	O ring		W × T 60 × 5	

* Dimension and expansion rate can be made according to clients' requirement.

AQUAQUELL SEALING MECHANISM

Figure 1 shows the basic principle of sealing segment joints.

Fig.1 Principle of sealing segment joints.

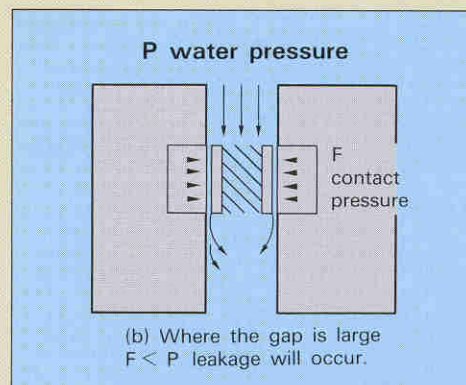
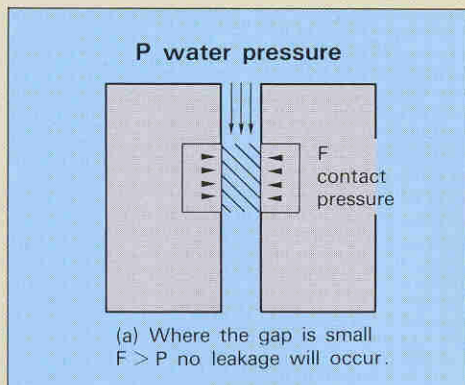


If F is larger than P , no leakage will occur.

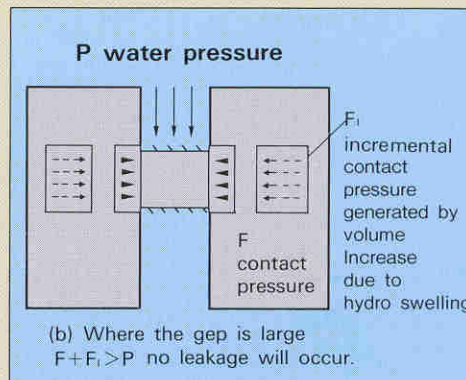
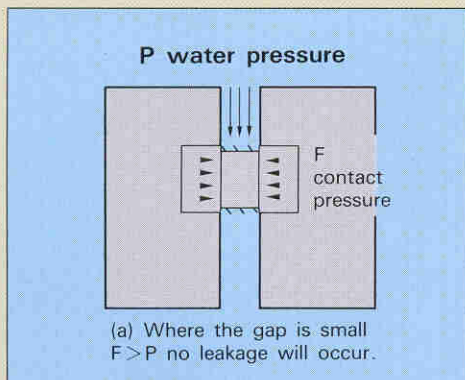
In case of use of conventional sealers of non-vulcanized butyl rubber or EPDM, the contact pressure F will decrease and leakage will take place when the gap becomes larger.

When AQUAQUELL is used, the contact pressure F remains constant or may even increase as a result of further swelling of the strip.

CONVENTIONAL SEALERS (non-vulcanized butyl rubber type or EPDM)



AQUAQUELL



AQUAQUELL has the hardness, deformability and strength required to meet the conditions of constriction before and after, respectively, and may therefore be regarded as a high-quality sealer for all applications.