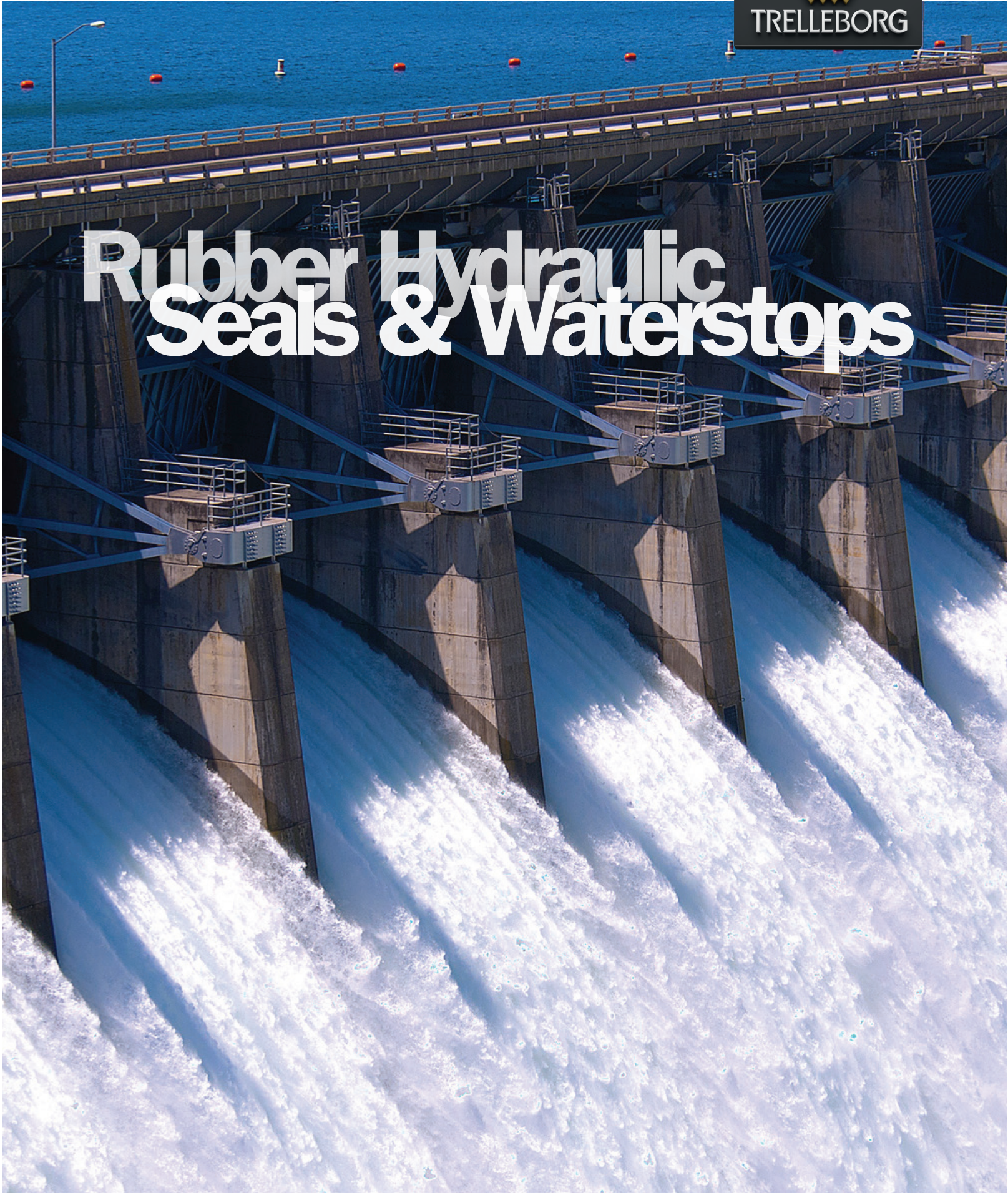




Rubber Hydraulic Seals & Waterstops



Engineering skill and experience

Trelleborg Engineered Products uses its extensive engineering skills and experience to develop, manufacture, market and distribute engineered solutions based on polymer materials to leading customers in Australia and Global Markets.

- **Infrastructure - Rail, Road & Bridges**
- **Infrastructure - Water Related**

- **Defence**
- **Electrical**
- **Industrial Rubber Products**

- **Marine Solutions**
- **Mining**
- **Transportation**

Trelleborg Hydraulic Seals

Trelleborg Engineered Products is an ISO9001-2008 certified manufacturer, designing and manufacturing Australia's widest range of rubber hydraulic seals for all infrastructure applications such as dam gates, dam wall extensions, tunnels and concrete slab joints. These are designed to either retain water, increase storage capacity, prevent water penetration or limit contaminated run off or water table penetration.

Unlike materials such as PVC, Trelleborg rubber seals remain dimensionally stable and functionally effective over many years, handling movement and ageing far beyond the capacity of PVC.

Rubber also provides superior resistance to chemical attack and heat degradation.

PTFE (Teflon) Faced and Special Seals

A recent innovation is the use of PTFE on seals to reduce the friction created by water flow thus reducing the energy required to close gates, improving the life of the seal by abrasion reduction and reducing the potential for the seal to "contact bond" to steel closure surfaces.

PTFE is available as an option on solid 'Hump' and 'Music Note' seals. Two types of PTFE are available, either virgin white or carbon filled black, usually 1.5mm thick. The black PTFE offers superior U.V. and rubber to PTFE bond strength.

Trelleborg can also supply seals with fabric and Kevlar® reinforcement, or made to a customer specific shape and purpose and also in purpose designed rubber compounds.

Joining and Corners

Moulded Joins and corners should be used for high tolerance seals manufactured using the moulding process. These seals provide the highest integrity solution.

We recommend all joins should be carried out in our factory using the hot vulcanising process.

On site joining can be done by Trelleborg personnel by arrangement.

Where hot vulcanising is not possible, one of our 'cold vulcanising' kits should be used. These kits contain all the essential materials to make an effective joint.



Specification

Trelleborg Seals are moulded, or extruded, usually from compounds of Natural Rubber, EPDM or Neoprene.

Natural Rubber has superior mechanical properties. If the seals are to be exposed to extended periods of sunlight then we recommend EPDM, Neoprene or blends with Natural Rubber for increased ozone resistance.

Other synthetic rubbers can be used to cope with aggressive gases or fluids.

In general, rubber hydraulic seals should have high tensile strength, high tear resistance, good abrasion resistance, low water resistance and excellent weathering resistance.

A typical specification for a Natural Rubber seal is shown below.

TEST	STANDARD / METHOD	SPECIFICATION
Hardness (IRHD)	AS1683.15.2, ASTM D2240, BS903A.Z	65 ± 5
Tensile strength at failure	AS1683.11, ASTM D412, BS903A.Z	> 21 MPa
Elongation at failure	AS1683.11, ASTM D412, BS903A.Z	> 450%
Tensile strength after heat aging for 96 hr at 70°C	AS1180.3, ASTM D573, BS903A.Z	> 80% of tensile strength before aging
Water absorption for 168 hr at 20°C	ASTM D471	< 5% (by weight)
Resistance to ozone cracking for 100pphm at 20% strain at 40°C for 96hr	AS1683.24, ASTM D1149	No cracks
Compression set after 22hr at 70°C	AS1683.13B, ASTM D395, BS903A/6A	< 30%
Tear resistance	AS1683.12, ASTM D624, BS903A.3	> 70 kN/m
Abrasion resistance	AS1683.21, ASTM D1630, BS903A.9	< 0.5 ml

Trelleborg Corner sections and straight joins are fully moulded, unless otherwise specified.

Finished seals are visually inspected for compliance with the customer’s requirements and our stringent workmanship standards.

The choice between a moulded and extruded seal is often a compromise between seal tolerances and tooling costs.

If new tooling is required to manufacture the seal then an extrusion die is a cheaper alternative to machining a mould.

Seals with teflon coatings or non-radiused corner sections must be moulded.

A comparison of dimensional tolerances for rubber mouldings (Class M4) and extrusions (Class E3), as per the International Standard ISO3302, is summarised below.

NOMINAL DIMENSIONS MM	MOULDING TOLERANCE (CLASS M4)MM+/-1	EXTRUSION TOLERANCE (CLASS E3)MM+/-
0 - 6.3	0.50	0.80
6.3 - 10	0.70	1.00
10 - 16	0.8	1.3
16 - 25	1.00	1.6
25 - 40	1.3	2.00
40 - 63	1.6	2.5
63 - 100	2.00	3.2
100 - 160	2.5	-
160 -	1.5%	-

Trelleborg Dam Gate Seals

Music Note Seals

Trelleborg Music Note seals are manufactured with either a solid or hollow bulb depending on required load deflection criteria.

The solid profile is less prone to compression set while the hollow profile is more suitable for low hydrostatic pressures.

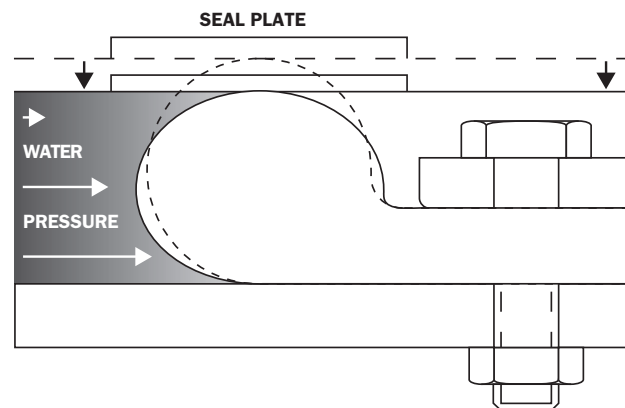
Trelleborg Music Note seals are often used for side seals and can be supplied with a PTFE coating.

The bulb on the Music Note seal is designed to be forced against the seal seat when water pressure is applied.

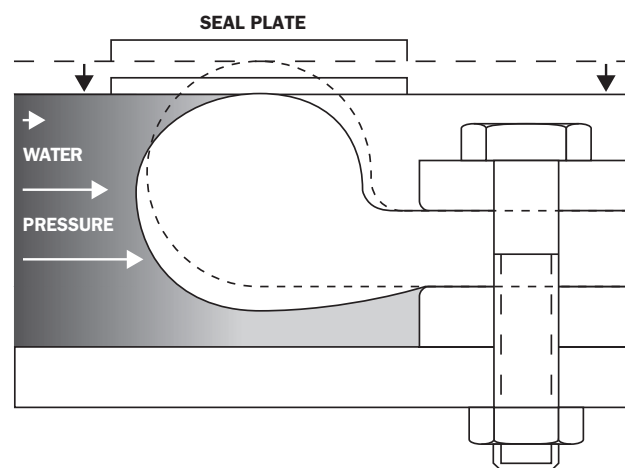
Sealing can be achieved by either bulb deflection, or stem deflection. Seals under high compression loads are usually designed with bulb deflection.

Stem deflection is more suitable for:

- Low compression loads
- Sealing irregular surfaces
- Large tolerances in the gates dimensions



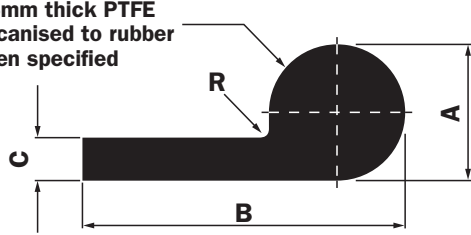
BULB DEFLECTION



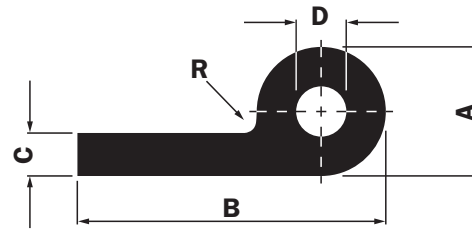
STEM DEFLECTION

Music Note Seals

1.6mm thick PTFE
vulcanised to rubber
when specified



Solid

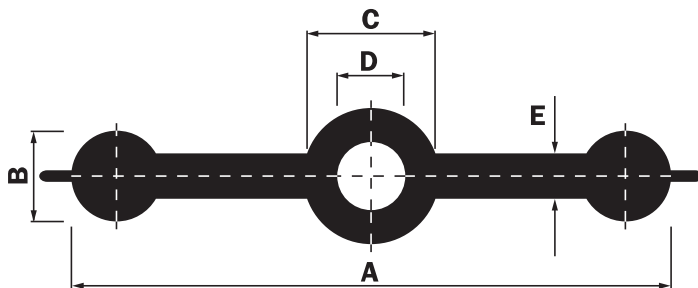


Hollow

Solid					
Description	A mm	B mm	C mm	Material	Weight Kg/m
SMQ40-1	40	100	15	NR	2.69
SMQ45-1	45	110	15	NR	3.24
SMQ44-1	44.5	102	15	NR, CR	3.22
SMQ44-5	44.5	120	15	NR, CR	3.43
SMQ44-6	44.5	150	15	NR, CR	3.80
DMQ50-1	50	120	15	NR, CR	3.87
SMQ23-1	23	63	5	NR, CR	0.82

Hollow						
Description	A mm	B mm	C mm	D mm	Material	Weight Kg/m
HMQ44-3	44.5	102	15	19, 22, 25	NR, CR	2.55
HMQ30-2	30	80	12	19, 22, 25	CR	1.43
HMQ44-4	44	102	15	19, 22, 25	NR	2.59
HMQ40-7	40	110	15	19, 22, 25	NR	2.66

Centre Bulb Waterstop



Description	A mm	B mm	C mm	D mm	E mm	Material	Weight Kg/m
CWQ100-1	100	13	25	15	10	NR	1.24
CWQ150-1	150	20	30	22	15	EPDM	1.82
CWQ230-1	230	25	43	25	9.5	EPDM	4.0
CWQ335-1	355	25	50	32	9.5	EPDM	6.5

NR = Natural Rubber | CR = Polychloroprene (Neoprene®) | EPDM = Ethylene Propylene Neoprene® - Du Pont's Trademark

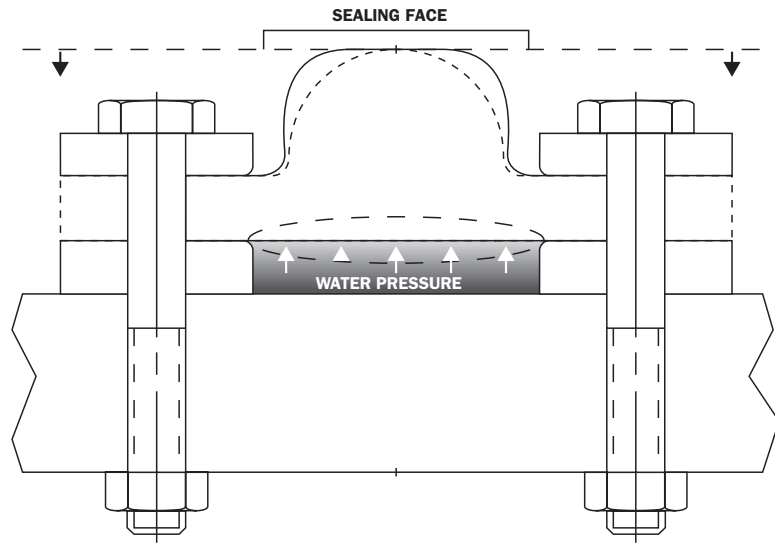
Hump Seals

Trelleborg Hump seals can be manufactured with either a single or double hump and can be supplied with a PTFE coating.

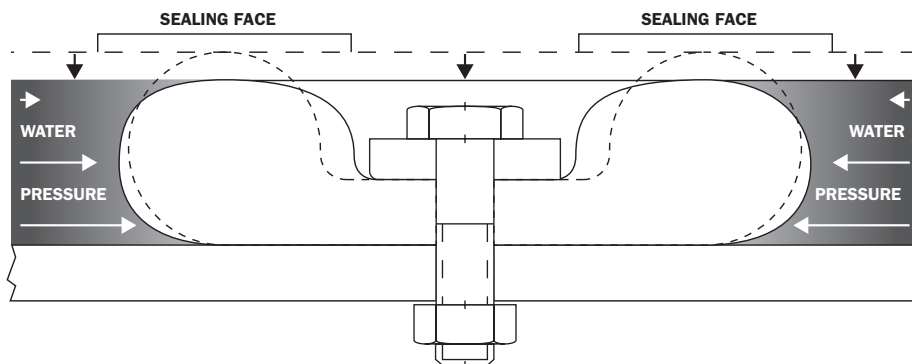
Double hump seals are usually installed for sealing against a reversal of head, such as tidal river gates.

Hump seals are commonly used for sealing the top edge of submerged vertical-lift gates and radial gates.

The seal can be supplied with a hollow profile for low hydrostatic pressures.

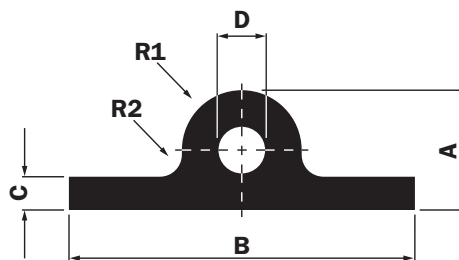
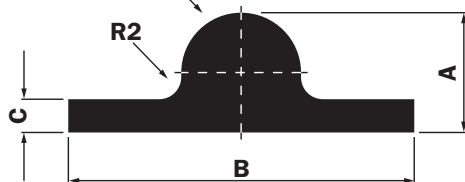


HUMP SEALS



DOUBLE HUMP SEALS

1.6mm thick PTFE vulcanised to rubber when specified

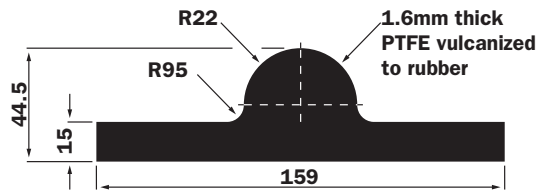


Description	A mm	B mm	C mm	D mm	R1	R2	Material	Weight Kg/m	Process
SHQ44-1	44.5	159	15	15	22	9.5	NR	4.48	Mould 2.5m
SHQ45-3	45	175	15	15	22.5	12	NR	4.54	Mould 2.1m

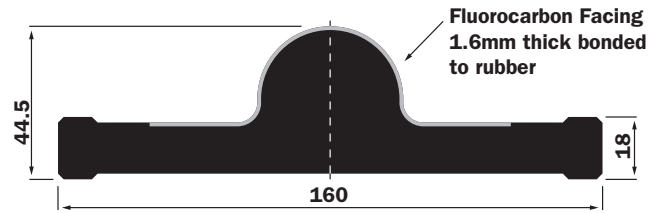
NR = Natural Rubber | CR = Polychloroprene (Neoprene®) | EPDM = Ethylene Propylene Neoprene® - Du Pont's Trademark

Hump Seals

Special Profiles

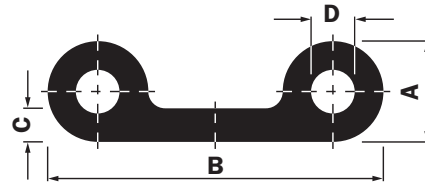
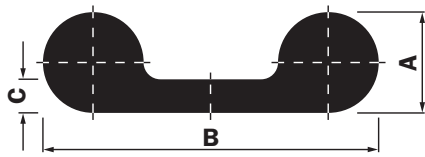


Material: NR, CR
Weight: 4.49 kg/m
Code: HQ 44-3



Material: NR
Weight: 4.57 kg/m
Code: HQ 45-4

Double Hump Seals



Description	A mm	B mm	C mm	D mm	Material	Weight Kg/m
DH 30-1	30	100	10	-	NR	2.34
DH 45-1	45	150	15	-	NR	5.22
DH 35-1	35	130	10	10	NR	2.96

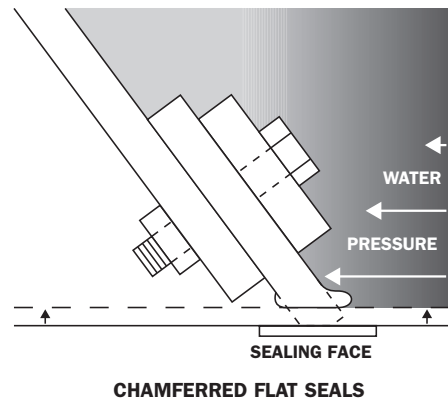
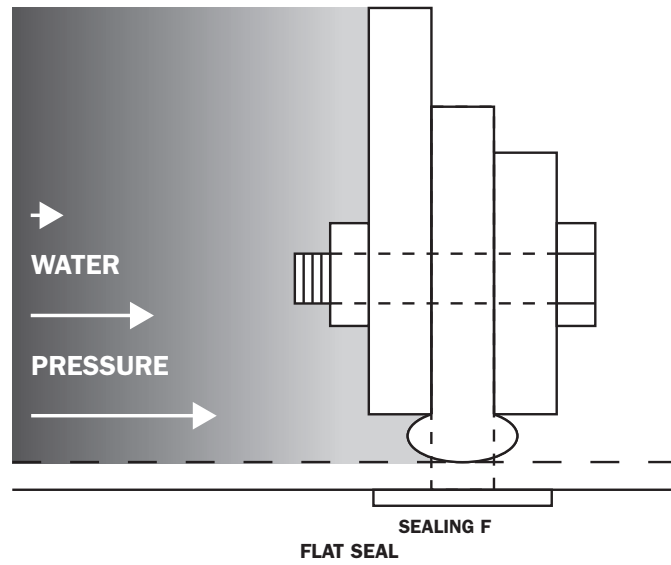
Flat Seals

Trelleborg Flat seals can be supplied with either flat, chamfered or radiused seal faces.

Chamfered and radiused seals reduce the seal's contact area for ready compression and provide space for the rubber to displace when deflecting.

Flat seals are commonly installed as bottom seals.

Flat bottom seals on high head gates should project no more than the deflection required to seal (e.g. 3-5mm).



Description	A mm	B mm	Material	Weight Kg/m
FS12-1	57	12	NR	*
FS19-1	76	19	NR	*
FS12-2	102	12.7	NR	*
FS19-2	100	19	NR	*

Bull Nose Seals



Description	A mm	B mm	Material	Weight Kg/m
FS12-1	57	12	NR	*
FS19-1	76	19	NR	*
FS12-2	102	12.7	NR	*
FS19-2	100	19	NR	*

NR = Natural Rubber | CR = Polychloroprene (Neoprene®) | EPDM = Ethylene Propylene Neoprene® - Du Pont's Trademark

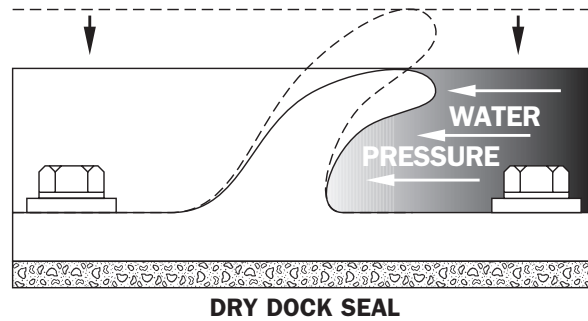
Trelleborg Specialty Seals Dry Dock Seals

Trelleborg Seals for dry docks are usually designed as a lip profile with a steel baseplate vulcanised into the seal.

The seal is formed by the water pressure acting on the lip.

These seals are designed to respond to large movements in the gate's position on a regular basis.

The steel-reinforced baseplate ensures a rigid and watertight seal to the dock wall.



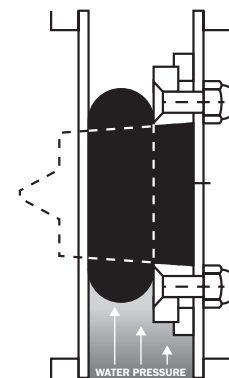
Gina-type Seals

Trelleborg Gina-type seals are commonly used for providing a seal between two concrete segments on an underwater tunnel, or for sealing the temporary bulkhead at the end of the tunnel.

These seals are often subjected to high hydrostatic pressures.

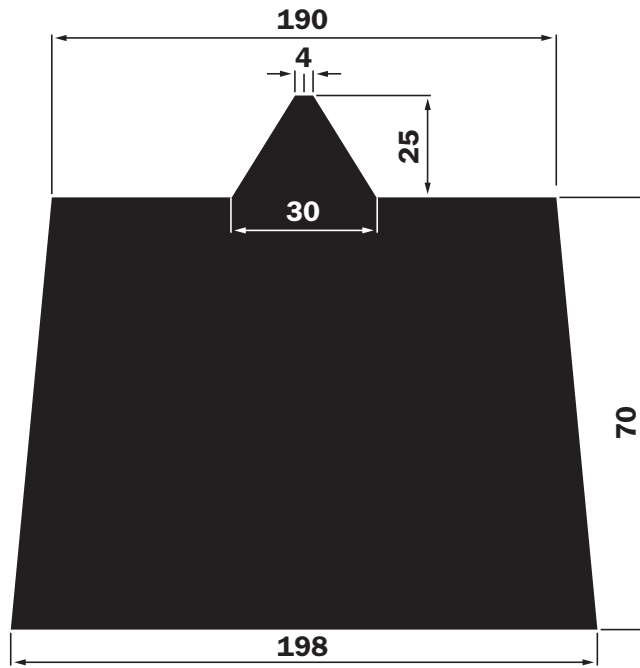
The seal can be manufactured with a soft rubber nipple on the sealing face to ensure a watertight seal under low contact pressures on the irregular surface.

This nipple is designed to assist during positioning of the two concrete elements.

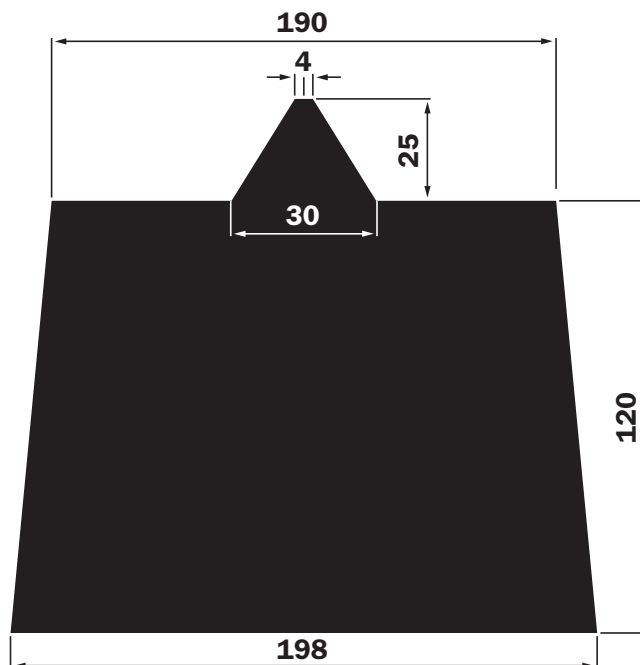


TYPICAL GINA-TYPE SEAL

Tunnel Seals



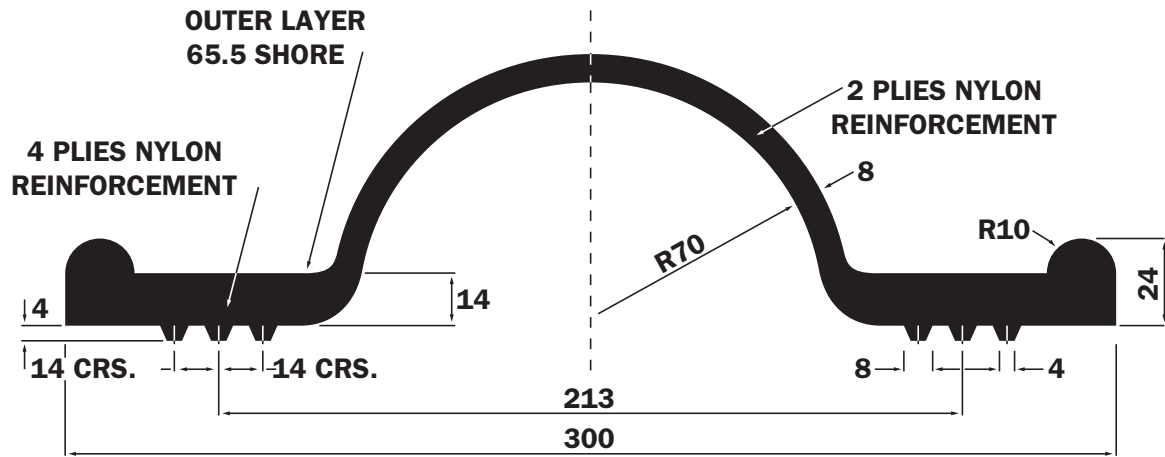
Material: NR
Weight:
Code: TQ 70 - 2



Material: NR
Weight: 28.4 kg/m
Code: TQ 120 - 1

NR = Natural Rubber | CR = Polychloroprene (Neoprene®) | EPDM = Ethylene Propylene Neoprene® - Du Pont's Trademark

Tunnel Seals



Weight: 4.79 kg/m

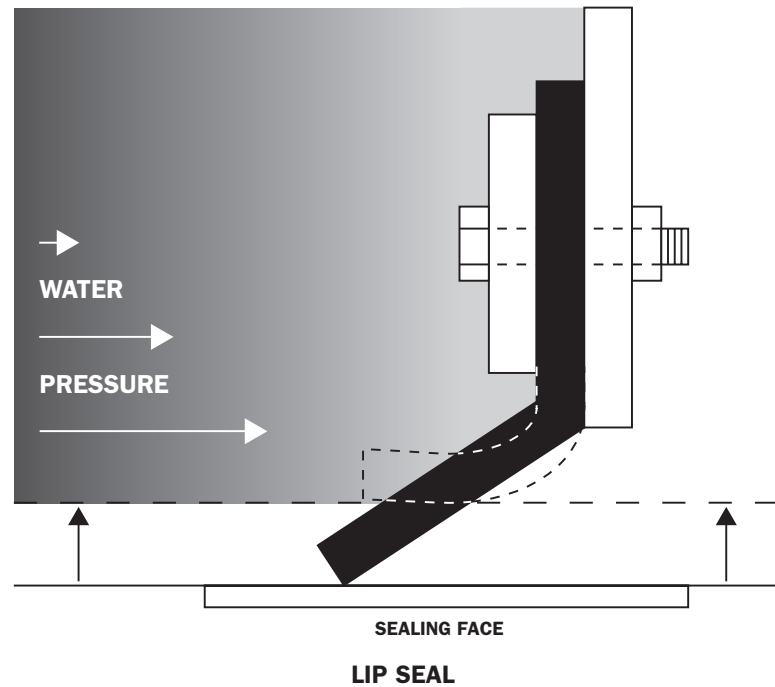
Code: TQ 70-1

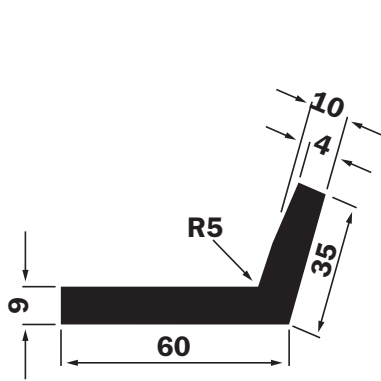
Lip Seals

Trelleborg Lip seals can be supplied with a range of different lip angles and profiles.

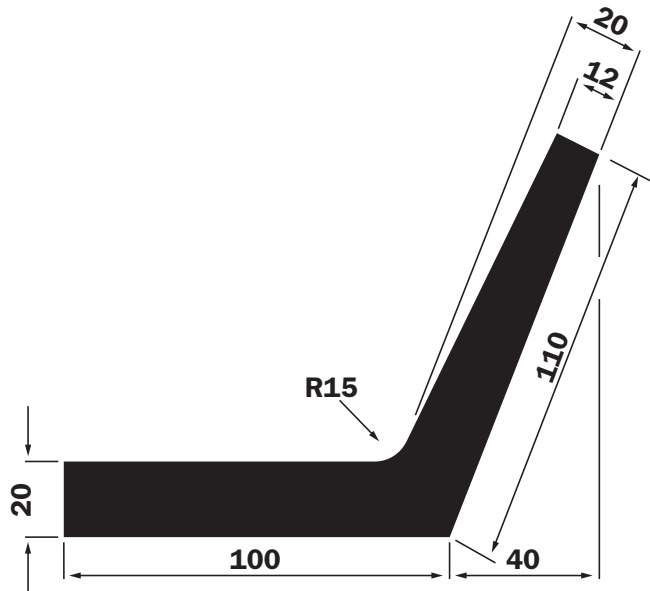
These seals are inherently flexible, however they can only be used for movement in one plane (e.g. radial or vertical-lift gates).

Sealing is achieved by compression of the sealing lip which is activated by the water pressure.

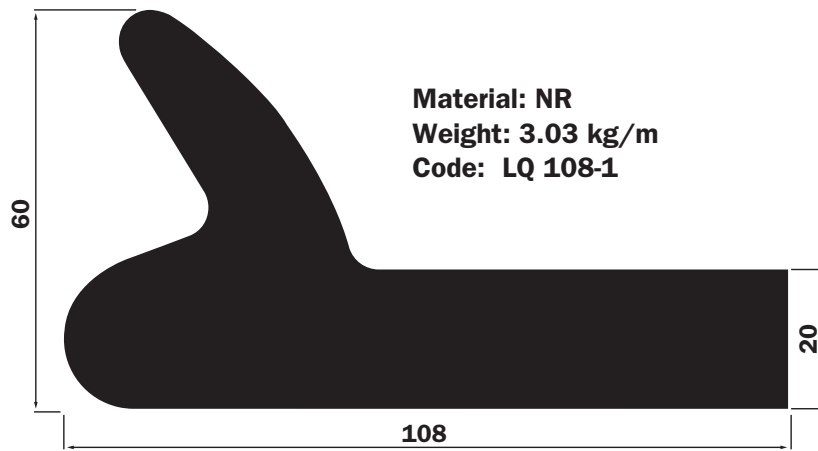




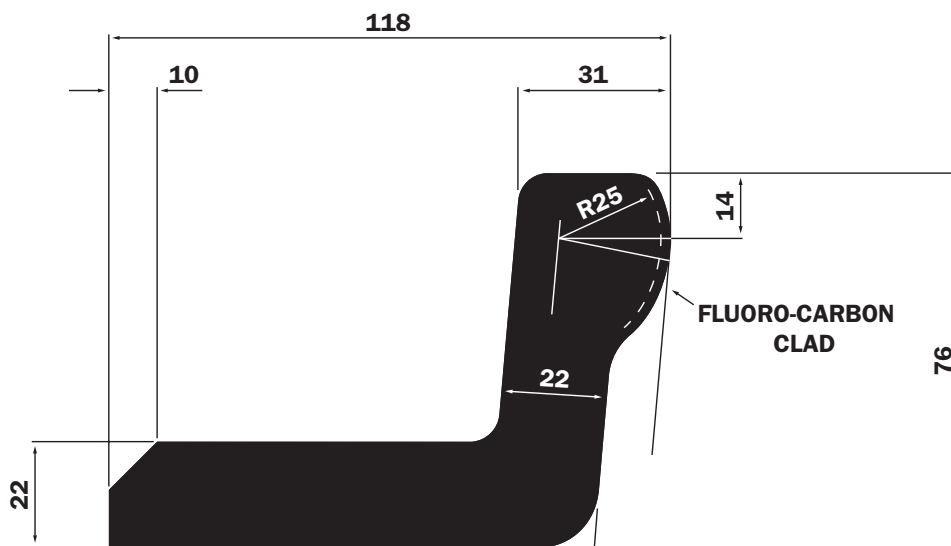
Material: NR
Weight: 0.95 kg/m
Code: LH 60-1



Material: NR
Weight: 4.02 kg/m
Code: LH 100-1



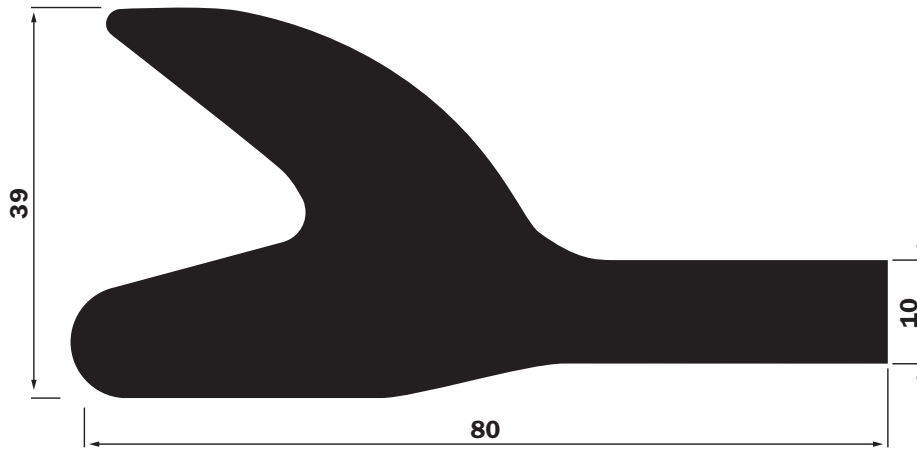
Material: NR
Weight: 3.03 kg/m
Code: LQ 108-1



Material: NR
Weight: 4.43 kg/m
Code: LQ 118-1

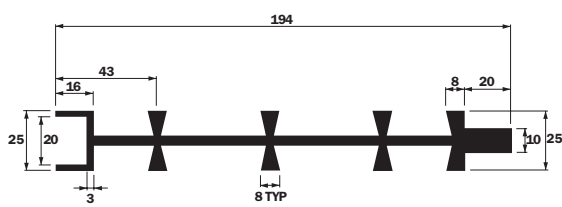
NR = Natural Rubber | CR = Polychloroprene (Neoprene®) | EPDM = Ethylene Propylene Neoprene® - Du Pont's Trademark

Lip Seals

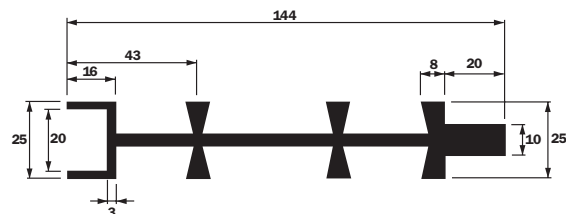


Material: NR
Weight: 1.39 kg/m
Code: LQ 80-3

Dovetail Waterstops



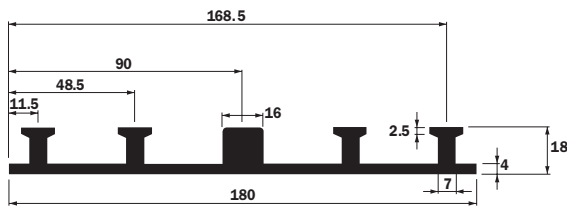
VWQ194S



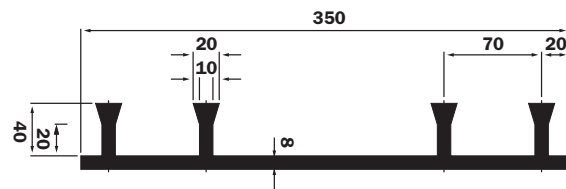
VWQ144S

Description	Material	Weight Kg/m	Die Number
VWQ144-1	NR	1.63	384
VWQ344-1	NR	3.73	898
VWQ144S	NR	1.4	151
VWQ194S	NR	1.6	149

Backstop Waterstops



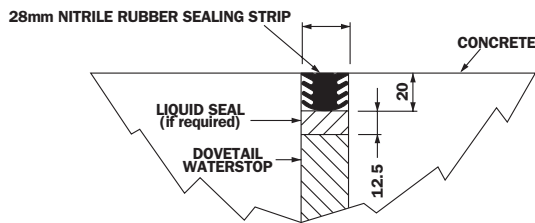
BWQ180S



BWQ350-1

Description	Material	Weight Kg/m
BWQ180-1	NR	1.71
BWQ350-1	EPDM	6.01
BWQ360-1	NR	7.1
BWQ180S	NR	1.4

Joint Sealing Strip



Description	Material	Weight Kg/m
28mm Sealing Strip	Nitrile	2kg

Omega-type Seals

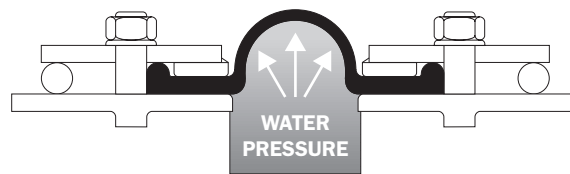
Trelleborg Omega-type seals are commonly used for providing an internal seal between two concrete segments on an underwater tunnel.

These seals are usually fabric-reinforced and subjected to large three dimensional movements.

The seal acts as a membrane mounted over the area between the tunnel sections. The number of internal fabric layers is

dependent on the maximum hydrostatic pressure and required safety factor.

The seal can be designed with small ridges on the sealing face to ensure a watertight seal.



TYPICAL OMEGA-TYPE SEAL

Inflatable Seals

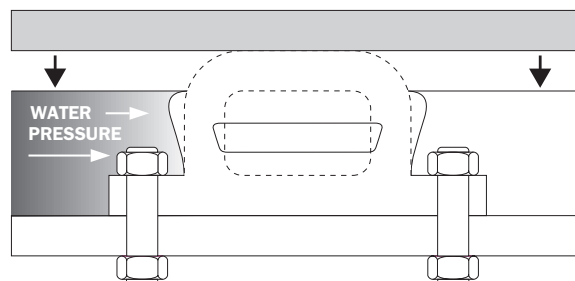
Trelleborg Inflatable seals are commonly used for sealing gates and tunnels where there are large movements or variations in the sealing face.

Sealing is obtained by controlling the inflation pressure of the gas or fluid above the maximum hydrostatic pressure.

An air compressor or water pump and automatic controls are required to maintain the required inflation pressure.

These seals can be fabric-reinforced to provide increased strength under high inflation

pressures and to improve puncture resistance.



TYPICAL INFLATABLE SEAL

Storage and Handling

Trelleborg Seals are specially packaged to withstand damage during transportation. Rubber seals should be handled and stored carefully in the correct manner.

1. Avoid exposure to direct sunlight and high concentrations of ozone
2. Preferably store in a cool room, free of UV radiation and significant temperature variations
3. Preferably store flat in the relaxed position (unrolled and straight)
4. Store without other objects loaded on top
5. Avoid bending or rolling the delivered seals in tighter coils, especially teflon-coated seals
6. Avoid seals coming in contact with sharp objects
7. Store under dry conditions away from oils, chemicals etc.
8. Avoid exposing seals to extremes of temperature
9. Ensure seals are not resting on abrasive surfaces
10. If seals are stored outside provide a cover to exclude light, however ensure free circulation of air
11. If seals are stored in their rolled position, unroll at least 72 hours prior to installation
12. Seals with PTFE should **NOT** be bent or folded **IN ANY WAY** and **MUST** be stored out of sunlight in cool dry storage until installed.

Trelleborg Teflon Coated Seals

Trelleborg Engineered Products has extensive experience in manufacturing rubber seals with teflon coatings.

The PTFE is bonded to the rubber seal surface during the vulcanisation process.

The inclusion of teflon on the sealing surface:-

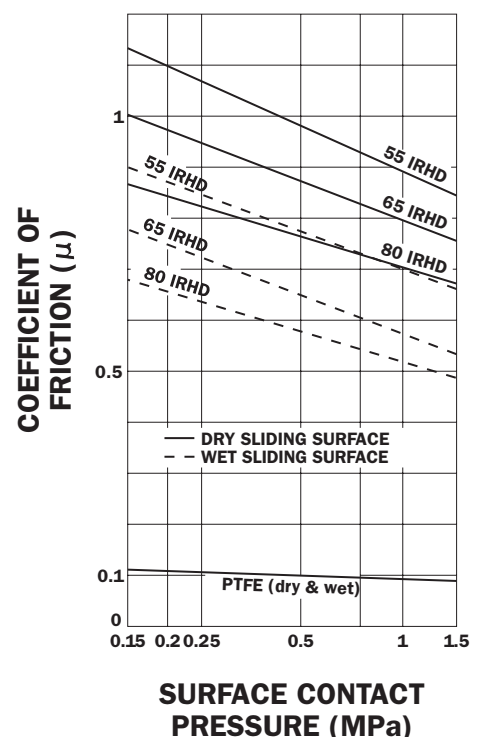
- Significantly reduces the friction coefficient
- Reduces the potential for sticking or “contact bonding” to the seal plate especially when the seal is under high compression for prolonged periods
- Assists in reducing abrasive wear and increases the life of the seal

The friction coefficient for rubber to metal is typically in the range of 0.6 to 1.4 compared to a friction for teflon to metal of typically 0.1.

The friction is dependent on the seal hardness (IRHD), the surface finish of the contact face, the average surface contact pressure, the sliding speed, and the wetness/dryness of the seal.

A plot of friction coefficient versus contact pressure for wet and dry seals (rubber and teflon-coated rubber) is shown below.

Trelleborg recommends carbon filled PTFE because of its superior U.V. resistance properties.



Onsite Joins

Options for joining Trelleborg Seals onsite include:-

- (a) Cold vulcanised join using an appropriate adhesive
- (b) Hot vulcanised join using an electrically heated mould

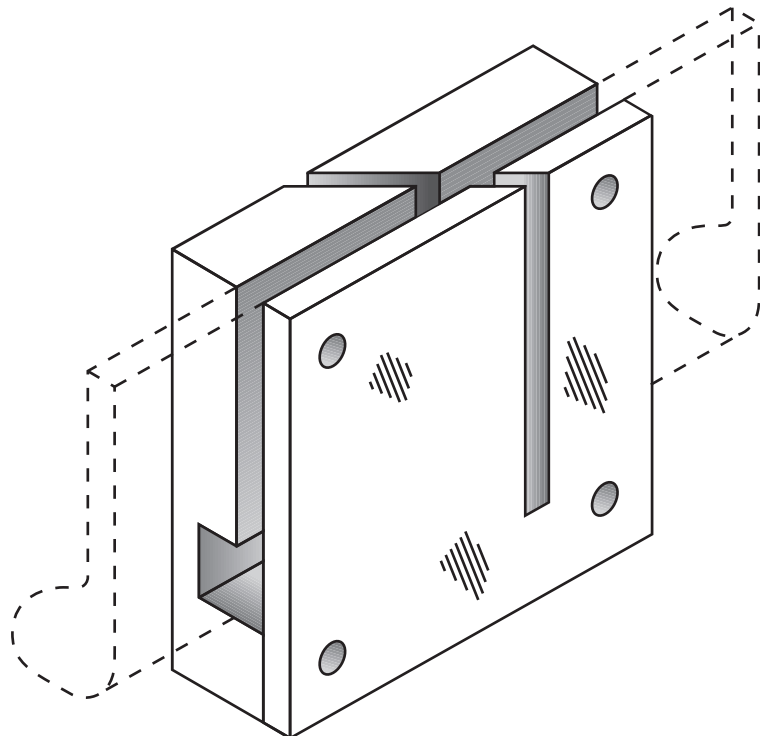
The latter option is expensive due to the high tooling costs, but is recommended for seals under high hydrostatic pressures requiring high strength bonds. Electrically heated moulds can be supplied for more commonly used sizes. If you are interested in investigating the option of hot vulcanised joins then contact a Trelleborg Engineered Products representative. We can arrange for an onsite technician to assist in making hot vulcanised joins.

It is recommended that the following materials are used to complete a cold vulcanised join:-

- Cold vulcanising adhesive (e.g. SC2000)
- Toothless saw sharpened to a knife edge
- Mitre box for ensuring a straight, uniform cut
- Disc sander or coarse emery paper
- Rubber dust (optional)
- Cleaning solvent such as acetone
- Small paintbrush

The recommended procedure for completing the cold vulcanised join is:-

1. Place the seal in the mitre box and make a skived cut at an angle of approximately 30 degrees to the seal profile. If a mitre box is not available then a butt joint should be made at right angles. Match the ends of the two sections to check for an accurate fit.
2. The surfaces to be joined should be roughened with the disc sander or coarse emery paper, then cleaned with acetone.
3. Mix a small quantity of the adhesive. Apply the first coat to the cleaned surfaces to be joined with the small paint brush and allow to dry. Do not allow the two surfaces to come in contact.
4. Apply a second coat of adhesive and allow to touch dry. Place the two edges together and clamp in position.
5. If there are any gaps across the joint, then mix the rubber dust with a small amount of adhesive to form a paste. Spread the paste into the gaps and allow to dry.



MITRE BOX FOR STRAIGHT JOINS

Recent Projects

Australia

• New Southern Railway (NSW) - Waterstops and Gina- type Seals

• Kununurra Diversion Dam (WA) - Lip and Flat Seals

• Hume Dam Note Seals (NSW) - Music Note Seals

• Cataract Dam (NSW) - Music Note Seals

• Snowy Mountains Hydroelectric Scheme (NSW) - Specialty Gate Seals

• Hydroelectric Scheme (Tasmania) - Specialty Gate and Inflatable Seals

• Swanbank Power Station (QLD) - Discharge Valve Seals

• Wyangala Dam (NSW) - Gate Seals

• Eildon Reservoir (VIC) - Bulkhead Seals

• Royal Pines Resort (QLD) - Lock Gate Seals

• Boobegan Creek (QLD) - Lock and Weir Gate Seals

• Stanwell Power Station (QLD) - Expansion Bag Assemblies

• Sunwater Queensland - Butterfly Valve Seals with Kevlar®

• NRG Gladstone (QLD) - Music Note Seals

• Melbourne Water, Paterson Lakes - Gate Seals

• Wivenhoe Dam (QLD) - Bulkhead, Hump Seals with PTFE

Recent Projects

Overseas

• London Underground	-	Fabric-reinforced Omega-type Seals
• Rosyth Royal Dockyard (England)	-	Dry dock Seals
• Devonport Royal Dockyard (England)	-	Dry dock Seals
• Tanggari II Hydro-electric (Indonesia)	-	Music Note Seals
• Hong Kong Harbour	-	Gina-type Seals
• Lumut Power Station (Kuala Lumpur)	-	Specialty Tunnel Seals
• Bouwdienst Rijkswaterstaat	-	Specialty Lip Seals
• Devonport Royal Navy Dockyard	-	Spare set Dry Dock Seals
• Ruacana Hydro Namibia	-	Music Note Seals with PTFE
• Victoria Dock, Cape Town (South Africa)	-	Dry Dock Seals
• Auckland, New Zealand Devonport RNZN Dock	-	Floating Dock Gate Seals



Trelleborg Engineered Products is part of the Trelleborg Offshore & Construction business area of the Trelleborg Group. Trelleborg Engineered Products is a leading global developer, manufacturer and provider of engineered polymer solutions to the energy, infrastructure and mining industries. Performing in some of the harshest environments on earth, its principal products are sealing systems for tunnels, a wide range of bearings, polymer solutions for floatover technology and wear resistant products for the mining industry. With local support, a track record of over 100 years and its everyday ingenuity, customers can rely on Trelleborg Engineered Products to deliver innovative polymer solutions that significantly improve the quality, safety and efficiency of its customers' operations worldwide.

WWW.TRELLEBORG.COM/ENGINEEREDPRODUCTS



facebook.com/Trelleborggroup
twitter.com/TrelleborgGroup
youtube.com/trelleborg
flickr.com/trelleborg
linkedin.com/company/trelleborg

