



PIONEERING UNDERGROUND TECHNOLOGIES

HERRENKNECHT E-POWER PIPE®

The microtunnelling innovation for two-step pipe installation

Supported by



on the basis of a decision
by the German Bundestag



Herrenknecht E-Power Pipe®

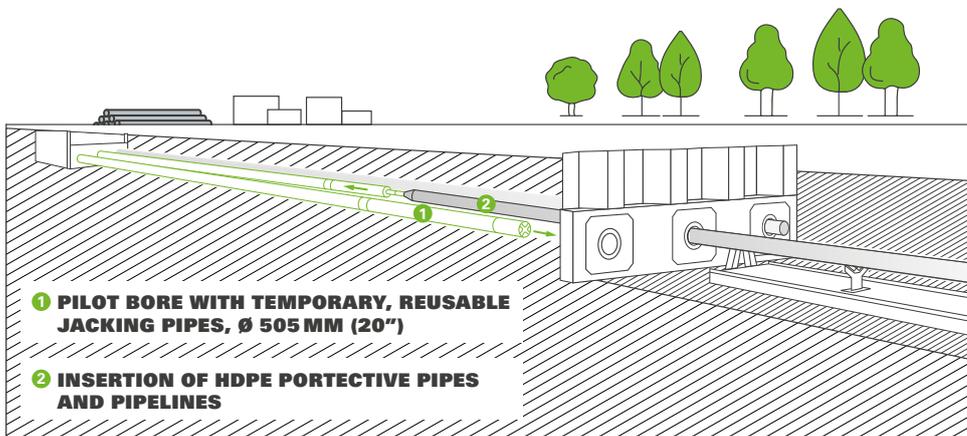
Environmentally friendly alternative to the open-cut method

The Herrenknecht E-Power Pipe® method is used for the trenchless installation of small-diameter product pipes at shallow depths. Over long distances of up to two kilometers, both pressure-resistant (e.g. steel) and non-pressure-resistant (e.g. HDPE) product pipes are installed quickly, safely, reliable and precisely. The two-stage process integrates advantages of the proven Horizontal Directional Drilling (HDD) technology and microtunnelling (pipe jacking). Even with the most diverse project requirements, E-Power Pipe® offers the possibility of trenchless installation of near-surface protective pipes and pipelines – with minimized impact on the surface.

The Herrenknecht E-Power Pipe® method shows its advantages particularly in minimal earthmoving, no heavy equipment between launch and target pits and thus no impact for local residents and the environment due to noise and exhaust emissions, continued use of agricultural land during construction, hardly any recultivation measures.

The machine can keep to the planned alignment with high precision while safely crossing under existing infrastructure such as pipelines, roads, railways or small bodies of water.

Two-stage installation of HDPE protective pipes and pipelines, with borehole mechanically supported at all times



2 x 2,000 M (6,500 FT) DRIVE LENGTH IN TILBURG NOORD – BEST PROJECT

PRODUCT HIGHLIGHTS

Precise controlled installation of cable protection pipes for AC and DC cable connections

Wide geological range of applications from non-stable soils (e.g. sand, gravel) to light rock

No settlement risk as borehole is mechanically supported at all times

Minimal risk of blowouts due to low bentonite volume and pressure

Material transport by jet pump directly behind the cutterhead

Installation length up to 2,000 m (6,500 ft)

Installation depth up to 1.5 m (5 ft) below ground level and up to 30 m (98.4 ft) below GW, constant depth possible

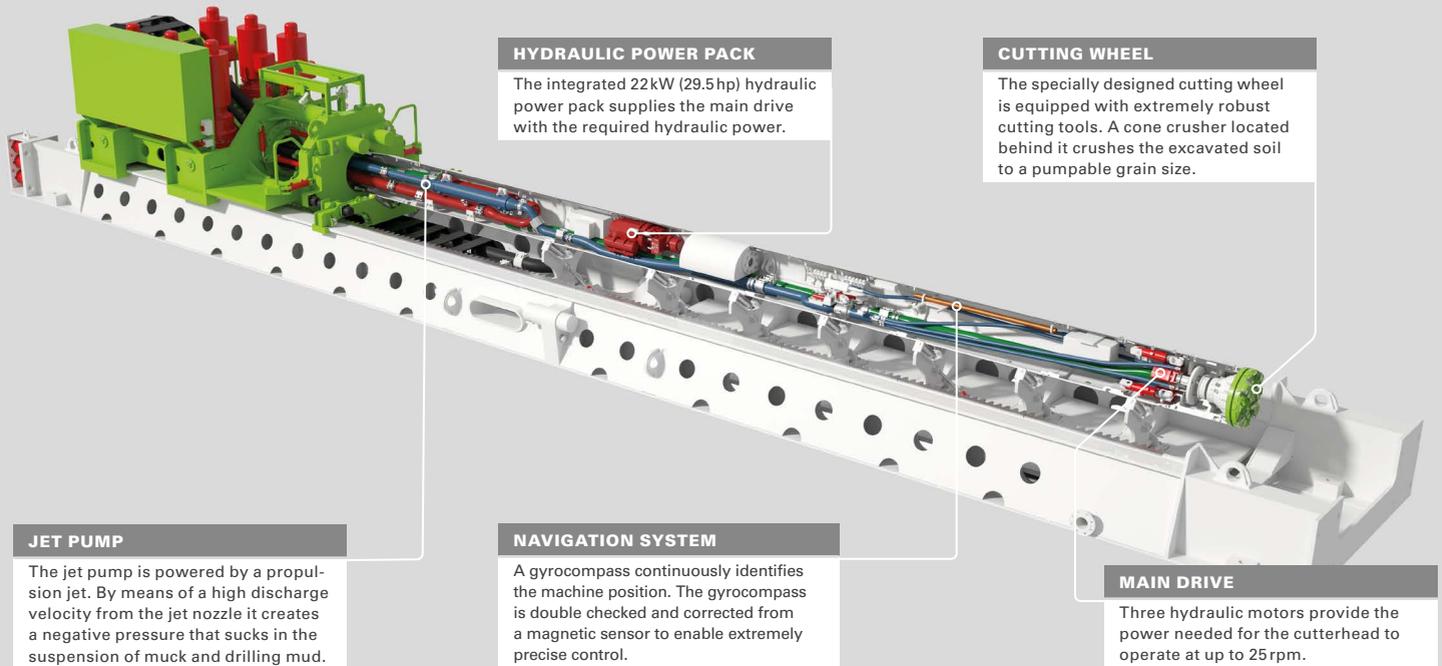
Distance between parallel boreholes at least 1 m (3.3 ft), consistently high installation accuracy with 3D boring line of plus/minus 200 mm (8") horizontally and vertically

Minimum earthmoving. Excavation only at launch and target shafts

No heavy equipment between launch and reception points

The fully remote-controlled AVNS350XB is equipped with a jet pump as the slurry discharge pump, a hydraulic unit integrated into the tunnelling machine and improved control and navigation systems. By using jet pump discharge technology for the excavated material, it is now possible to realize drives up to 10 times

longer than before in the small diameter range – this means drives up to 2,000 meters (6,600ft) long at a shallow installation depth of 1.5 meters (5ft). The machine can keep to the planned alignment with high precision while crossing under existing infrastructure safely and quickly.



HYDRAULIC POWER PACK

The integrated 22kW (29.5hp) hydraulic power pack supplies the main drive with the required hydraulic power.

CUTTING WHEEL

The specially designed cutting wheel is equipped with extremely robust cutting tools. A cone crusher located behind it crushes the excavated soil to a pumpable grain size.

JET PUMP

The jet pump is powered by a propulsion jet. By means of a high discharge velocity from the jet nozzle it creates a negative pressure that sucks in the suspension of muck and drilling mud.

NAVIGATION SYSTEM

A gyrocompass continuously identifies the machine position. The gyrocompass is double checked and corrected from a magnetic sensor to enable extremely precise control.

MAIN DRIVE

Three hydraulic motors provide the power needed for the cutterhead to operate at up to 25 rpm.

DIAMETER



GEOLOGY



Heterogeneous soils

AVNS350XB

Cutting wheel

- › Diameter: min. 505 mm (20")
- › Outer diameter: 490 mm (19")
- › Max. drive length: 2,000 m (6,500 ft)

Machine dimensions

- › Length: 10,500 mm (413")
- › Max. individual weight: 3,500 kg (7,716 lb)

Drive

- › Max. torque: 10 kNm (7,376 lbf.ft)
- › Revolution: 5 rpm–24.5 rpm
- › Hydraulic power pack: 22 kW (29.5 hp)

Control

- › Cylinders: 3
- › Force per cylinder: 95 kN
- › Oil pressure: 400 bar
- › Stroke per cylinder: 15 mm (0.6")

Navigation

- › Navigation system: ParaTrack system, gyrocompass
- › Fuzzy control (automatic steering)
- › Control accuracy: 2 cm (0.8") per meter depth (under optimal conditions, without disruptive influences)
- › Fully visualized process control
- › Computer data acquisition system

JACKING FRAME

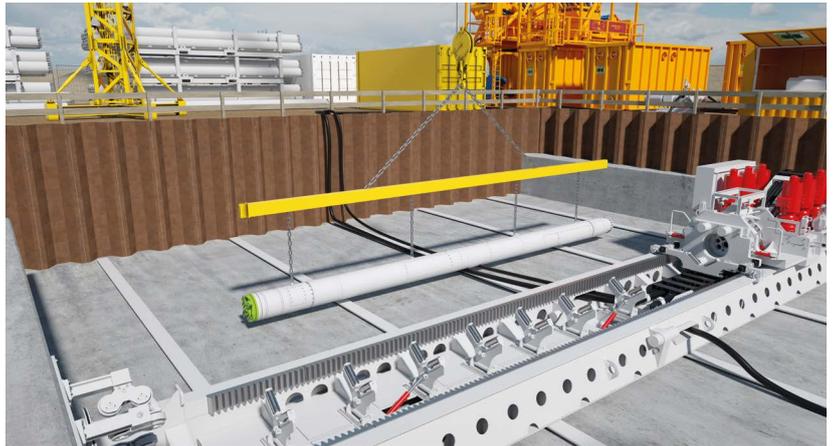
- › Rack and pinion guide
- › 6 electric motors, 66 kW (88.5 hp) in total
- › High speeds of up to 5 m/min (16 ft/min)
- › Max. push and pull force: 340 t
- › Length: 15,000 mm (60")
- › Distance from boring axis to foundation: 1,075 mm (42")
- › Width: 2,260 mm (89")
- › Travel distance: 10 m (32.8 ft)
- › Height: 2,700 mm (106")

Two-step installation process

1. Pilot hole

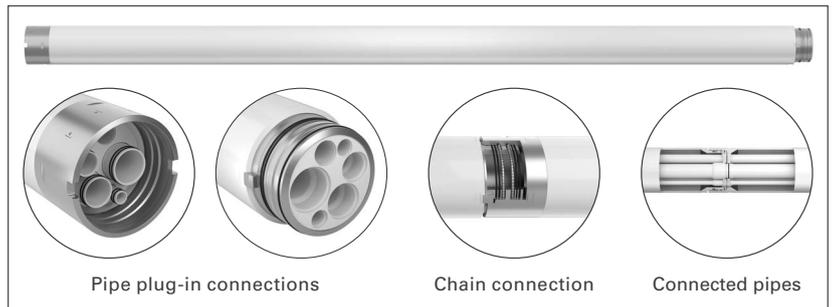
A jacking frame is installed in the launch shaft. In the first step the microtunnelling machine (AVNS350XB) and the reusable steel jacking pipes developed for the E-Power Pipe® method are pushed through the ground along the specified alignment.

With the slurry-supported microtunnelling machine, tunnelling is possible even below groundwater level (groundwater pressure up to 3 bar) and in varying soil conditions ranging from silty soils to gravel and light rock.



Temporary steel jacking pipes

The special temporary steel jacking pipes form a tension-resistant pipe string. All necessary lines e.g. for slurry circuit, power supply and data transmission are integrated. With a pipe length of 9 meters and an innovative connection system, fast coupling times (10 minutes per pipe) and high advance rates can be achieved. The connection system creates the compressive and tensile strength necessary for pushing the machine forward and pulling in the product pipe.



2. Installation of protective pipes

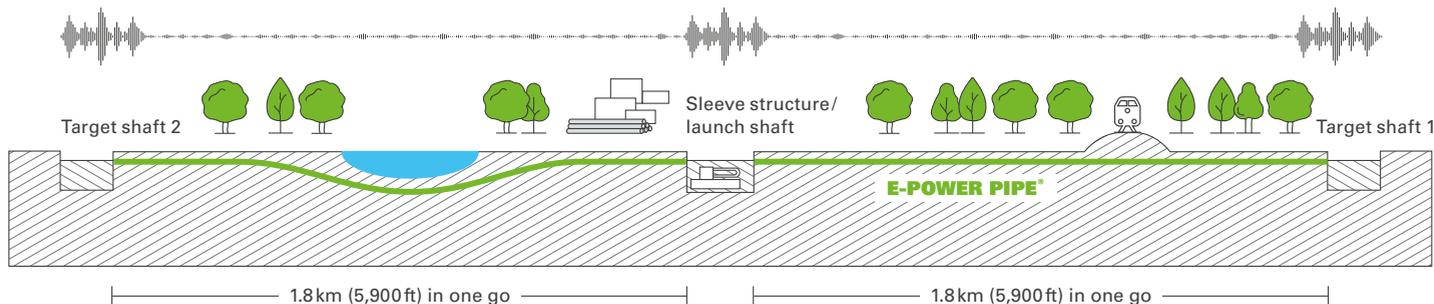
After breakthrough at the target point, the TBM is separated from the jacking pipe string. In the target pit a pullhead is now attached to the jacking pipe string. The prefabricated product pipe laying ready for installation is connected. As the jacking pipes are pulled back by the jacking frame, the product pipe is successively pulled into the borehole. During the pull process the overcut between product pipe and tunnel alignment is backfilled with material. Material injection is volume- and pressure-controlled. The borehole thus remains mechanically supported the whole time.



For more detailed information about the process we recommend our technical animation.

Ecological-sensitive, near-surface tunnelling over long distances

Example:



Advantages at a glance

- › Cable alignment from one shaft structure
- › Near-surface installation with constant depth or crossing under obstacles
- › Precise, parallel installation within a narrow corridor possible
- › High-precision measurement enables three-dimensional curves and precise entry with a tolerance of up to 20 cm (0.7 ft) over 1.8 km (5,900 ft)
- › All-time 24/7 operation, as it is independent of weather conditions and low in noise emissions

E-POWER PIPE®

Tunnelling performance*

- › Line length in one direction: 1,800 m (5,900 ft)
- › Number of cable protection pipes: 4
- › Number of directions from one shaft: 2
- › Bore length from one shaft: 14,400 m (47,200 ft)
- › Alignment length: 3,600 m (11,800 ft)

*The values depend on soil and specific project conditions.

Daily performance*

- › Advance rate per day (boring and pull-in): 90 m (295 ft); 1,800 m (5,900 ft) in 20 days
- › Pilot bore and pull-in of pipe: 160 days (90m/day)
- › Assembly of equipment in shaft: 10 days
- › Several shifts of jacking frame: 6 days
- › 180° turnaround of jacking frame: 2 days
- › Installation of cable protection pipes (without shafts): 178 days

Annual performance per E-Power Pipe System*

- › Working days per year: 260 days
- › Output per year: up to 5,300 m (17,400 ft) of alignment
- › Output per year: up to 21,150 m (69,400 ft) of cable protection pipe

PROJECT REFERENCES

1 Borken, TSO Amprion

- › Drives: 3 × 300 m (3 × 984 ft), constant depth
- › Geology: alluvial sand, sand, clay
- › Construction period: Feb – March 2017

2 Conneforde, TSO TenneT

- › Drives: 6 × 300 m (6 × 984 ft), S curves r = 500 m (1,640 ft)
- › Geology: boulder clay
- › Construction period: Nov 2017 – Jan 2018

3 Bacharach, TSO Amprion

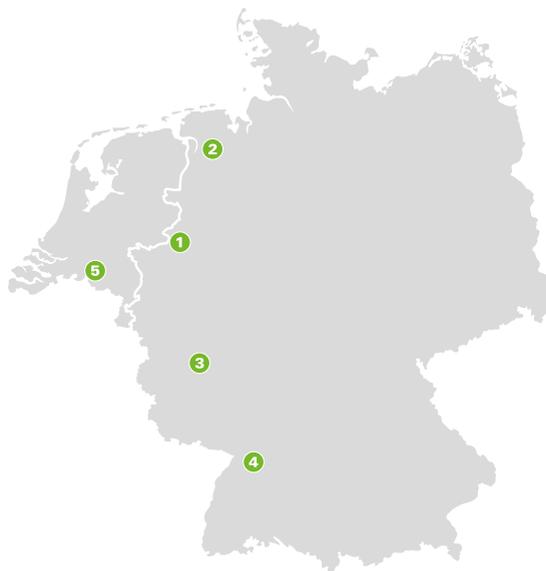
- › Drives: 6 × 680 m (6 × 2,230 ft), curves r = 500 m (1,640 ft)
- › Geology: silt, sand, sticky clay, schist, quartzite boulders, iron ore
- › Construction period: Nov 2017 – Jan 2018

4 Grossgartach, TSO Transnet BW

- › Drives: 3 × 455 m (3 × 1,492 ft), curves rV = 500 m (1,640 ft), rH = 788 m (2,585 ft)
- › Geology: clay
- › Construction period: Feb – Mar 2021

5 Tilburg Noord-Best, TSO TenneT

- › Drives: 2 × 2,000 m (2 × 6,500 ft), 2 × 400 m (2 × 1,312 ft)
- › Geology: sand and earth
- › Construction period: Nov 2021 – Feb 2022



Detailed information on the project references:

› www.herrenknecht.com/en/epp

Herrenknecht

A world leader in groundbreaking tunnelling technology

Herrenknecht is a professionally positioned and internationally oriented family enterprise. Herrenknecht delivers cutting-edge tunnel boring machines for all ground conditions and in all diameters – ranging from 0.10 to 19 meters. Under the umbrella of the Herrenknecht Group, a team of innovative specialists has formed to provide integrated solutions around mechanized tunnel construction with project-specific additional equipment and services.

Pioneering technology by Herrenknecht is always involved when paving the way for the future underground – whether for tunnelling, mining or exploration. Herrenknecht ensures safe and fast progress when constructing modern infrastructures in all areas of application. Exactly where they are needed.



Headquarters in Germany, active worldwide. With more than 6,200 project references, we are a technology leader all around the globe.



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