

# Timken Bearings Help Make Way for the World's Longest, Deepest Rail Tunnel

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## Customer

Herrenknecht Tunneling Systems

## Market

Mining

## The Timken Advantage

Timken helped Herrenknecht avoid work stoppage over an eight-year work period by providing more than 25,000 bearings, with exceptional service and delivery levels.

It took 15 years, 3,000 workers, €9.1 billion (US \$12.7 billion) -- and thousands of bearings made by The Timken Company -- to make way for Switzerland's colossal 57-km (35.4-miles) Gotthard base railway tunnel. The tunnel is the world's longest, most deeply set passage of its kind.

Four Herrenknecht Gripper tunnel-boring machines completed the work, which excavated and secured two parallel, main-tunnel tubes of more than 85 km (52.8 miles), for a combined expanse of 114 km (70.8 miles). Since 2003, the cutter assemblies in these machines required thousands of Timken® standard and P900 tapered roller bearings. Frequent bearing replacement helped the machinery manage grueling loads and difficult conditions while making the passageway through the mountains.

Timken's P900 bearings feature surface modifications to help address performance concerns associated with the mountain conditions such as marginal lubrication, a maintenance constraint caused by an overburden of rock of 2,500 m (8,202 feet). Additionally, special race profiles in the P900 bearings help manage the higher loads and misalignment conditions, which pose particular engineering challenges for deep tunneling applications.

"This is perhaps one of the most challenging applications for cutter-specified tapered roller bearings," said Steve Boyd, Timken principal application engineer, who assisted the cutter design. "The rugged terrain required a cutting action that subjected the bearings to highly variable loads. Leading up to the start of this massive project, our customer engineering group provided detailed modeling of the bearing loads to assist in optimizing the bearing design."

Supplying such a large quantity of bearings through the duration of the project was a challenge. “During the actual tunneling phase, our customer service and supply chain teams had to maintain delivery and service levels to avoid any work stoppage over the eight-year work period,” said John O’Hearn, specialist, Timken tunnel boring sales.

Herrenknecht’s best boring-machine performance on this project was a record-breaking 56 m (184 feet) – at a 9.5 m (31 feet) diameter – in a 24-hour period. The top monthly tunneling performance for Herrenknecht’s boring machines was 711 m (2,333 feet). As they cut deep inside the mountain, grippers at the rear of the boring machines braced themselves with two gripper plates against the rock. From there, hydraulic cylinders pushed the cutter heads into the tunnel face. Rock chips that broke out between the 75-mm-to-90-mm spaced concentric cutter tracks at the face were removed from the tunnel to the surface on a conveyor belt.

David Krauter, Herrenknecht cutter product manager based in Sumner, Wash., said, “The cutters are rated for a load capacity of 267 kilonewtons (approximately 60,000 pounds). Because of the severe and challenging environment, bearing reliability was of great importance.”

The Gotthard base tunnel in Switzerland connects the north portal in Erstfeld (Canton Uri) with the south portal in Bodio (Canton Ticino) and consists of two side-by-side, single-track tubes that are connected every 325 m (1,066 feet) with 40 m (131 feet) galleries. Projected to be operational by the end of 2017, officials expect the tunnel to markedly improve high-speed passenger and heavy-freight transport in Europe. Travel time between Zurich and Milan, for example, would be reduced nearly an hour – from 3 hours and 40 minutes to 2 hours and 50 minutes.

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