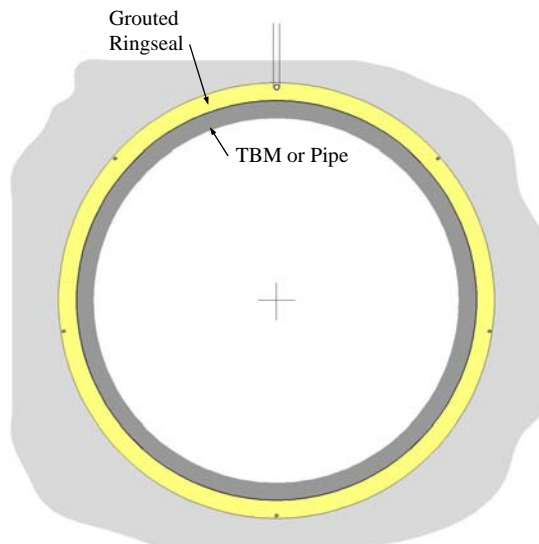


## Grouted Tunnel Seals



### Ringseals

Condensed Ringseals are pre-fixed and pump filled with neat cement grout to form insitu grouted seals for:

- TBM Launch and reception
- Tunnel after grouting
- Tunnel Linings
- Pipe connections

### Advantages

- Robust concrete seal
- Complete Ringseal - no joints
- Prefixed seal for filling control and top contact
- Open vented system - No bursting
- Engineered and reliable system

Ringseals are custom engineered and manufactured by Proserve to suit site specific size and conditions, and the contractors chosen installation method. APS and Proserve work in partnership with APS marketing and supplying to the tunnelling industry.

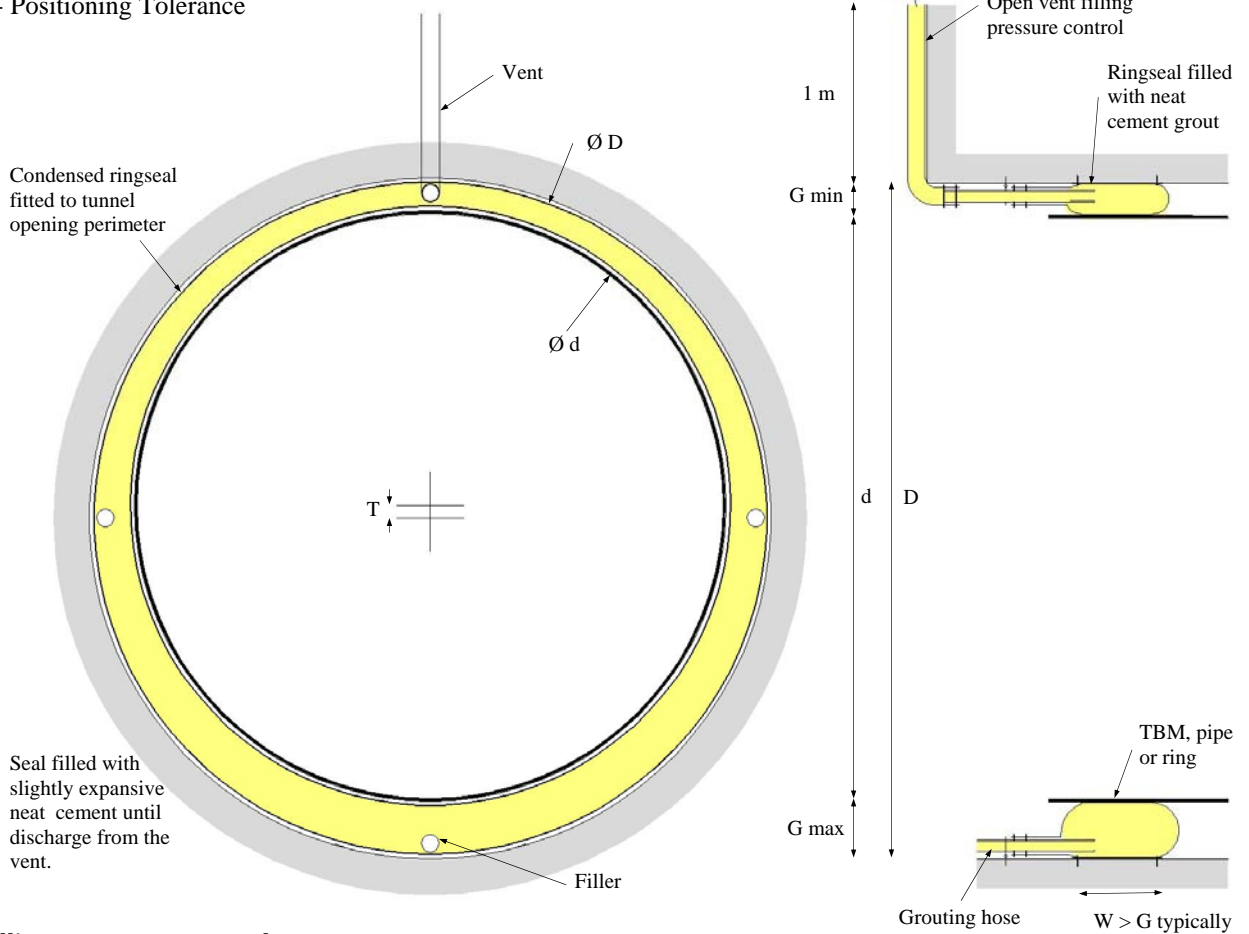
For sales contact:           aps1@btconnect.com           +44 (0) 1142447916  
For engineering contact:   office@proserveltd.co.uk   +44 (0) 1926 512222

## System

Condensed fabric ringseals are pre-fixed in a protective recess for temporary protection, often a steel can or concrete recess, with filler and vent pipe connections pre-installed. The ringseal is filled with highly fluid neat cement grout to form a grouted seal.

## Information Required from Customer

- D - Tunnel Diameter
- d - TBM or Pipe Diameter
- T - Positioning Tolerance



## Filling Pressure Control

Ringseals are filled at a pre-determined rate to control the ringseal filling pressure. The open top vent provides controlled pressure for top contact, and avoids bursting.

## Bearing Pressure

The grouted ringseal can be designed for ground water/ after grouting pressure as required.

## Water By-pass

Temporary water bypass piping is installed for water pressure relief during ringseal grouting where required.

# ringseal Installation

## Construction Engineering of the System

- Ringseal diameter, gap and tolerances advised by contractor
- Ringseal fixing arrangements and temporary protection agreed
- Filler pipes and grouting arrangements
- Construction Risk Assessment
- General Arrangement and Fabrication Drawings for approval
- Filling Plan and Installation Guide
- Site Support (where needed)

## Ringseal Fabrication and Delivery (In-house by Proserve)

### Ringseal Fixing

- Condensed Ringseal fixing in protective recess (bolt or screw fixings with steel fixing bar typically)
- Filler and Vent pipe connections made
- Water bypass / any after grouting connections etc.

### TBM, Pipe or Lining Moved in to Place

### Ringseal Filling

- Ringseal pump filled with highly fluid neat cement grout from the bottom filler sleeve initially
- Filling rate typically 3 m vertically per hour (for seal gaps below 250 mm)
- Filling stops upon vent discharge
- Top-up vent after 15-30 minutes to replace bleed losses and ensure top contact.



# ringseal Grout Mix

Ringseals are typically filled with neat cement grout, mixed and pumped on site, using a 1 m<sup>3</sup> grout pan or similar.

The grout is highly fluid for filling performance, with water: cement ratio adjusted to give a fluidity of 13 to 17 seconds using a 12.7 mm Proserve flow cone (WCR typically 0.5). An expansive or non shrink additive can be used if required, for example:

- BASF MasterLife 314
- Fosroc Cebex 100

Surplus mix water 'bleeds' through the permeable ringseal fabric, giving improved water: cement ratio, strength and set time.



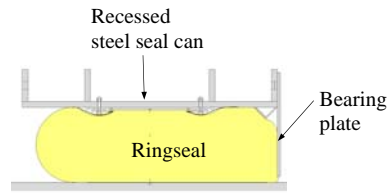
Proserve Flow Cone



Grout Pan

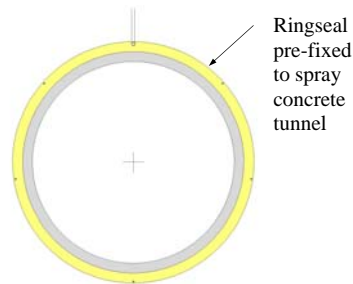
**Lee Tunnel, Beckton Launch**  
 Contractor : Morgan - Vinci - Bachy JV  
 Ringseal Diameter : 9020 mm  
 Seal Gap : 260 mm  $\pm$  70 mm  
 Purpose : TBM Launch Ringseal

2011



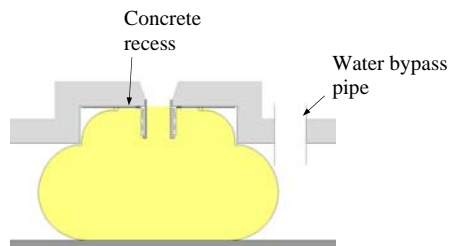
**Crossrail, Eastern Running Tunnels**  
 Contractor : Dragados - Sisk JV  
 Ringseal Diameter : 7420 mm  
 Seal Gap : 310 mm  $\pm$  50 mm  
 Purpose : TBM Launch Ringseal

2013 - 15



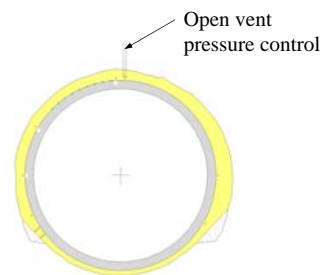
**Brighton**  
 Contractor : Costain  
 Ringseal Diameter : 2470 mm  
 Seal Gap : 165 mm  $\pm$  50 mm  
 Purpose : TBM Reception Ringseal

2011



**Crossrail, Limmo Peninsula Launch**  
 Contractor : Dragados - Sisk JV  
 Ringseal Diameter : 6800 mm  
 Seal Gap : 420 mm  $\pm$  220 mm  
 Purpose : TBM Launch Ringseal

2012



**Lee Tunnel, Slip Lining**  
 Contractor : Morgan - Vinci - Bachy JV  
 Ringseal Diameter : 7800 mm  
 Seal Gap : 300 mm  $\pm$  50 mm  
 Purpose : Stopped Ringseal for Tunnel Lining

2014 - 15

