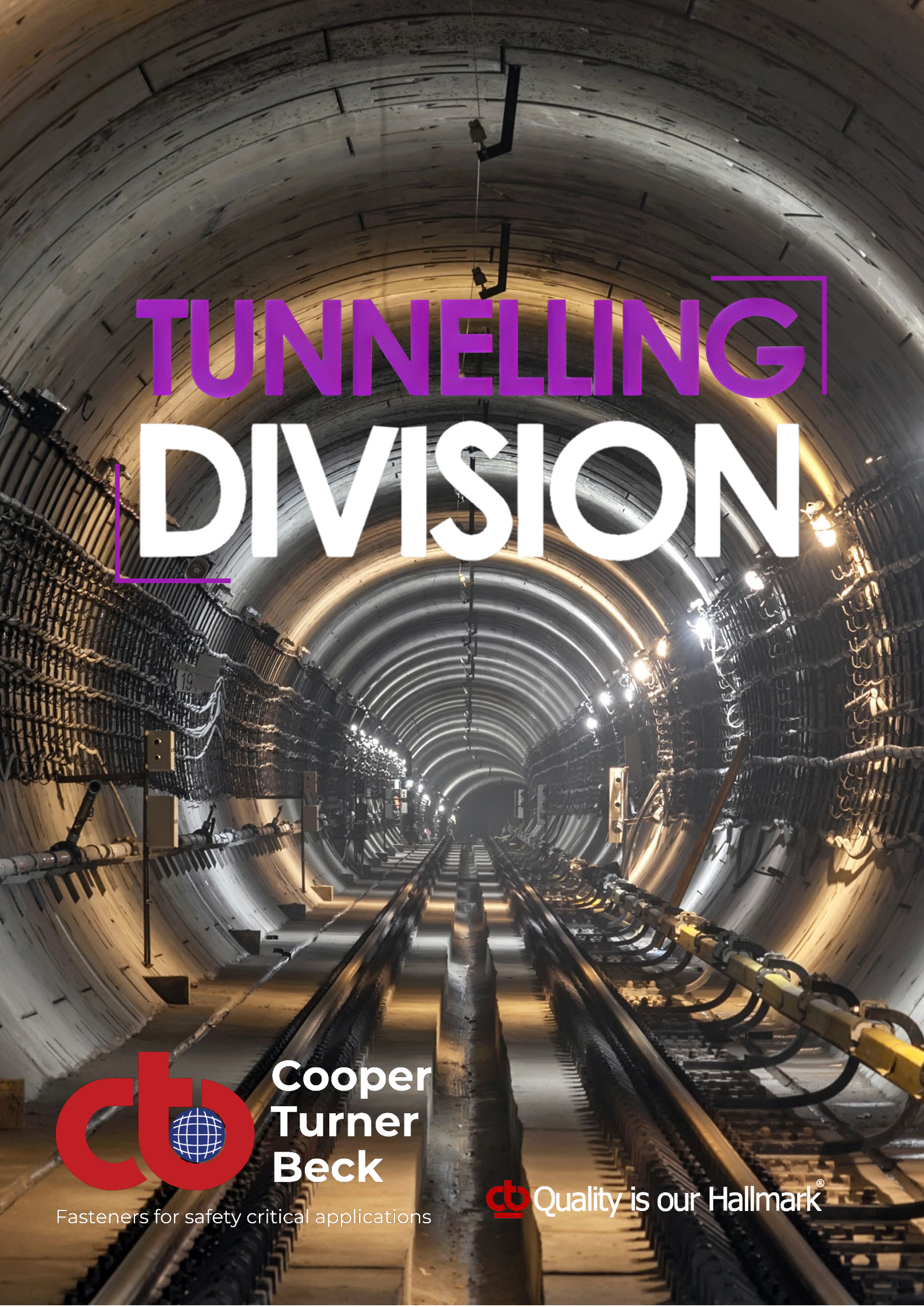

TUNNELLING
DIVISION
Cooper
Turner
Beck
Fasteners for safety critical applications
Quality is our Hallmark®

Cooper Turner Beck

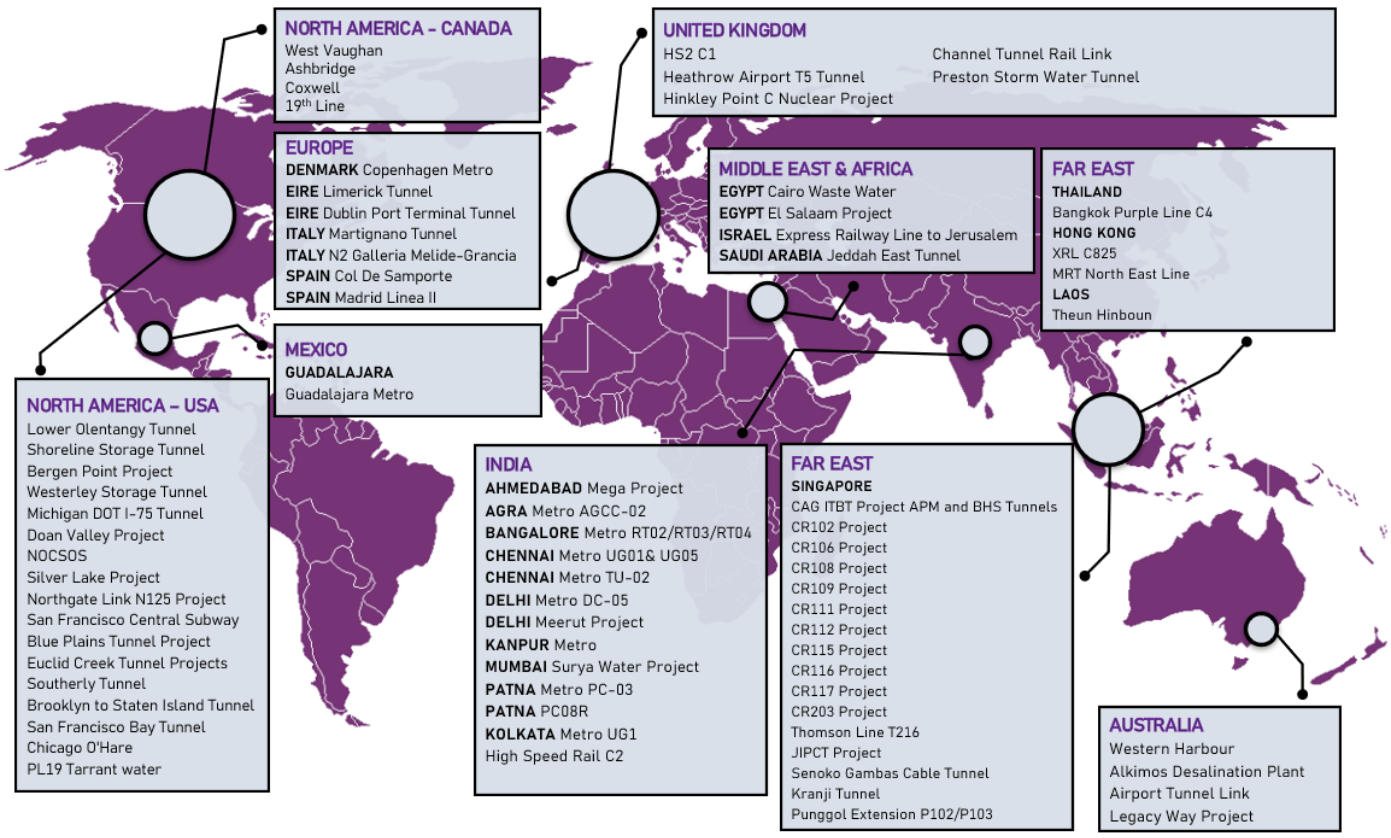
TUNNELLING DIVISION

Tunnelling is a key facet of infrastructure development. Whether constructed for transport or for water transfer, sewage management and storage purposes, Cooper & Turner products provide an integral part of the structure.

With more than 30 years of experience in the tunnelling business, Cooper & Turner is a key manufacturer and provider of an extensive range of segment accessories. Whether your need is a Bolt, Seal, Segment Packer or the Grouting System, we developed solutions dedicated to support this market.

We are experienced designers and manufacturers driven by the perpetual desire to improve our products and services. Our manufacturing and distribution facilities in Europe, North America and Asia allow us to follow all the projects of our customers around the world.

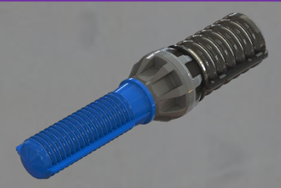
PROJECTS SUPPLIED BY COOPER & TURNER



C&T TUNNEL SEGMENT LINING ACCESSORIES

SHEAR ALIGNMENT DOWEL

MODULOCK SYSTEM



LIFTING / GROUTING SYSTEM

GROUT

PLUG

NON-RETURN VALVE

Cooper Turner Beck

STRAIGHT OR CURVED BOLT

PLASTIC SOCKET

GUIDING ROD

INTRADOS ACCESSORIES

Cooper Turner Beck

CONCRETE SEGMENT

PLASTIC SOCKET

GUIDING ROD

CAST-IN SOCKET

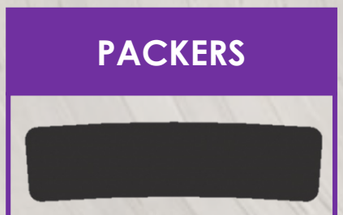
CENTRAL PIN WITH FINS

SCREW IN SOCKET

MODULOCK AND SCREW

STRAIGHT BOLT

PACKERS

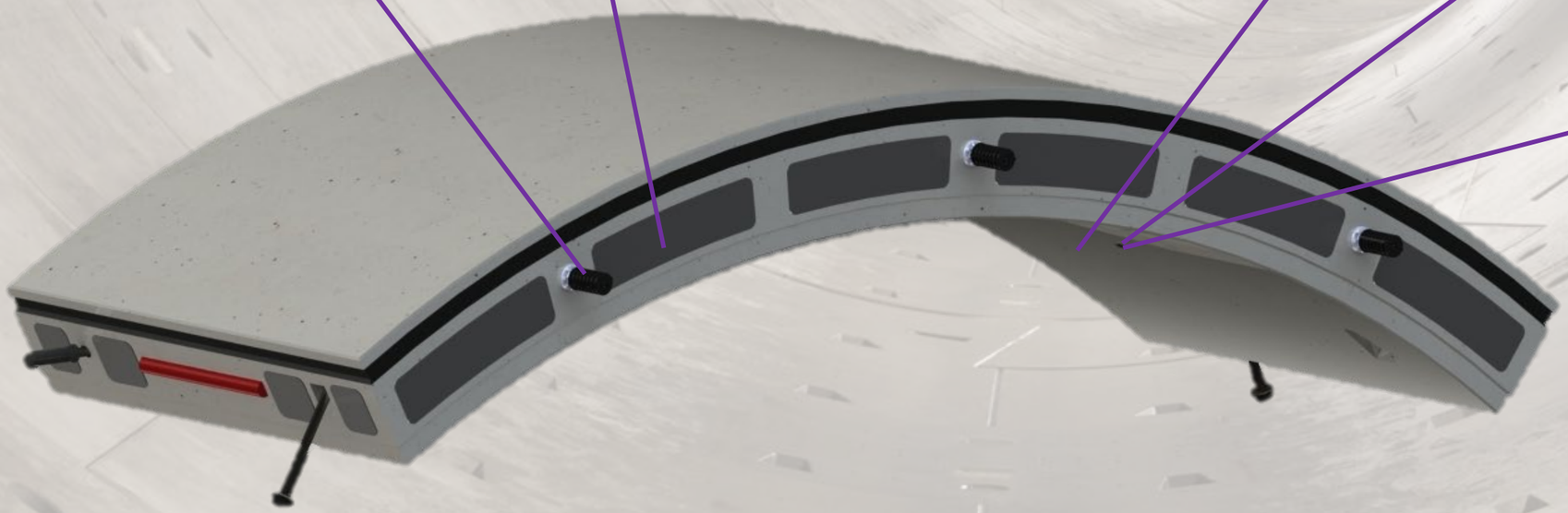


SHEAR ALIGNMENT DOWEL

QR CODE PLATE

INTRADOS SOCKET

SELF BREAKABLE HOLDER



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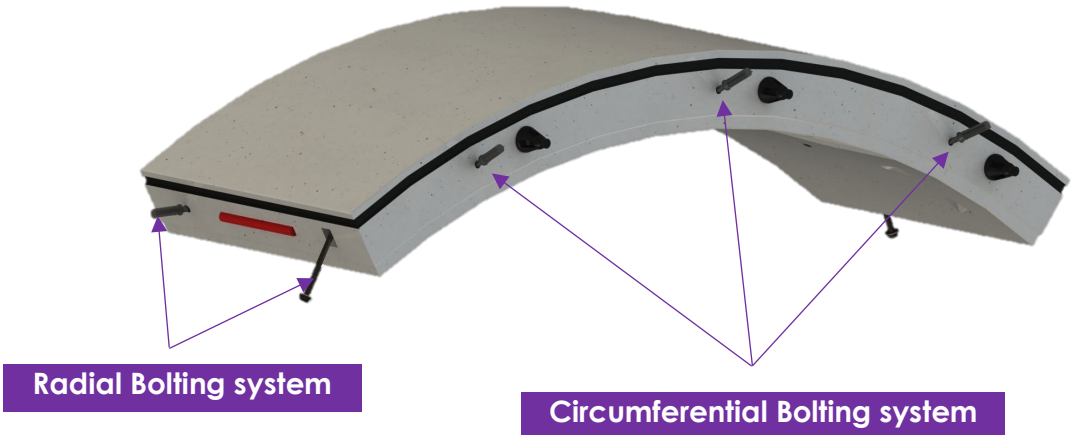
BOLTING SYSTEM

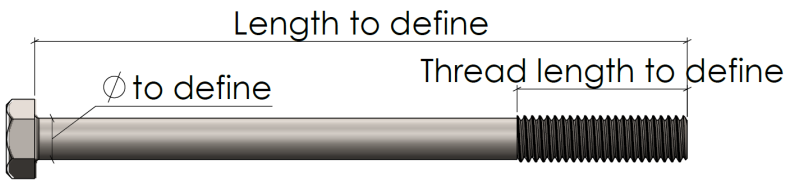
This system can be used in **radial** and **circumferential** side.

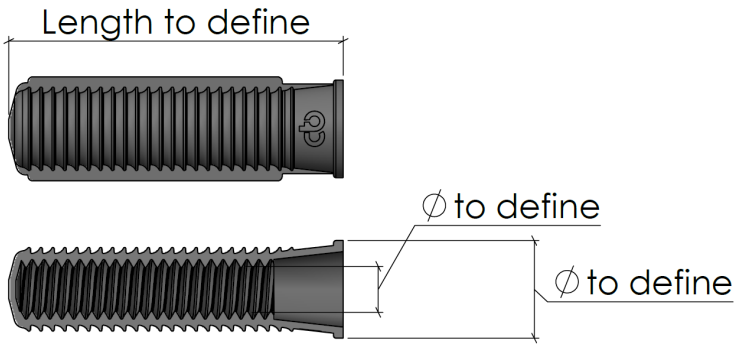


Hex Head Straight Bolting System and Plastic Socket

Bolts and the accompanying 'cast-in' sockets are used as connectors to **fix tunnel segments together** and can be used in both **radial** and **circumferential** sides of the segment. Bolt is screwed into the socket in order to ensure the **correct geometry** of the ring but also to **compress correctly** the gasket.

Additional accessories like **washers** and **grommets** can be installed in order to ensure the accuracy of the connection. Cooper & Turner manufacture the complete range of bolts in various lengths, diameters and material properties.

Cooper & Turner - Standard Straight Bolts			
Item	**Drawing**	**Material**	**Finish**
From M12 to M27		Steel Grade (4.6/8.8/ A325/…) Stainless Steel (A2/SS304/ A4/SS316)	Raw Steel / Hot Dip Galvanized / Sherardized

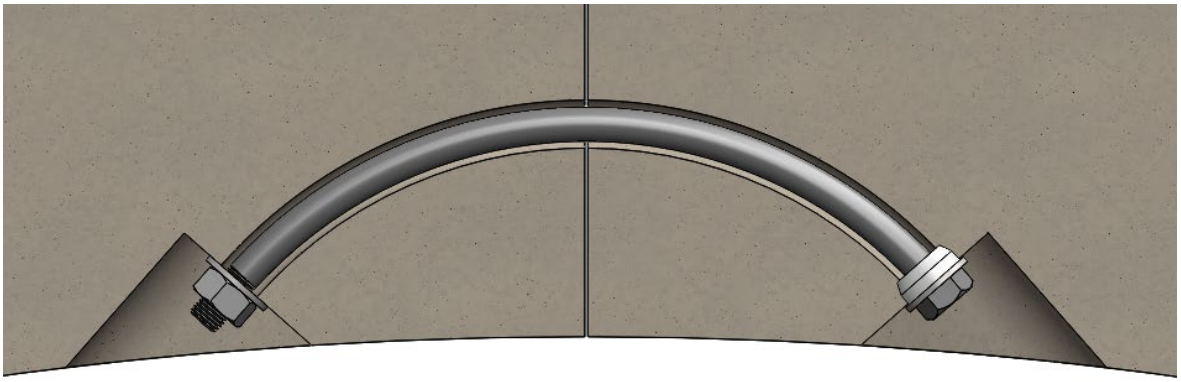
Cooper & Turner - Standard Plastic Sockets			
Item	**Drawing**	**Material**	**Pull-Out Resistance**
From M12 to M27		ABS PA6+30%GF	FROM 50 TO More than 400 kN

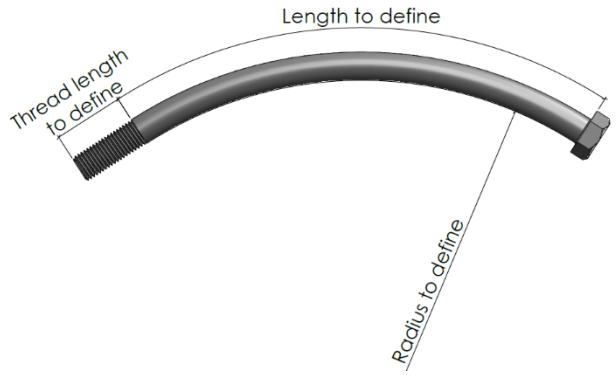
Cooper Turner Beck

Curved Tunnel Bolts

Curved bolts are used to permanently **fix tunnel segments together** through a radius hole. They can be applied to both **radial** and **circumferential** joints.

Additional accessories like washers and nuts are also offered by Cooper & Turner.
We adapt the lengths, the diameters and the materials to the needs of our customers.

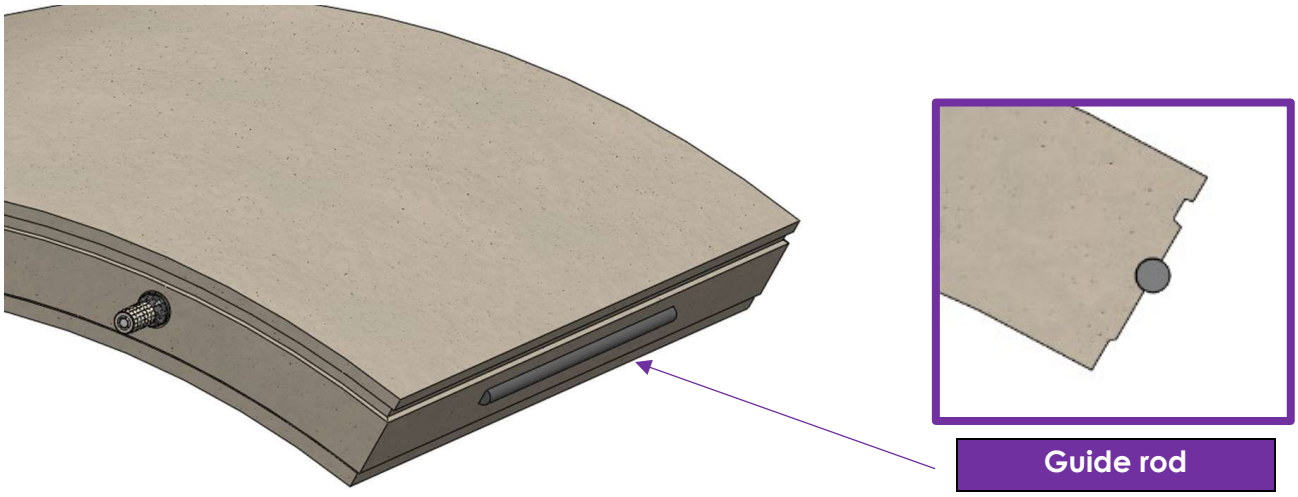


Cooper & Turner – Standard Curved Bolts			
Item	**Drawing**	**Material**	**Finish**
From M16 to M27		Steel Grade (4.6/8.8/ A325/…) Stainless Steel (A2/SS304/A4/ SS316)	Raw Steel / Hot Dip Galvanized / Sherardized

Cooper Turner Beck

GUIDE RODS

Guide rods are extruded cylindrical plastic part that come in a variety of diameters and lengths to suit different ring sizes. They can be **glued or clipped into cast semi-circular grooves** in the **radial** side of the concrete segment.



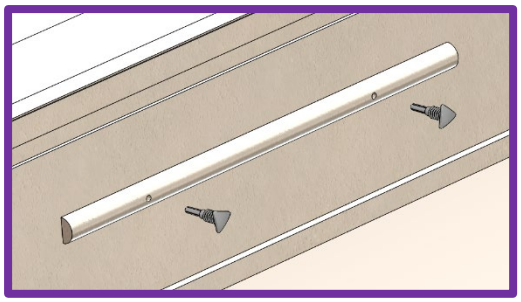
Cooper & Turner – Guide Rods		
Item	**Drawing**	**Material**
Glued Guide Rod	∅ to define Length to define	Recycled PVC Recycled PE
Clip Guide Rod	∅ to define Length to define Comes with studs Spacing to define	Recycled PVC Recycled PE
Anchored Guide Rod	∅ to define Length to define	Recycled PVC Recycled PE

Cooper Turner Beck

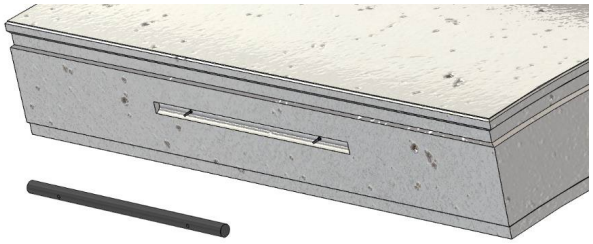
Clip Guide Rods

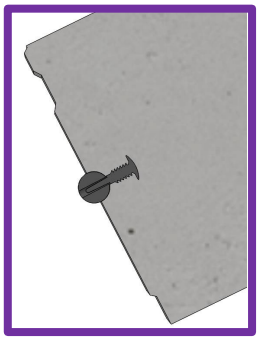
The **guide rods** are typically glued into their concrete recesses. However, the **C&T clip guide rods** provide a **more efficient alternative** by securing the rods with **plastic studs**.

These studs can be installed in the segment mould while the others accessories are installed, **saving time**.



Then after the segment casting, the guide rods can be **easily clipped** on the studs protruding from **the segment**



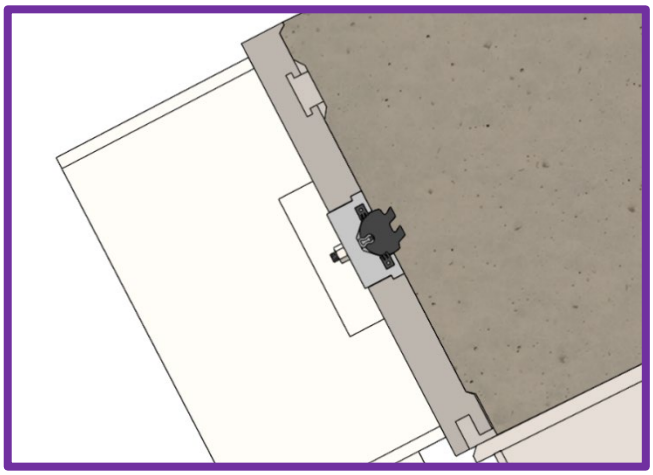


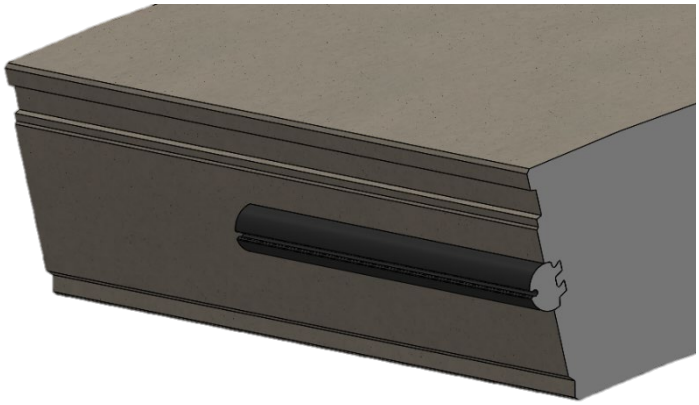
Anchored Guide Rods

Through discussion with pre-casters, Cooper & Turner's experienced technical department has developed a **new type of guide rod** that **reduces** installation time.

The anchored guide rod is clipped directly into the mould before concrete casting. Once the concrete is dry, thanks to its shape, the guide rod is **perfectly positioned** and **anchored** in the segment.

The **best solution** to save time and money.





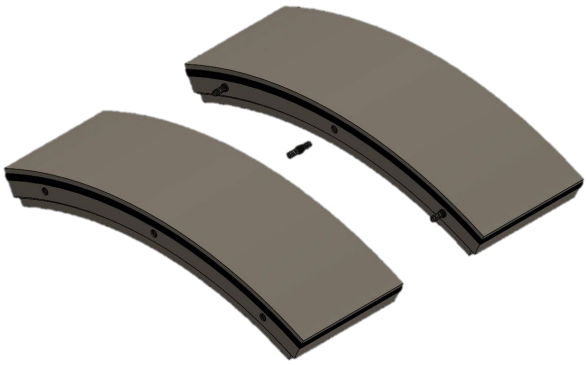
Cooper Turner Beck

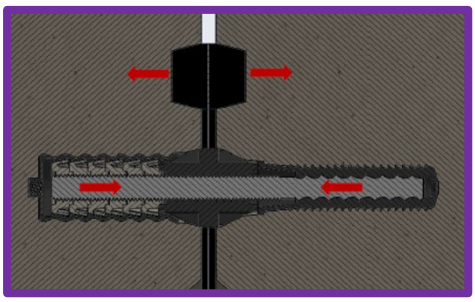
CIRCUMFERENTIAL CONNECTORS

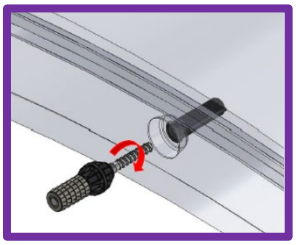
MODULOCK and Screw System

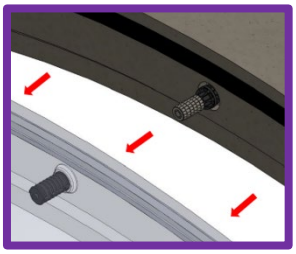
MODULOCK is the circumferential connector developed by Cooper & Turner. Thanks to our unique clip-on fins, we ensure an **easy and firm connection** between segments, and **perfect compression** of the gasket.

The shape of our product and its shear capacity **facilitate the centering** of the segments on the circumferential joints. Thanks to its experience, Cooper & Turner has developed a full range of **MODULOCK** in order to be in line with the different needs of our customers.
Our product is, for sure, the **most modular** connector on the market.









MODULOCK FAMILY		
MODULOCK and Screw	**MODULOCK High Shear Capacity**	**MODULOCK Removable**
		
Screw side of the MODULOCK makes its installation **easier** without questioning the pull-out resistance of the system ▪ **Pull-out resistance** capacity: from 50 to 135 kN ▪ **Shear resistance** capacity: 160 kN ▪ **Optimized** displacement	The central part of the pin is reinforced in order to **increase** the shear resistance of the system ▪ No need to use **bicones** ▪ No need to cast **specific segments** ▪ Can be used with **standard MODULOCK** or **MODULOCK and Screw sockets** ▪ **Shear resistance** from 250 to more than 1000 kN	Specific soft fins that allow to **easily** remove the central connector ▪ Perfect for **temporary rings** in the shafts or in the stations ▪ No need to cast **specific segments** ▪ Can be used with **MODULOCK and Screw sockets** ▪ **Pull out resistance** from 3 to 5 kN (easy to remove with a crane)

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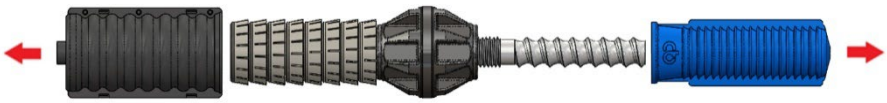
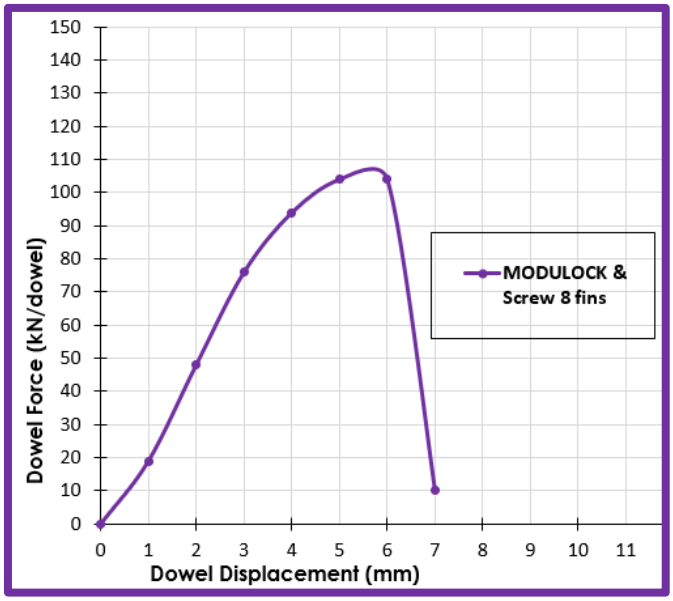
MODULOCK and Screw

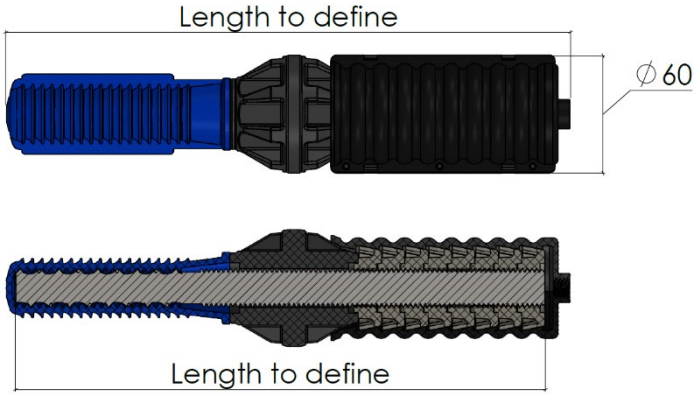
- **Ensure the alignment of the segments**
- **Easy and quick installation** – Thanks to the **screw side**, the operator can easily install the connector **just before segment erection**, eliminating any risk of **misalignment**.
- **Guarantee perfect gasket compression**

For example, with the **8-fins solution**: **80 kN with only 4 mm of displacement**, ensuring that the gaskets remain **fully compressed** – currently the **smallest displacement on the market**.

Load displacement curve – Pull Out

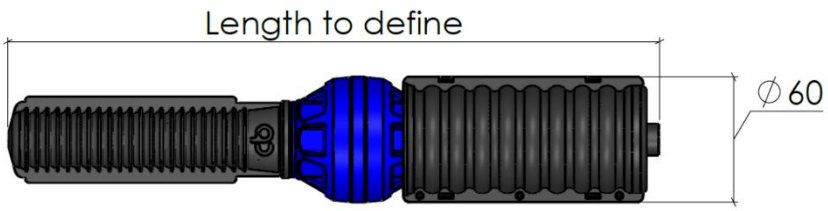




MODULOCK and Screw		
	**Pull-out from 50kN to 135kN**	**Shear 160kN**

Cooper Turner Beck

MODULOCK High Shear Capacity (HSC)

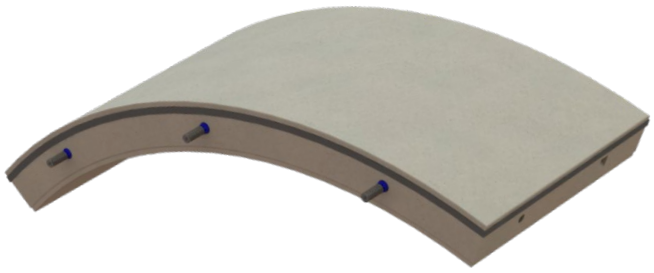
MODULOCK HSC	
	**Shear from 250kN to 1000kN**

In recent tunnel projects, circumferential joints need **reinforcement** at cross passages or shafts. Bicones are typically used alongside connectors to enhance ring resistance due to their **high shear capacity**.

However, bicones are costly and require special segments with dedicated recesses, demanding **expensive** custom moulds for limited production. To address this, Cooper & Turner developed the **HSC MODULOCK system**, leveraging modularity for a more cost-effective solution.

This connector keeps the gasket **perfectly compressed** and features a **central pin** that enhances shear resistance without altering its shape. Its shear resistance increases from **250kN to over 1000kN**.

Ring with Bicone and MODULOCK



Ring with HSC MODULOCK System

Since it uses the same sockets as the standard **MODULOCK** system, no **special moulds** or dedicated segments are needed. When high resistance is required, the **HSC MODULOCK** central pin can be installed on the segment and placed in the tunnel using the **same procedure**.

Its **blue central part** ensures easy identification, preventing installation errors.

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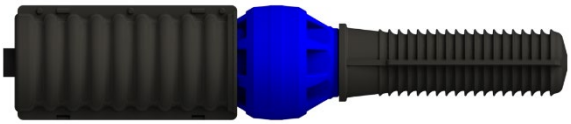
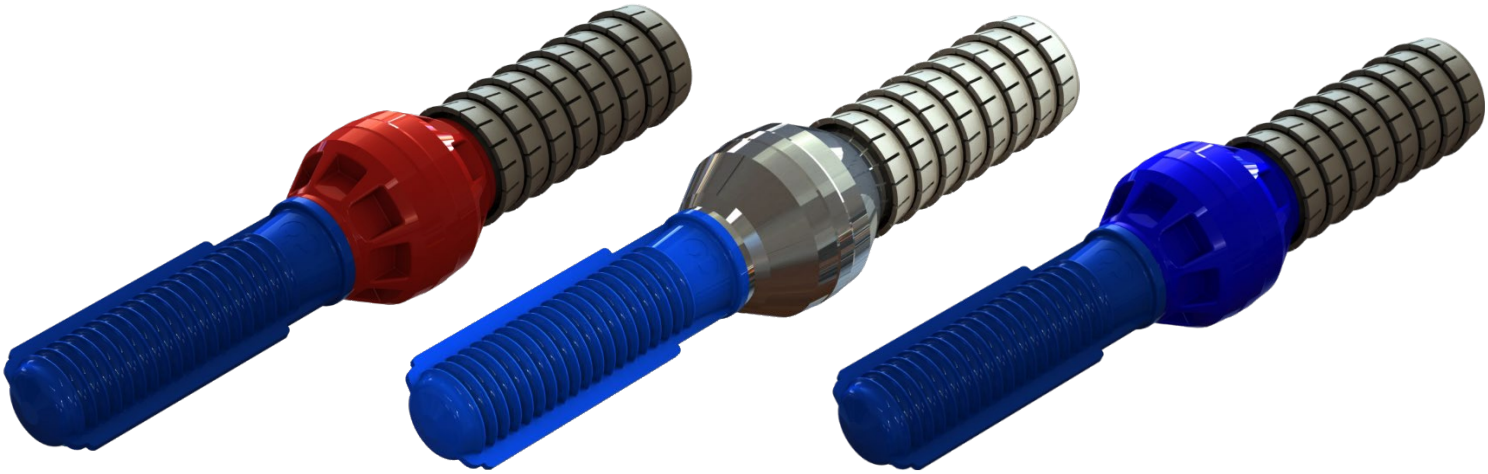
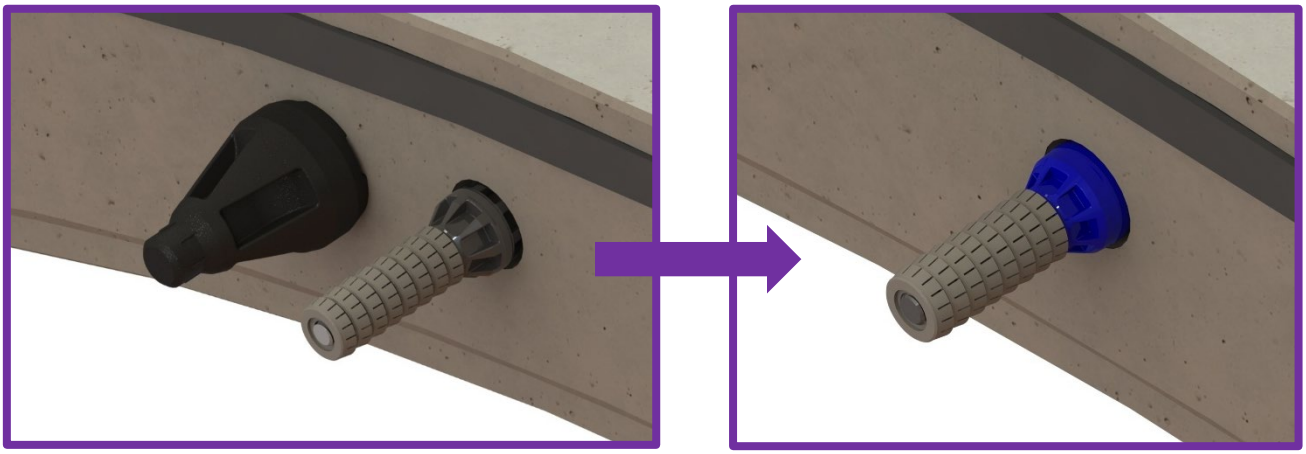
MODULOCK and Screw



HSC MODULOCK and Screw



HSC Advantages



- **MODULOCK and screw HSC** can be manufactured for all the circumferential connectors from the MODULOCK family. Whatever the quantity of fins required; we **adapt our product** to manufacture the equivalent HSC.
- No need to **modify the design** of the ring, even for the cross passages
- No need to **purchase dedicated segment's moulds**.
- Only need to purchase the **exact quantity** of central pins HSC required, only where **important shear resistance** is required; for the other areas, the standard MODULOCK and screw is sufficient.

The High Shear Capacity MODULOCK will save you time and money.

Cooper Turner Beck

MODULOCK Family

Pull-Out Resistance	MODULOCK FAMILY		Shear Resistance				
							
			100kN	160kN	250kN	850kN	1000kN
		Removable with cranes	MODULOCK Removable Central core PP	MODULOCK Removable Standard Central core PA6	/	/	/
		65 kN Ultimate 50 kN @ 2,5mm	MODULOCK 5Fins Central core PP	MODULOCK 5Fins Standard Central core PA6	MODULOCK 5Fins Central core HSC 250	MODULOCK 5Fins Central core HSC MAX	MODULOCK 5Fins Central core HSC Steel
		75 kN Ultimate 60 kN @ 3mm	MODULOCK 6Fins Central core PP	MODULOCK 6Fins Standard Central core PA6	MODULOCK 6Fins Central core HSC 250	MODULOCK 6Fins Central core HSC MAX	MODULOCK 6Fins Central core HSC Steel
		105 kN Ultimate 80 kN @ 4mm	MODULOCK 8Fins Central core PP	MODULOCK 8Fins Standard Central core PA6	MODULOCK 8Fins Central core HSC 250	MODULOCK 8Fins Central core HSC MAX	MODULOCK 8Fins Central core HSC Steel
		135 kN Ultimate 110 kN @ 5mm	MODULOCK 9Fins+ Central core PP	MODULOCK 9Fins+ Standard Central core PA6	MODULOCK 9Fins+ Central core HSC 250	MODULOCK 9Fins+ Central core HSC MAX	MODULOCK 9Fins+ Central core HSC Steel

In addition to our family of products, C&T can develop a special **MODULOCK** to meet project requirements **perfectly**.

All our products also exist with both symmetrical clipped sides : the Standard MODULOCK

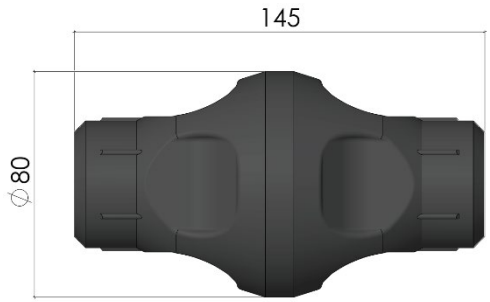
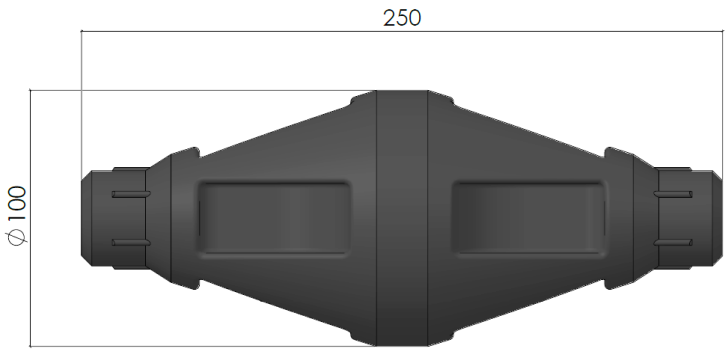
Standard MODULOCK

Cooper Turner Beck

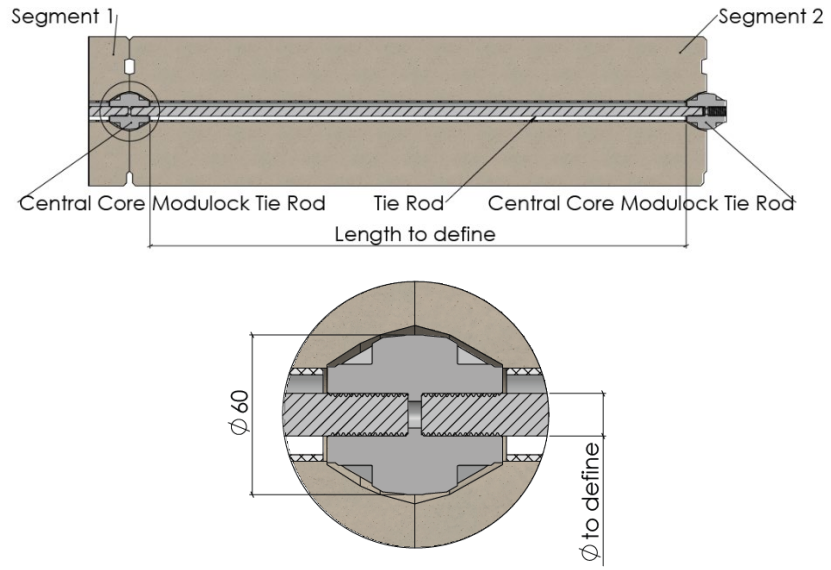
Alignment Dowels

Alignment dowels are used in conjunction with a straight bolt or dowel connection system to **assist alignment** during the erection phase on the circumferential joint. They are placed into corresponding cast voids in the segments to **guide the installation** of the next segment and to increase the shear capacity at the openings.

They can be manufactured with or without steel bar reinforcement, depending on the **shear resistance** required.

Cooper & Turner - Standard Alignment Dowels			
Item	**Drawing**	**Material**	**Shear resistance**
Ø80x145		PP With Steel Rod	100 kN To 500 kN (Depending on design)
Ø100x250		PP With Steel Rod	100 kN To 500 kN (Depending on design)

Tie Rods

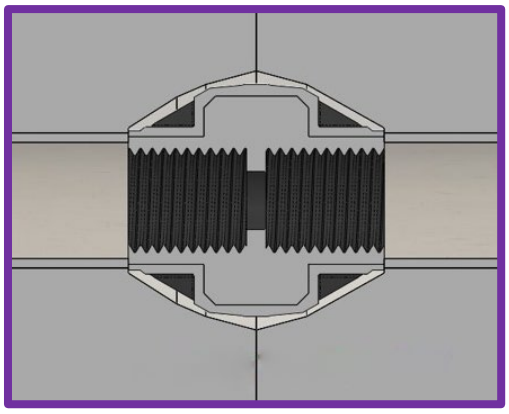
Cooper & Turner - Standard Tie Rods			
Item	**Drawing**	**Pull out resistance**	**Shear resistance**
MODULOCK Tie Rod From M16 to M27		From 130kN to 380kN	From 500kN

Thanks to the modularity of our **MODULOCK system**, Cooper & Turner has adapted the central part of our connector to integrate a **threaded insert**, allowing it to be connected with **threaded rods**.

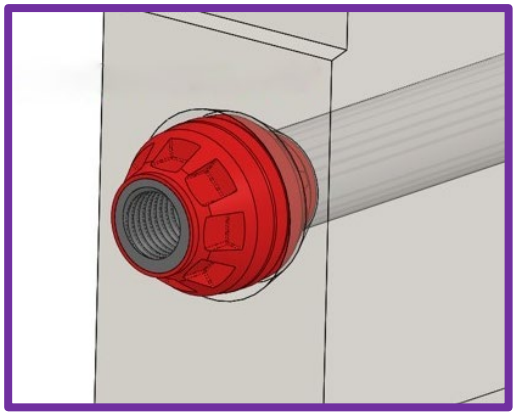
This special connector would have a **shear resistance** similar to the **HSC-MAX (850 kN)**, as the central **steel insert** would have a similar **outer diameter**, and the **pull-out resistance** would be ensured by the **threaded rods**.

The advantage of this system is that it would require only **few modifications** to the moulds. The concept is to use the **MODULOCK socket holders** to secure the **PVC tube** instead of the sockets.

MODULOCK Tie Rod



MODULOCK Tie Rod

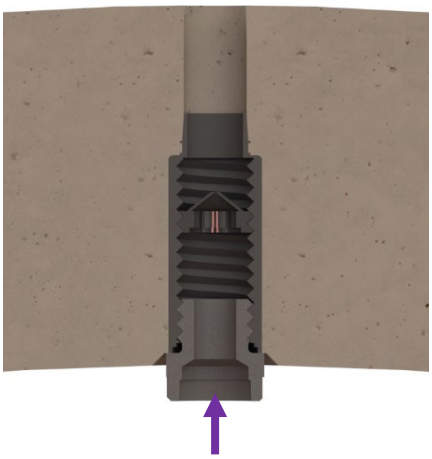


Cooper Turner Beck

GROUTING SYSTEM

Threaded Grout Lifting Sockets

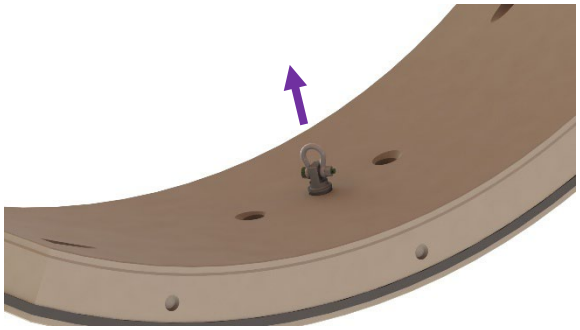
Grout sockets are specially designed to allow secondary grouting work after installation of the segment.



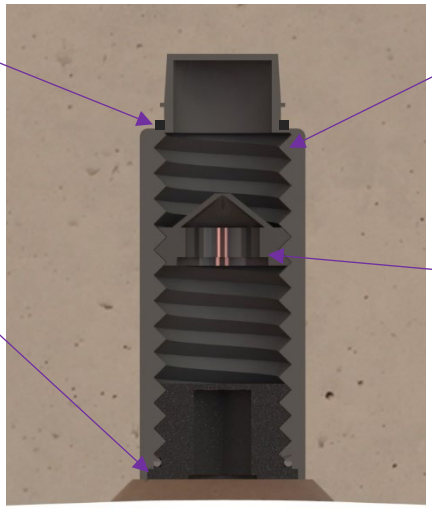
Grouting injection

All our sockets can be also used as **lifting** sockets for the handling and installation of the concrete segments, thanks to a dedicated lifting pin installed on the TBM's erector.

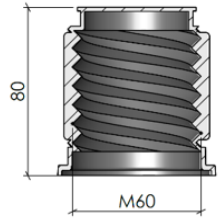
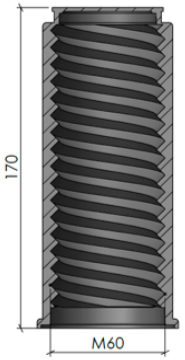
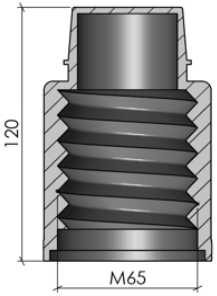
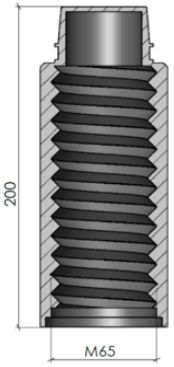
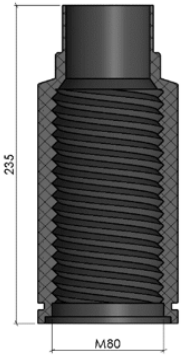
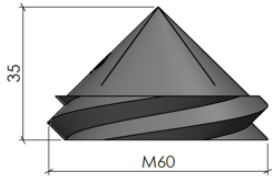
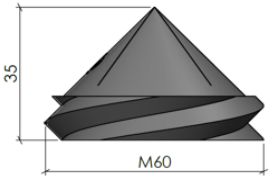
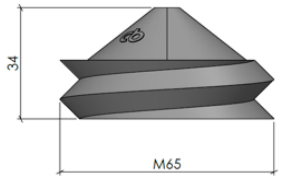
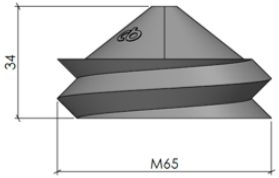
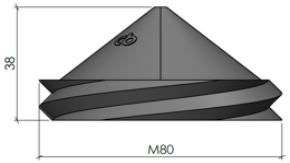
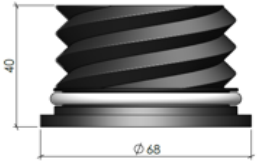
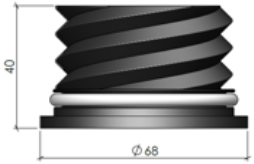
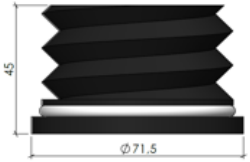
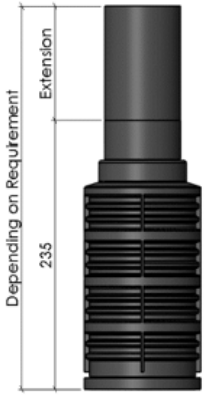
Segment Lifting



A variety of designs can be supplied to suit any requirements.
Dedicated **non-return valves** and **sealing plugs**, with EPDM or hydrophilic O-ring, can be supplied.
Cooper & Turner can also manufacture a large range of steel grout sockets when it is required.



Cooper Turner Beck

Cooper & Turner – Standard Grout Lifting Sockets					
Grout socket	M60x80 Opened end or closed end	M60x170 Opened end or closed end	M65x120 Opened end or closed end	M65x200 Opened end or closed end	M80x235 Opened end or closed end
					
Non- return valve	NRV M60	NRV M60	NRV M65	NRV M65	NRV M80
					
Grout plug	Plug M60	Plug M60	Plug M65	Plug M65	Plug M80
					
Option	/	/	/	Extension	Extension
	/	/	/		

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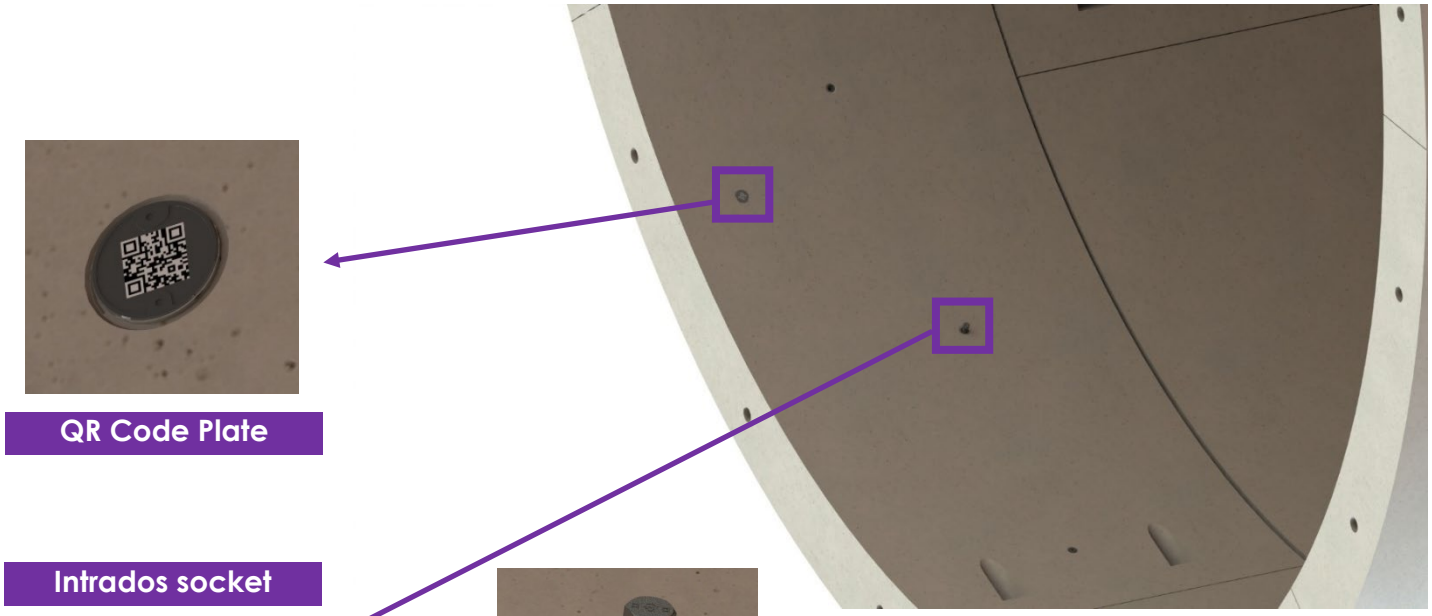
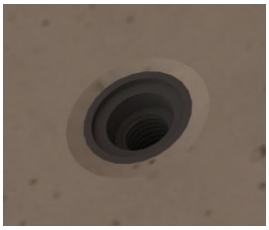
INTRADOS ACCESSORIES

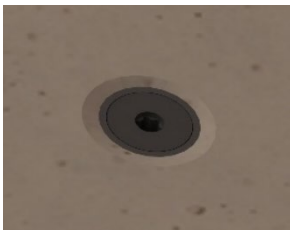


QR Code Plate

Intrados socket



With bolt

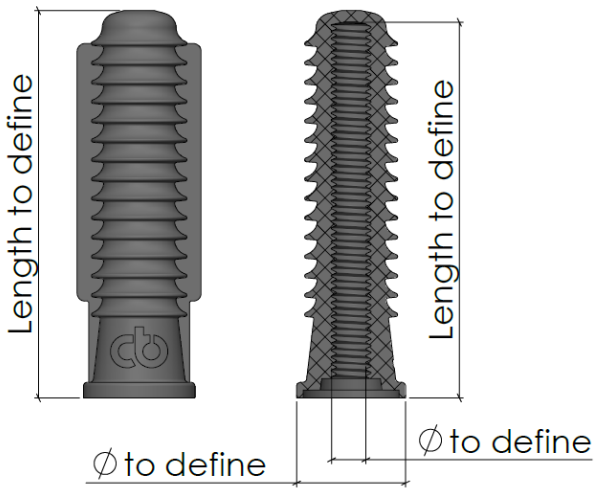


With protective cap

Intrados Sockets

Cooper & Turner also proposes a large range of **intrados sockets** designed in order to allow the installation of additional **brackets/services** inside the tunnel after installation of the **ring**. The **sockets** can be made in **steel, in plastic or in ceramic**.

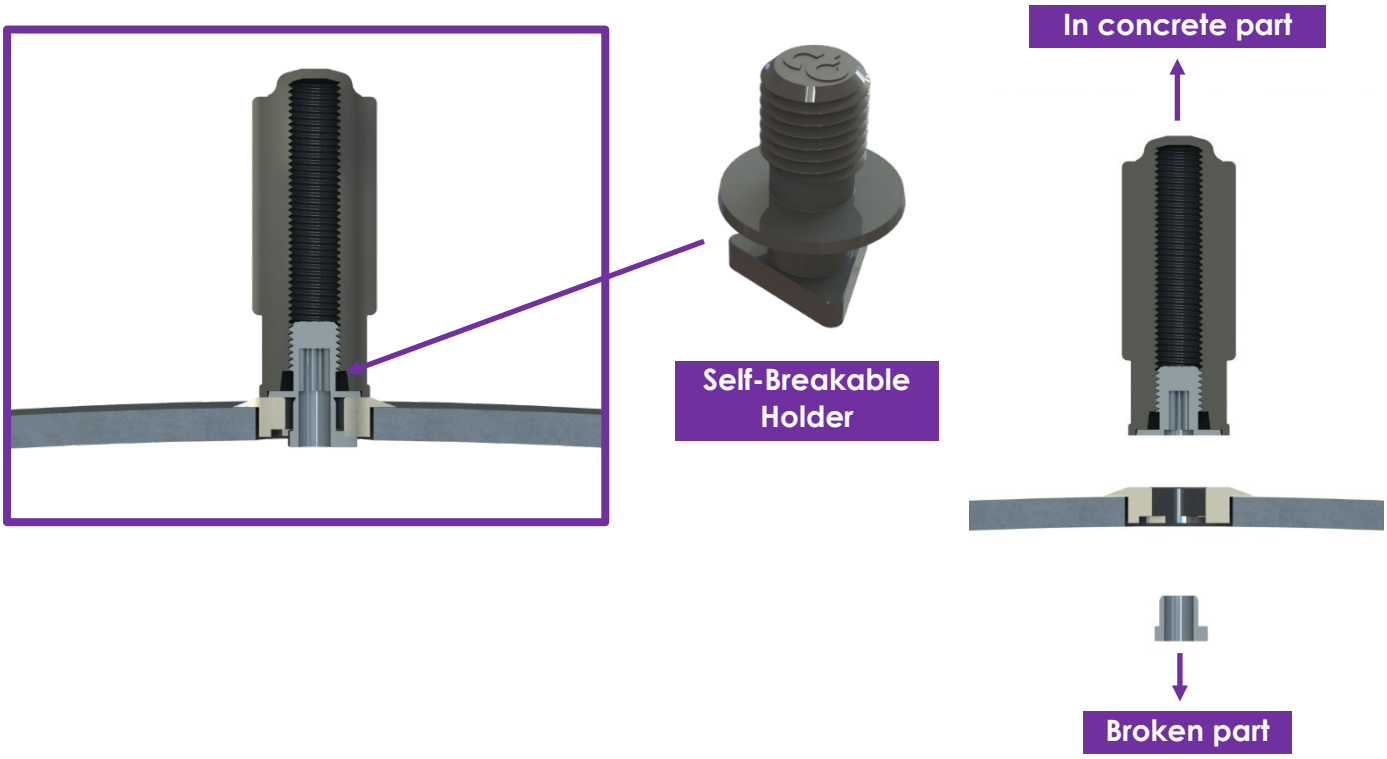
We developed a full range of holders in order to install these sockets inside the segment moulds.

Cooper & Turner – Standard Intrados Sockets		
Item	**Drawing**	**Material**
From M10 to M30		ABS HDPE Ceramic Steel Stainless Steel

Cooper Turner Beck

Self-breakable Holder

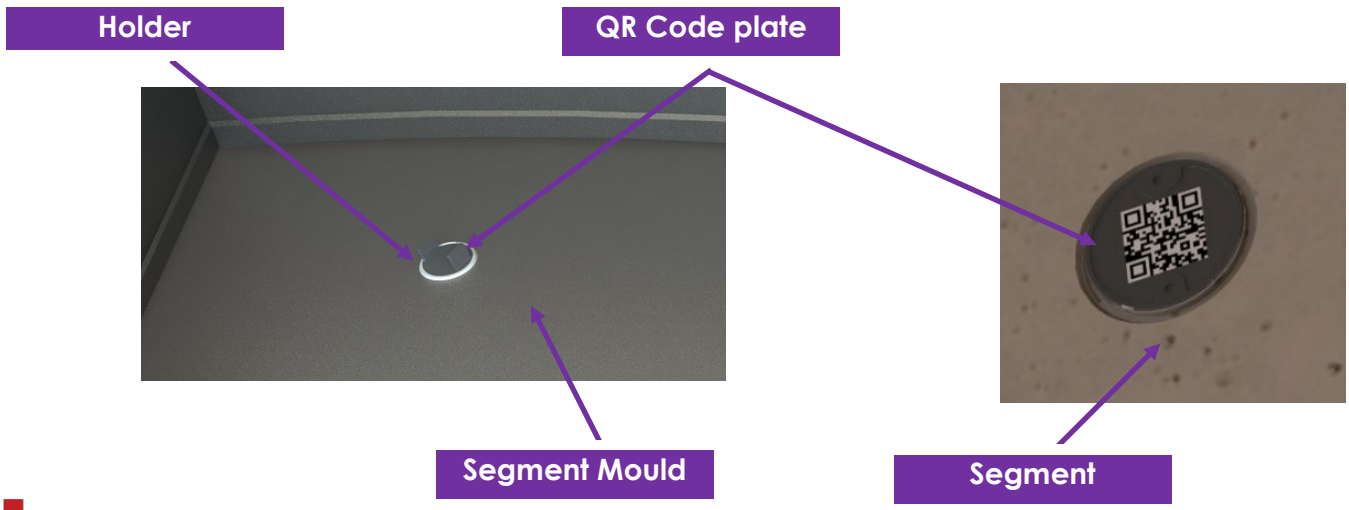
Cooper & Turner also offers a **self-breakable holder** designed for the installation of **intrados sockets** at any location into the mould. Its innovative shape ensures that it breaks during demoulding, allowing the lower part to detach while the upper part remains in place, acting as a **protective cap** to **protect the socket from water, dust or freezing**.



QR Code plates

The Cooper & Turner **QR Code Plates** are used for the **traceability** of segments. It allows to have an access to the reference of the segment, of ring, data of production, storage and many others…

The **QR Code Plates** are **easy to install** in the mould thanks to our unique design. After demoulding of the segment, the plate is visible on the **intrados** of the segment.



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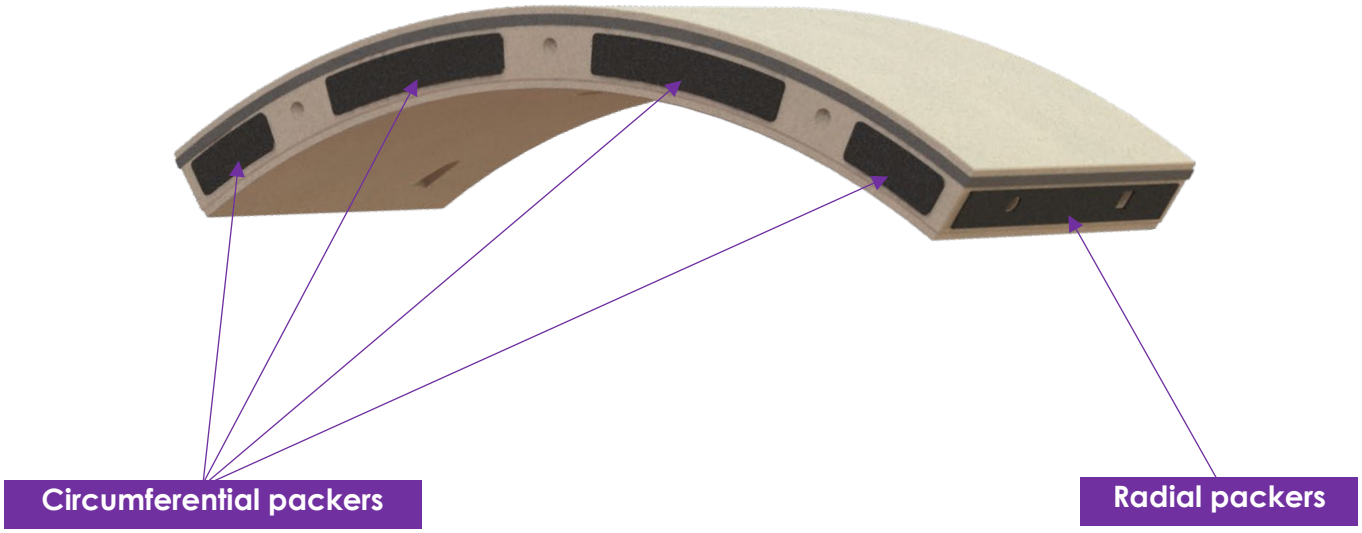
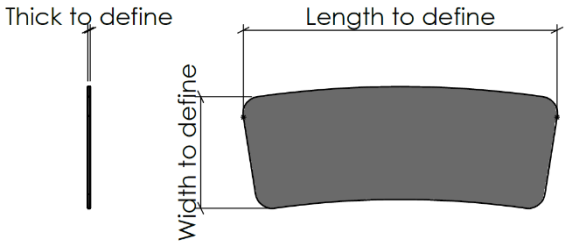
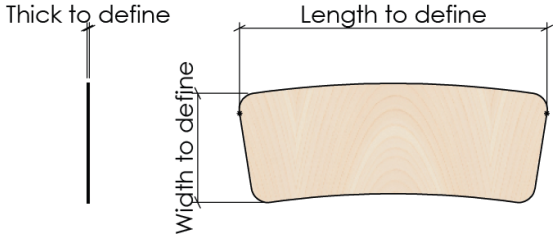
LOAD DISTRIBUTION PADS (PACKERS)

Packers for segmental linings are usually installed on the **circumferential joints** in order to transfer TBM's hydraulic loads between adjacent rings.

They can be manufactured in different raw materials and can be **made self-adhesive.**

The size and the shape of the packers are adjusted on demand.



Cooper & Turner – Packers		
Item	**Drawing**	**Material**
Plastic Packers		LDPE Self-Adhesive PP Self-Adhesive
Plywood Packers		Plywood

Cooper Turner Beck

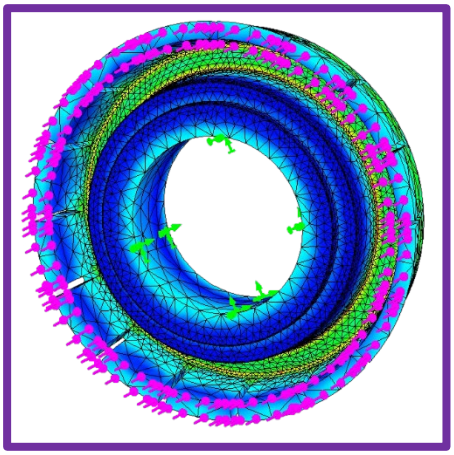
DESIGN, SIMULATION AND TESTING

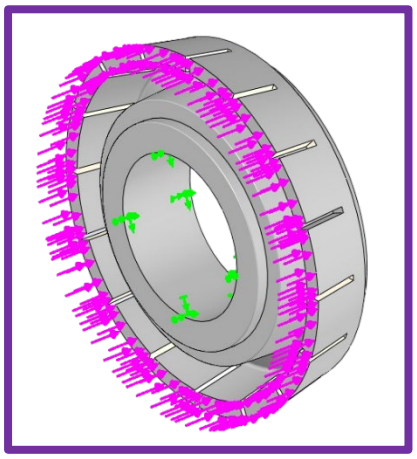
All the Cooper & Turner's products have been designed and developed by **experienced engineers** specializing in the **tunnelling market**. Our designers work on the constant improvement of our products, as well as on the design and the production of **new testing processes and tools**. Our computer simulations are always confirmed by empiric tests made in **laboratory**.

Thanks to our quality department, all our products are subject to quality control during the design phase and throughout all our projects.

Cooper & Turner – Tunnelling Division

Design and Simulation





In-house and On-site Testing

Cooper Turner Beck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Quality is our Hallmark®