

ROBBINS

DOUBLE SHIELD TBMs



HOW THEY WORK

Robbins Double Shield TBMs are the long-haul specialists of the tunnel boring world. Since their development in 1972, Double Shield machines have excavated some of the world's longest tunnels and achieved world records in the process. The secret lies in their ability to simultaneously bore and line the tunnel with segments, making for faster excavation even in difficult ground.

The design consists of a rotating cutterhead that holds disc cutters from 17 to 20 inches in diameter. The cutterhead is mounted to a cutterhead support and followed by three shields: a telescopic shield, a gripper shield and a tail shield. The completely enclosed shielded design provides a safe working environment for the crew.

In Double Shield mode, the gripper shoes are energized, pushing against the tunnel walls to react the boring forces. The main propel cylinders push the cutterhead support and cutterhead forward. The telescopic shield extends as the machine advances keeping everything in the machine under cover and protected from the ground surrounding it. The gripper shield remains stationary during boring. A segment erector is fixed to the gripper shield allowing pre-cast concrete tunnel lining segments to be erected simultaneously while the machine is boring.

If the ground becomes too weak to support the gripper shoe pressure, the machine can be operated in Single Shield mode.

BEST TBM DESIGN FOR

- Slightly fractured to very fractured medium to hard rock
- Hard rock up to and over 400 MPa UCS
- Abrasive conditions
- Blocky ground
- Hard rock conditions requiring a shield to protect the crew
- Non-pressurized tunneling. Can operate in significant water inflows
- Tunnels that require segmental lining

DESIGN OPTIONS

- Abrasion-resistant wear plating on the cutterhead
- Back-loading cutterhead for faster and safer cutter changes
- Difficult Ground Solutions (DGS):
 - Multi-speed gearboxes to enable the machine to advance through blocky, fractured, or squeezing ground
 - 360-degree probe drills for pre-excitation investigation
 - Specialized grout injection systems for ground consolidation
 - Forepoling capabilities for fractured ground
 - Ultra-high emergency thrust system
 - Rapid Advance Shield Design, including shield lubrication and hydraulic shield breakout capabilities for high cover and squeezing ground conditions
 - Water Inrush Control, including a sealable guillotine gate to contain water and inflatable seals to keep the telescopic shields water-tight in the event of a large water inflow



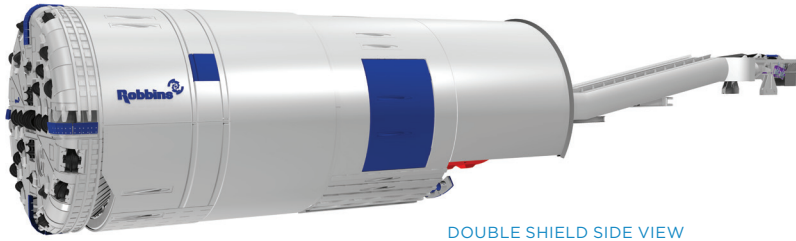
Onsite First Time Assembly of a 10.0m diameter Double Shield TBM in Turkey



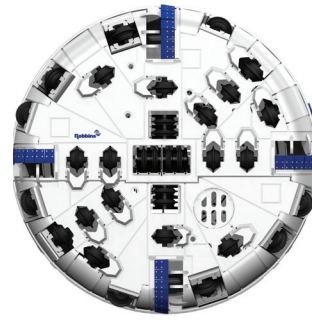
Mid-sized Double Shield TBM in the Solon, Ohio, USA manufacturing facility



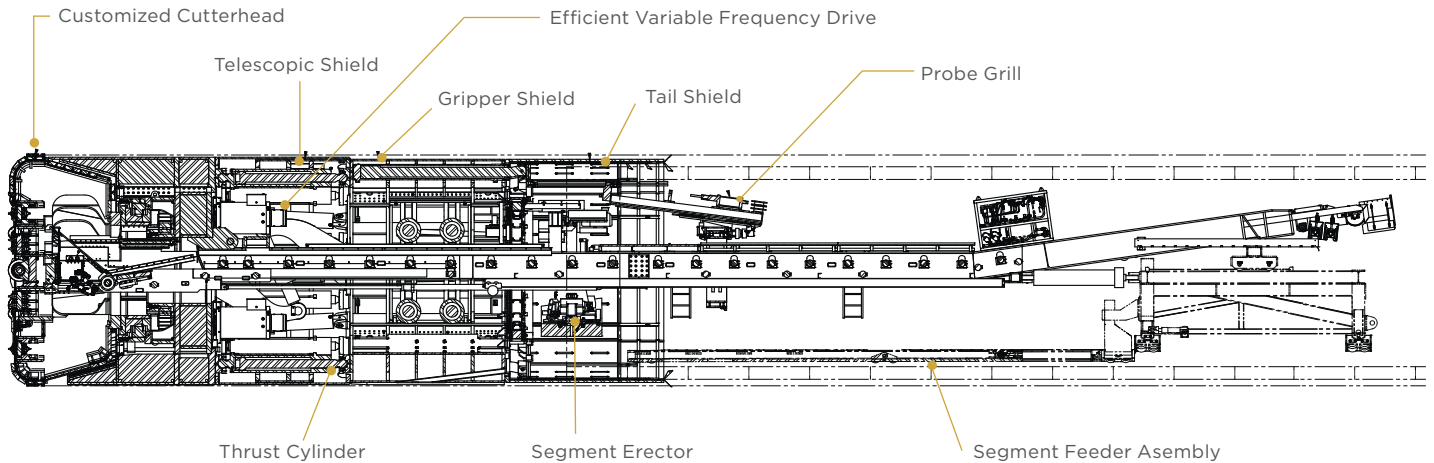
Rear view of a Double Shield TBM showing segment erector



DOUBLE SHIELD SIDE VIEW



DOUBLE SHIELD CUTTERHEAD



SPECIFICATIONS: ROBBINS DOUBLE SHIELD

DOUBLE SHIELD DESIGN SERIES

2.5 m TO 3.5 m SERIES 1

3.2 m TO 4.8 m SERIES 2

4.3 m TO 5.8 m SERIES 3

5.3 m TO 7.0 m SERIES 4

6.8 m TO 8.7 m SERIES 5

8.5 m TO 11.2 m SERIES 6

10.9 m TO +17 m SERIES 7

PROVEN IN THE FIELD

- Robbins invented the first Double Shield TBM for Italy's Orichella project in 1972.
- Since the use of Robbins Double Shield TBMs began, they have excavated more than 760 km of tunnel worldwide.
- Robbins cutterheads are designed from actual field data: Our cutterheads have gotten 30% heavier over the last 25 years, and they are also 30% heavier on average than other manufacturers' heads, making them the most long-lasting design on the market.
- Robbins introduced large diameter 19-inch and 20-inch cutters to the TBM market in order to excavate hard rock more efficiently with improved cutter life.
- Robbins High Performance (HP) Double Shield TBMs come equipped with highly efficient, electric variable frequency drives (VFDs).
- Robbins Double Shield TBMs are designed with the largest main bearing to tunnel diameter ratio in the industry—a robust design for high thrust in hard rock conditions.



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