## Purchase 1 AVN2000AB Tunnelling Machine

**Mixed Ground Cutting Wheel**

The mixed ground cutting wheel is designed for AVN2000AB in mixed ground such as: mixture of soft ground, gravel or coarse gravel, weathered/soft rock.
Supplied with soft ground cutting tools & disc cutters.
Full set of cutting tools bolts and cutting wheel bolts included.

| | | | |
|---|---|---|---|
| Maximum Unconfined Compressive Strength (UCS ) | | 60 | MPa |
| | Closed face type | | |
| | Cutting diameter | 2 575 | mm |
| Cutting tools | Chisel | 12 | No |
| | Chisel width | 100 | mm |
| | Scraper | 8 | No |
| | Cutting disc | 11 | No |
| | Cutting disc diameter | 305 | mm |
| | Tooling system | backloading | |

**Machine AVN2000AB**

Articulated shield with face support / excavated material transportation by slurry.
Slurry feed by 6 nozzles into crusher / excavation chamber and 2 nozzles to area around slurry discharge pipe. All nozzles (crusher/excavation) are equipped with interchangeable nozzles inserts for different nozzle diameters to run in medium pressure mode.
Integral conical stone crusher behind cutting wheel.
Face access for cutter inspection / change.
Optional easily fitted cutting wheels for soft ground, mixed soil conditions with some rock and full rock conditions.
Central drive unit with splinted shaft for reliable, heavy duty torque transmission to cutting wheel.
Standard design for groundwater pressure up to 3 bar.
Connection to remote control container via electrical cables and control cable.

| | | | |
|---|---|---|---|
| Technical name | AVN2000AB-2525PR-078250 | | |
| Drive | Hydraulic drive motors | 1 | No |
| | Rated power | 250 | kW |
| | Maximum torque continuous | 620 | kNm |
| | Maximum torque intermittent | 780 | kNm |
| | Variable speed | 0 - 8.4 | rpm |
| Face access door | Rectangular | 500 mm x 420 | mm |
| Slurry valves | Hydraulically remote controlled | | |
| | Invert nozzle through feed lines | 100 | mm |
| | Annulus / Cutting Wheel | 200 | mm |
| | Discharge line | 200 | mm |
| | By-pass | 200 | mm |
| | Emergency valve for slurry discharge line automatic closure with power supply failure | 200 | mm |
| Medium pressure water nozzles | Nozzles installed | 6 | No |
| | Diameter | 15-50 | mm |
| | Nozzles control by ball valve | 4 | No |
| | Maximum working pressure | 16 | bar |
| | Nozzles insert interchangeable | | |

| | | | | |
|---|---|---|---|---|
| | Articulation joint | With adjustable seal | | |
| | Steering cylinders | With inductive electronic stroke measurement | 4 | No |
| | | Stroke mechanical | 100 | mm |
| | | effective | 10 - 80 | mm |
| | | Maximum single thrust at 450 bar | 1 145 | kN |
| | Dimensions | Diameter | 2 525 | mm |
| | | Length | approx. 3 800 | mm |
| | | Weight | approx. 26 500 | kg |

**Machine Can with Power Pack**

Reduces tendency of machine roll.
Includes hydraulic power pack for main drive.

| | | | |
|---|---|---|---|
| Power pack | Installed el. power cutting wheel drive | 250 | kW |
| | Installed el. power telescopic station / interjack station | 55 | kW |
| | Supply voltage | 960 V / 50 | Hz |
| | Outlets for interjack stations | 3 | No |
| | Outlets for telescope station | 1 | No |
| Equipment | Halogen tunnel light 24VDC | 18 | W |
| | Pipe lubricant ports 22L | 3 | No |
| | Slurry hoses DN 200 | 2 | No |
| | Flow meter DN 200 | 2 | No |
| Dimensions | Diameter | 2 515 | mm |
| | Length | approx. 3 200 | mm |
| | Weight | approx. 13 500 | kg |

**Tailskin Ring**

Project specific adapter between last machine section and product pipe. Suitable for pipe jacking OD2 500.

**Lubrication Ring**

Add-on ring providing circumferential pipe lubrication and improving bentonite distribution around the pipe. Located behind the last machine section before or integrated into the tailskin ring.

**Mixed Ground Cutting Wheel**

The mixed ground cutting wheel is designed for AVN2000AB with extension kit in mixed ground such as: mixture of soft ground, gravel or coarse gravel, weathered/soft rock.
Supplied with soft ground cutting tools & disc cutters.
Full set of cutting tools bolts and cutting wheel bolts included.

| | | | |
|---|---|---|---|
| | Maximum Unconfined Compressive Strength (UCS ) | 60 | MPa |
| | Closed face type | | |
| | Cutting diameter | 2 775 | mm |
| Cutting tools | Chisel | 10 | No |
| | Chisel width | 100 | mm |
| | Scraper | 6 | No |
| | Cutting disc | 12 | No |
| | Cutting disc diameter | 305 | mm |
| | Tooling system | backloading | |

**Extension Kit (Machine)**

Steel shell to increase the outer diameter of a given tunnelling machine.
Bolted steel can structure for multiple mantling and dismantling.
Consisting out of both necessary shield sections for the machine's articulated shield as well as a shield for the machine can.
Articulated joint sealing system between various extension cans to prevent blockage of joints and secure machine steering.

Suitable for — Machine: AVN2000AB

| | | |
|---|---|---|
| Jacking pipe inner diameter | 2 200 | mm |
| Jacking pipe outside diameter | 2 700 | mm |

Dimensions

**Extension cans for articulated shield (delivered in two parts)**

| | | |
|---|---|---|
| Overall length (section 1) | approx. 1 900 | mm |
| Diameter | 2 725 | mm |
| Weight (section 1) | approx. 5 200 | kg |
| Overall length (section 2) | approx. 2 400 | mm |
| Diameter | 2 720 | mm |
| Weight (section 2) | approx. 8 300 | kg |

**Extension can for machine can**

| | | |
|---|---|---|
| Overall length | approx. 3 200 | mm |
| Diameter | 2 715 | mm |
| Weight | approx. 9 800 | kg |

**Lubrication Ring**

Add-on ring providing circumferential pipe lubrication and improving bentonite distribution around the pipe. Located behind the last machine section before or integrated into the tailskin ring.

**Tailskin Ring**

Project specific adapter between last machine section and product pipe. Suitable for pipe jacking OD2 700.

## Purchase 2 Container

**Control Container C40**

Adaptable for operation of a certain range of microtunnelling machines.
Containerized with separate compartments for power pack and operator.
Window in operator compartment for site and shaft observation.
Single connection port for all electric power cables and hydraulic lines for cutting head and jacking rig.
Ergonomic layout of controls with industrial PC and color monitor for full on-line visualization of all operating parameters; PLC-system Siemens S7.
Data logger records all drive parameters for output to printer in either tabular or graphical form (time- or distance based record interval).
Container equipment allows to operate a machine with mixshield mode.

| | | | |
|---|---|---|---|
| Dimensions | Length | 6 060 | mm |
| | Width | 2 450 | mm |
| | Height | 2 800 | mm |
| | Weight | approx. 12 000 | kg |

| | | | |
|---|---|---|---|
| Operator Controls | Cutting wheel | Speed | rpm |
| | | Direction | |
| | Cutting wheel drive | Pressure | bar |
| | Slurry pressure | at cutting wheel | bar |
| | Steering cylinder | Pressure | bar |
| | | Stroke | mm |
| | Bypass valves | Position of valves | |
| | | Pressure | bar |
| | Slurry lines | Flow rate | $m^3/h$ |
| | Slurry pumps | Speed | rpm |
| | Jacking rig | Pressure | bar |
| | | Advance rate | mm/min |
| | Interjacks | Pressure | bar |
| | | Stroke (optional) | mm |
| | General controls | Start & stop | |
| | Hydraulic oil | Temperature | °C |

| | | |
|---|---|---|
| Safety Features | Emergency | Emergency Stop |
| | Faults & Warnings | e.g. filters |
| | Automatic shutdown | max. oil temperature |
| | | min. oil level |
| | | min. coolant level |
| | | Fault oil cooler |
| | Counter for operating hours | |
| | Loudspeaker | for microphone at cutting wheel |
| | Emergency telephone | container – shaft/machine |

| | | |
|---|---|---|
| Drive Data Records | Date and time | |
| | Tunnel length | m |
| | Total drive length (via length encoder) | m |
| | Steering cylinder stroke | mm |
| | Vertical deviation | mm |
| | Horizontal deviation | mm |
| | Roll | degrees |
| | Vertical angle of cutting head | mm/m |
| | Horizontal angle of cutting head | mm/m |
| | Jacking rig thrust | t |
| | Cutting wheel torque (hydr. pressure) | bar |
| | Cutting wheel speed | rpm |

| | | | |
|---|---|---|---|
| | Cutting wheel pressure (hydr.) | | bar |
| | Earth pressure (face pressure) | | bar |
| Air compressor | installed inside compartment of hydraulic unit | | |
| | Flow Rate (at 6bar pressure) | 230 | l/min |
| | Maximum pressure | 10 | bar |
| Jacking Rig Remote | wired remote control to operate jacking rig remotely from the shaft (e.g. during set up and pipe installation). | | |
| Direct Connections | for Bentonite pump, laser, slurry feed & discharge pumps | | |
| Hydraulic tank | Capacity | 2 300 | l |
| | Oil quantity | 2 300 | l |
| Main Jacking Pump | Installed electrical power | 55 | kW |
| | Supply voltage | 400 V / 50 | Hz |
| | Additional cartridge valve for faster retraction speed of telescopic hydraulic cylinders (main jacking station) | | |
| | Pump-Valve block combination | 0 – 80 | l/min |
| | Ports for interjacking stations (50l/min) | 4 | No |
| | Ports for interlocking jacking rigs, pilot oil, pipe brake | | |
| Transformer | Main drive power pack and interjack power pack 400 / 950 V | 450 | kVA |
| Transformer | Slurry discharge pump (machine) 400 / 950 V | 165 | kVA |
| Transformer | Slurry discharge pump (tunnel) 400 / 950 V | 165 | kVA |
| Frequency converter | Slurry feed pump | 132 | kW |
| | Supply voltage | 400 V / 50 | Hz |
| | Output voltage | 400 | V |
| Frequency converter | Slurry discharge pump (machine) | 132 | kW |
| | Supply voltage | 400 V / 50 | Hz |
| | Output voltage | 400 | V |
| Frequency converter | Slurry discharge pump (tunnel) | 132 | kW |
| | Supply voltage | 400 V / 50 | Hz |
| | Output voltage | 400 | V |
| Machine surveillance | Monitor installed inside control container to provide view into the tunneling machine (if equipped with camera) and/or shaft (camera not included). | | |
| | Small tool & storage cabinet in the operator control room. | | |

## Purchase 3 Guidance System

**U.N.S. integral Module ELS**

The U.N.S. (Universal Navigation System) is a consistent system structure that meets all requirements towards navigation in tunnelling.
With its modular concept, the U.N.S. system can easily be expanded by additional navigation modules quickly and economically. The base module is the U.N.S. – ELS.
The integral version is build into the PLC and the visualization of the control container. It is compatible to the following navigation modules:

- ELS (base module)
- ELS-HWL
- GNS

Optional data logging is available (e.g. cylinder stroke measuring of interjack stations).

| | | | |
|---|---|---|---|
| Application | Tunnel length<br>Straight Drives | approx. 200 | m |
| Components | Industrial computer with touch screen monitor mounted inside control container<br>Software ELS<br>Distance Sensor (measuring wheel) | | |

**Module HWL**

The Hydrostatic Water Leveling system determines the altitude through a reference sensor that is mounted in the jacking shaft, and through an altitude sensor that is mounted inside the tunnelling machine.

| | | | |
|---|---|---|---|
| Application | Tunnel length<br>Straight & Curved Drives | approx. 400 | m |
| Components | Software ELS-HWL | | |
| | Reference sensor | 1 | No |
| | Altitude sensor | 2 | No |
| | Hose reel with HWL Hoses filled with special liquid (anti-freeze for -20°C) | 14 | No |
| | Length | 50 | m |
| | Quick disconnect fittings for HWL Hoses | | |

**Module GNS**

Software package, which in combination with the gyro compass (available separately) enables specified navigation solutions – such as long distance tunneling and curved drives.
Calculation of the actual position is based on the method of polygonal navigation.

| | | | |
|---|---|---|---|
| Components | Software GNS | | |

**Tunnel Laser VL-80**

Compact laser sending a laser beam either level (horizontal) or with a defined inclination. A secondary split laser beam aims at a reference point on the shaft wall, thus, monitoring the directional angle.
The power level of the diode laser is adjustable in 5 steps depending on the specific situation.
Level/grade, low-voltage, and end position are monitored and displayed through alarms.
Line and grade adjustments are protected against accidental changes.
The laser can be mounted standing upright or hanging vertically.

| | | | |
|---|---|---|---|
| Laser | Laser beam (target) | < 5 | mW |

| | | | |
|---|---|---|---|
| | Wave length | 658 | nm |
| | Beam diameter | 13 | mm |
| | Laser class | 3R | |
| | Laser Beam (direction) | < 1 | mW |
| | Power supply | 10..13,8 | V / 0,4A |
| | Distance | < 500 | m |
| Setting range | Directional setting range | +/- 5 | % |
| | Inclination setting range | -10% - +40 | % |
| | Smallest reading | 0.001 | % |
| | Watertight | 0.35 | bar |
| | Temperature | -10°C - +50° | C |
| | Weight | 3.1 | kg |

**Laser Target ELS-NT**

Active laser target for precise measurement of position of machine.
Includes dual axis inclinometer component to monitor pitch / roll of machine.
Measurement of horizontal angle of machine (yaw).

| | | | |
|---|---|---|---|
| Data | Effective size | 146 x 88 | mm |
| | Required laser power | 2 | mW |
| | Accuracy of measurement | +/- 1 | mm |
| | Maximum operating gradient positive or negative | 150 | mm/m |
| | Watertight to depth | 10 | m |
| | Degree of protection | IP | 68 |
| | Update interval | 0.5 | s |
| | Roll & pitch accuracy | 0.1 | ° |
| | Yaw accuracy | 1 | mrad |

**Data Cable**

Data cable extension cable with quick couplings.
24-strands “Profibus” type.

| | | | |
|---|---|---|---|
| PLC-cables | Required amount | 13 | No |
| | Single length | 50 | m |
| | Connection | Quick coupling | |

**Gyro Compass (HGO)**

North-seeking gyro compass, specifically designed for tunnelling systems. It is mounted inside the tunnelling machine and does not require a clear line of sight between the tunneling machine and the shaft (only for control measurements by surveyor).
Measuring while tunnelling is in progress and without stopping the tunnelling machine.

| | | | |
|---|---|---|---|
| Data | North-reference accuracy | 1 | mrad |
| | Operational range | + / - 70 | ° lat |
| | Roll & pitch accuracy | + / - 0.2 | mrad |
| | Watertight to depth | 5 | m |
| | Power supply buffering | | |
| | Operation under slight vibrations | | |
| | Continuous measuring | | |

## Purchase 4 Jacking Equipment

**Compact Jacking Rig**

Compact design featuring three-piece construction for fast set up and handling with bolted / interchangeable push ring for simple adaptation to different pipe diameters.
Individually controlled hydraulic cylinders for frame alignment.
The 2-stroke hydraulic interlock push system achieves minimum shaft dimensions.
Rectangular back plate.
Suitable for circular or rectangular shafts.

| | | | |
|---|---|---|---|
| Shaft | Min. clear dimensions | 7 500 x 5 500 | mm |
| | Min. diameter (alternative) (dimensions without pipe brake) | 6 500 | mm |
| | Height shaft base to pipe axis (+/-100) | 1 885 | mm |
| Jacking pipe | Maximum outside diameter | 2 875 | mm |
| | Maximum length | 3 000 | mm |
| Capacity | Total thrust (at 500bar) | 11 300 | kN |
| | Cylinder type | 2x 380/300 | mm |
| Installed dimensions | Length | approx. 5 180 | mm |
| | Width | approx. 4 540 | mm |
| | Height | approx. 3 185 | mm |
| | Weight | approx. 31 300 | kg |

**Adaptor Ring**

Interchangeable steel push ring for machine launch and product pipe jacking procedure.
Bolted to jacking thrust ring; fitting to machine tailskin and pipe tailskin.
During launch procedure: Roll protection for stable machine advance.

| | | | |
|---|---|---|---|
| Suitable for | Machine, outer diameter | 2 525 | mm |
| | Product pipe, inner diameter | 2 000 | mm |
| | Product pipe, outer diameter | 2 500 | mm |

**Adaptor Ring**

Interchangeable steel push ring for machine launch and product pipe jacking procedure.
Bolted to jacking thrust ring; fitting to machine tailskin and pipe tailskin.
During launch procedure: Roll protection for stable machine advance.

| | | | |
|---|---|---|---|
| Suitable for | Machine, outer diameter | 2 725 | mm |
| | Product pipe, inner diameter | 2 200 | mm |
| | Product pipe, outer diameter | 2 700 | mm |

## Purchase 5 Interjacking Stations

**Interjack – Seal casing**

Steel casing for seal of interjack station.
Including mechanism to adjust interjack seal.
Transmitting push force.
Bolted multiple-section-design for disassembling and removal after finishing tunnel.

| | | | |
|---|---|---|---|
| Suitable for | Interjack DN 2 000; outer diameter | 2 500 | mm |
| | Required amount | 3 | No |

**Interjack – Seal**

Profile seal for use in interjack station.
For adjustable steel casing.

| | | | |
|---|---|---|---|
| Suitable for | Interjack DN 2 000; outer diameter | 2 500 | mm |
| | Required amount | 3 | No |

**Cylinder Support Ring**

Steel support ring for push cylinders of interjack station.
Bolted multi-section-design for easy disassembling and removal after finishing tunnel.
Hydraulic interjack cylinders fixed and positioned by bolted clamps.

| | | | |
|---|---|---|---|
| Suitable for | Interjack DN 2 000; outer diameter | 2 500 | mm |
| | Hydraulic cylinders | 16 | No |
| | Required amount | 3 | No |

**Assembly Material Interjack Station**

Assembly and installation material for installation of interjack station.

| | | | |
|---|---|---|---|
| Suitable for | Interjack DN 2 000; outer diameter | 2 500 | mm |
| | Required amount | 3 | No |

**Interjack Station DN2 200**

Custom designed heavy duty hydraulic cylinders for assembly in shell / tailskin of customer supplied telescopic interjack pipe.
Cylinders have two ports at both the piston and annular side for simple pipework connection.
T-pieces are not required for distribution of oil around the interjack assembly.
Adjustable double profile seal system to prevent ingress of groundwater or pipe lubricant.

Offered amount of interjack stations for m 3 No

| | | | |
|---|---|---|---|
| Steelwork | Bolted multiple-segment seal housing / thrust ring for dismantling in tunnel<br>Bolted multiple-segment ring for cylinder installation / dismantling in tunnel | | |
| Hydraulic cylinders | Number of hydraulic cylinders installed | 18 | No |
| | Single thrust (at 420 bar) | 646 | kN |
| | Total thrust | 11 628 | kN |
| | Stroke | 700 | mm |
| | Closed length | 985 | mm |
| | Single weight | 146 | kg |
| | Port | M18 x 1.5 | |
| Control | Operated from control panel | | |
| Interjack station | Weight | approx. 3 613 | kg |

**Cylinder Stroke Measuring System**

Reliable inductive stroke measuring system, mounted into interjack station.
Interface to data monitoring system; stroke of each interjack station gets displayed at control panel respectively saved to hard disk.

Required amount of sets 3 No

**Telescopic Slurry Pipes DN200**

Set of extendable slurry pipes to compensate stroke of interjack station.
Usable as feed and discharge lines.

Required amount of sets 3 No

| | | | | |
|---|---|---|---|---|
| Slurry pipe set | Telescopic type | | 2 | No |
| | Diameter | | 200 | mm |
| | Closed length | | 1 350 | mm |
| | Stroke | | 1 000 | mm |
| Flexible hoses | Connection of telescopic pipes with tunnel lines | | 4 | No |
| | Diameter | | 200 | mm |

**Service Line (Interjack)**

Set of flexible hoses from hydraulic power pack to interjack station with quick couplers to reduce oil loss and contamination.
Hoses are flushed clean and filled with hydraulic oil.

| | | | | |
|---|---|---|---|---|
| Hoses | Type | DN20 / 25S | | |
| | Single line length | | 20 | m |
| | Required amount | | 29 | No |

## Purchase 6 Muck Removal System

**Feed Pump**

Pump P1.1, installed on surface.
Suitable for DN150 and DN200 slurry pipe.

| | | | | |
|---|---|---|---|---|
| 150PF/PCH | Nominal flow | DN150 | 0 – 250 | $m^3/h$ |
| | Total pumping head | DN150 | 126 | m |
| | Nominal flow | DN200 | 0 – 400 | $m^3/h$ |
| | Total pumping head | DN200 | 115 | m |
| Pump / Motor | Rotation speed | | 0 – 1 800 | rpm |
| | Drive motor | | 132 | kW |
| | Supply voltage | | 400 | V |
| | Electric cable length installed | | 30 | m |
| Dimensions | Length | | 2 300 | mm |
| | Width | | 850 | mm |
| | Height | | 1 200 | mm |
| | Weight | | 1 900 | kg |

**Discharge Pump**

Pump / motor mounted in line on chassis with polyurethane wheels.
Suitable for DN150 up to DN200 slurry pipe.
Pump P2.1, installed in tunnel approximately 15m behind shield.

| | | | | |
|---|---|---|---|---|
| 6/6EE-G | Nominal flow | DN150 | 0 – 250 | $m^3/h$ |
| | Total pumping head | DN150 | 62 | m |
| | Nominal flow | DN200 | 0 – 400 | $m^3/h$ |
| | Total pumping head | DN200 | 57 | m |
| Pump / Motor | Rotation speed | | 0 – 1 600 | rpm |
| | Drive motor | | 132 | kW |
| | Supply voltage | | 960 | V |
| Dimensions | Length | | 2 495 | mm |
| | Width | | 895 | mm |
| | Height | | 1 043 | mm |
| | Weight | | 2 600 | kg |

**Discharge Pump**

Pump / motor mounted in line on chassis with polyurethane wheels.
Suitable for DN150 up to DN200 slurry pipe.
Pump P2.2, installed in tunnel.

| | | | | |
|---|---|---|---|---|
| 6/6EE-G | Nominal flow | DN150 | 0 – 250 | $m^3/h$ |
| | Total pumping head | DN150 | 62 | m |
| | Nominal flow | DN200 | 0 – 400 | $m^3/h$ |
| | Total pumping head | DN200 | 57 | m |
| Pump / Motor | Rotation speed | | 0 – 1 600 | rpm |
| | Drive motor | | 132 | kW |
| | Supply voltage | | 960 | V |
| Dimensions | Length | | 2 495 | mm |
| | Width | | 895 | mm |
| | Height | | 1 043 | mm |
| | Weight | | 2 600 | kg |

## Purchase 7 Power Supply

**Launch Lines**

Set of electric cables and hydraulic hoses to connect articulated shield with machine middle section (which includes power pack).
Necessary if machine's articulated shield and middle section can not be launched together into start shaft due to small dimensions.

| | | | |
|---|---|---|---|
| Launch line set | Single length | 25 | m |

**Base Panel**

Insulated electric base panel including buttons to operate jacking equipment.
Mounted at shaft wall.
Assembly material included.

**Circuit Breaker**

Insulated electric switch; allows to interrupt power supply to electric equipment in the tunnel and to disconnect / connect electric cables in shaft.
Mounted at panel to be installed in shaft.

| | | | |
|---|---|---|---|
| Machine power (aux. Equipment) | Rated voltage | 400 | V |

**Electric Cable (Machine)**

Insulated electric cable extension providing plug & socket.
Power supply for machine auxiliary equipment (cooler, PLC, lighting etc.).

| | | | |
|---|---|---|---|
| Type | H07RNF | | |
| | Rated voltage | 400 | V |
| | Conductor size | 4 x 50 | $mm^2$ |
| | Single length | 50 | m |
| | Connection | Plug & Socket | |
| | Required amount | 13 | No |

**Circuit Breaker**

Insulated electric switch; allows to interrupt power supply to electric equipment in the tunnel and to disconnect / connect electric cables in shaft.
Mounted at panel to be installed in shaft.

| | | | |
|---|---|---|---|
| Main drive | Rated voltage | 960 | V |

**Electric Cable (Main Drive)**

Insulated electric cable extension providing clamp box connection.
Power supply for main drive.

| | | | |
|---|---|---|---|
| Type | NSSHOU | | |
| | Rated voltage | 960 | V |
| | Conductor sizes | 3 x 95 | $mm^2$ |
| | | 1 x 50 | $mm^2$ |
| | Single length | 50 | m |
| | Connection | Clamp box | |
| | Required amount | 13 | No |

**Circuit Breaker**

Insulated electric switch; allows to interrupt power supply to electric equipment in the tunnel and to disconnect / connect electric cables in shaft.
Mounted at panel to be installed in shaft.

| | | | |
|---|---|---|---|
| Discharge pump | | | |
| P2.1 | Rated voltage | 960 | V |

**Electric Cable (Discharge Pump)**

Insulated electric cable extension providing clamp box connection.
Power supply for machine slurry discharge pump (P2.1).

| | | | |
|---|---|---|---|
| Type | NSSHOU | | |
| | Rated voltage | 960 | V |
| | Conductor size | 4 x 50 | $mm^2$ |
| | Single length | 50 | m |
| | Connection | Clamp box | |
| | Required amount | 13 | No |

**Circuit Breaker**

Insulated electric switch; allows to interrupt power supply to electric equipment in the tunnel and to disconnect / connect electric cables in shaft.
Mounted at panel to be installed in shaft.

| | | | |
|---|---|---|---|
| Discharge pump | | | |
| P2.2 | Rated voltage | 960 | V |

**Electric Cable (Discharge Pump)**

Insulated electric cable extension providing clamp box connection.
Power supply for tunnel slurry discharge pump (P2.2).

| | | | |
|---|---|---|---|
| Type | NSSHOU | | |
| | Rated voltage | 960 | V |
| | Conductor size | 4 x 25 | $mm^2$ |
| | Single length | 50 | m |
| | Connection | Clamp box | |
| | Required amount | 5 | No |

## Purchase 8 Service Lines

**Surface Slurry System DN200**

Set of slurry feed and discharge lines at surface between shaft bottom and sedimentation tank resp. separation plant.
Quick coupling system (Victaulic latch type coupling).
Including flexible hoses, valves and adaptor for tunnel slurry pipes.

| | | | |
|---|---|---|---|
| Set | Diameter | 200 | mm |
| | Gate valves (pneumatic type, DN200) | 2 | No |
| | Maximum nominal pressure | 16 | bar |
| Shaft | Maximum depth | 20 | m |

**Slurry Pipes DN200**

Set of steel pipes for slurry feed and discharge line.
Quick coupling system (Victaulic latch type coupling).
Supplied in special pipe pallets for easy transportation and handling.

| | | | |
|---|---|---|---|
| Required amount of sets | | 200 | No |
| Set | Slurry pipes | 2 | No |
| | Diameter | 200 | mm |
| | Single length | 3 000 | mm |
| | Victaulic couplings | 2 | No |
| | Maximum nominal pressure | 16 | bar |

## Purchase 9 Lubrication System

**Bentonite Lubrication Plant**

Compact bentonite lubrication plant consisting of bentonite mixer, agitator tank, hydraulic power pack and piston pump, mounted on steel frame.
Inclusive control panel.
Attached pressure gauge.
Piston pump remote controlled from control panel.

| | | | |
|---|---|---|---|
| Mixer | Mixing capacity | 2 200 | l/h |
| | Batch capacity | 260 | l |
| Tank | Volume | 800 | l |
| Pump | Maximum pressure | 58 | bar |
| | Maximum flow (at 30 bar) | 63 | l/min |
| Power supply | Total installed power | 17 | kW |
| | Supply voltage | 400 V / 50 | Hz |
| Dimensions | Length | 2 050 | mm |
| | Width | 1 950 | mm |
| | Height | 1 780 | mm |
| | Weight | 1 300 | kg |

**Automatic Pipejack Lubrication System (Integral System)**

High performance automatic pipejack lubrication system fully programmable to allow the operator to inject a pre-determined amount of lubricant at all or specific areas in the tunnel.
Man entry to the tunnel not required for lubrication.
Controlled by Siemens PLC integrated in operator control panel.
Graphical display of all system features.
Up to 40 injection stations programmable for injection sequence and injection cycle time.
Flow meters and membrane pressure sensor in lubricant supply line applicable.

| | |
|---|---|
| Features | Volume record |
| | Time- or volume based injection program |
| | Automatic / Manual control |

**Lubricant Injection Station**

Injection station for lubricant distribution to 3 No lubrication injection ports in product pipe. Electronically controlled pneumatic valves to ensure precise amount of lubricant at each nozzle.
One set consists of lubrication injection station, control cable and air supply line. Lubrication hoses and fittings to / from the injection stations are not included.

| | | | |
|---|---|---|---|
| Injection station | Amount of sets | 40 | No |
| | Triple solenoid pneumatic valve block | | |
| | Three channel control box | | |

| | | | | |
|---|---|---|---|---|
| | Inlet port | DN24 / 28L | 1 | No |
| | Outlet ports | DN18 / 22L | 3 | No |
| Control cables | included | | | |
| Air supply hoses | included | | | |
| Dimensions | Length | | 750 | mm |
| | Height | | 250 | mm |
| | Width | | 190 | mm |
| | Weight | | 25 | kg |

**Pressure Sensor / Flow Meter**

Combined membrane pressure sensor and flow meter in combination with automatic lubrication system to provide volume based lubrication injection.
Fixed in steel frame to be installed in lubricant feed line.

| | | | | |
|---|---|---|---|---|
| | Quantity | | 1 | No |
| Dimensions | Length | | 700 | mm |
| | Height | | 535 | mm |
| | Width | | 300 | mm |
| | Weight | | 50 | kg |

**Service Line (Lubrication)**

Set of Steel pipes for Tunnel installation and flexible hoses for shaft and interjack stations.
Steel pipes DN70 partially with hydraulic hose connection to bentonite injection stations.
Coupling System (Victaulic coupling)

| | | | | |
|---|---|---|---|---|
| Set | Lubrication Main Line | DN70-PN50 | 100 | No |
| | Single line length | | 6 | m |
| | Working Pressure | | 40 | bar |

## Purchase 10 Launch Seal for both Diameters

**Launch Seal with Back Plate**

Double lip neoprene seal, fastened to steelwork structure which is fixed to rectangular back plate to be installed directly to shaft wall.
Providing sealing and stabilizing neoprenes.
Equipped with neoprene back flip protection.
Restricts groundwater and pipe jacking lubricant ingress into start shaft.
Working pressure up to 1.5 bar.
Can be combined with additional (optional) emergency seal.

| | | | |
|---|---|---|---|
| Jacking pipe | Outside diameter | 2 500 | mm |
| Dimensions | Height | approx. 3 300 | mm |
| | Width | approx. 3 300 | mm |
| | Length | approx. 570 | mm |
| | Weight | approx. 4 000 | kg |

**Launch Seal with Back Plate**

Double lip neoprene seal, fastened to steelwork structure which is fixed to rectangular back plate to be installed directly to shaft wall.
Providing sealing and stabilizing neoprenes.
Equipped with neoprene back flip protection.
Restricts groundwater and pipe jacking lubricant ingress into start shaft.
Working pressure up to 1.5 bar.
Can be combined with additional (optional) emergency seal.

| | | | |
|---|---|---|---|
| Jacking pipe | Outside diameter | 2 700 | mm |

| | | |
|---|---|---|
| Dimensions | Height | approx. 3 500 mm |
| | Width | approx. 3 500 mm |
| | Length | approx. 570 mm |
| | Weight | approx. 4 500 kg |

## Purchase 11 Separation Unit HKS 500

Separation unit HKS 500

The modular HKS 500 Separation Plant is specially designed for treatment of slurries and removal of solids in tunneling.
The max. capacity of the unit is 500m³/h slurry.
The capacity of the Unit is subject to the advance rate of the tunnel boring machine, viscosity and density of slurry, solids loading, grain size distribution, screen selection and properties along with operating conditions (setup, operating, configuration) and might therefore be lower than specified.

| | | | |
|---|---|---|---|
| Process unit | Double deck shaker | | |
| | including screens | 1 | pc |
| | Classifying 6,4 m² | 1 | pc |
| | Dewatering 6,4 m² | 1 | pc |
| | Vibrating motors 5,6 KW | 4 | pc |
| | Fold away walkway | 2 | pc |
| | Discharging chutes | 1 | pc |
| Coarse cyclones | 15“ hydrocyclon | 2 | pc |
| | Wear resistant centrifugal pump 75 KW | 1 | pc |
| | Piping system | 1 | pc |
| Fine cyclones | 6“ hydrocyclone | 12 | pc |
| | Wear resistant centrifugal pump 90 KW | 1 | pc |
| | Piping system | 1 | pc |
| | Lighting | 1 | pc |
| | Control cabinet | 1 | pc |
| | Support frame | 1 | pc |
| | Supply voltage | 400 V / 50 | Hz |
| | Installed power | 190 | kW |

| | | | | |
|---|---|---|---|---|
| Transport dim. | Process unit | L x B x H | 6058 x 2438 x 3200 | mm |
| | Process tank | L x B x H | 6058 x 2438 x 2800 | mm |
| | Cyclone unit | L x B x H | 3964 x 2438 x 3200 | mm |
| Tank volume | | | 20 | m³ |

**Sedimentation Tank**

Standard container to increase the drilling fluid volume in the water circuit. Including connection set to HKS 150/300/500
Serves as a transport container during shipment of equipment between sites.

| | | | |
|---|---|---|---|
| Connections | Slurry feed pump | 200 | mm |
| | Overflow (on each side) | 2 x 300 | mm |
| Required amount of tanks | | 1 | No |
| Dimensions (each) | Capacity | 30 | m³ |
| | Length | 6 058 | mm |
| | Width | 2 438 | mm |
| | Height | 2 800 | mm |
| | Weight | 3 710 | kg |

## Purchase 12 Centrifuge and Flocculation System

**HKD46150VSD Centrifuge**

The HKD46150VSD Centrifuge with variable speed drive is specially designed to keep pace with the demanding needs of slurry treatment in the tunneling business with high mineral solid throughput and high abrasivity of the solids.
The HKD46150VSD Centrifuge is directly fed by a variable eccentric screw pump.
The variable speed drive packages allow controlled impact of motor drive power to the Centrifuge Bowl, to the Screw and to the Feed Pump. The ability to vary the speed of the Bowl, the Screw and the Feed Pump power unit independently allows the centrifuge to be operated in the most efficient and productive manner subject to the encountered slurry properties.
The HKD46150VSD Centrifuge including feed pump and control panel is fitted in a standard 20 ft. steel frame and allows therefore reduction of assembly time to a minimum. The compact, self-contained frame with container corners for quick lifting and transport on container vessels acts as enclosure for the Centrifuge and is designed for installation on sedimentation tanks or adequate 20 ft. steel substructures.

| | | | |
|---|---|---|---|
| Scope of supply | 20 ft. Container frame | 1 | No |
| | Centrifuge HKD46150VSD | 1 | No |
| | Eccentric screw pump | 1 | No |
| Technical specification | | | |
| | Capacity | 10 – 60 | $m^3$/hr |
| | | 8 – 10 | t/hr |
| | *subject to solids loading and slurry properties | | |
| | Inlet | DN65 | |
| | Bowl inner diameter | 460 | mm |
| | Bowl length | 1 500 | mm |
| | Max. rotational speed | 3 400 | rpm |
| | G-force | 3 000 | G |
| | Supply voltage | 400 V / 50 | Hz |
| | Installed power bowl | 75 | kW |
| | Installed power screw | 30 | kW |
| | Installed power pump | 15 | kW |
| | Total Installed power | 120 | kW |
| Transport dimensions (incl. container frame) | | | |
| | Length | approx. 6 050 | mm |
| | Width | approx. 2 450 | mm |
| | Height | approx. 2 600 | mm |

**Automatic Flocculation System AFU3000 (powder)**

Fully automatic, self-contained 3-chamber polymer dosing station for continuous preparation and dosing of powder polymer solutions in the pretreated slurry for feeding of the centrifuges HKD46150VSD and HKD54172VSD.
The compact 20ft container with heater and lighting ensures safe working, ideal room conditions, storage capacity for polymer bin, and an optimum sequence of mixing and dosing process.
The unit is controlled user-friendly by a touch screen display and a programmable logic controller (PLC). This integrated control system allows an automatic preparation and dosing process. The dosing of the polymer solution into the slurry circuit is controlled by measuring of flow rate and density and is subject to the solids content of the slurry. Such a system makes sure that undesirable over- or under-dosing will not occur.

| | | | |
|---|---|---|---|
| Capacity | Flow rate at 60 min maturing time | 3 000 | l/hr |
| | Flow rate at 45 min maturing time | 3 750 | l/hr |
| | Dosing Pump against max. 3 bar | 360 -3 600 | l/hr |
| Power supply | Supply voltage | 400 V / 50 | Hz |
| | Installed power | 12 | kW |
| Dimensions | Length | approx. 6 050 | mm |
| | Width | approx. 2 500 | mm |
| | Height | approx. 2 600 | mm |