

Specifications

Lovat RME256SE / Series 26900 through 27100

Basic Dimensions

Cut Diameter	6,514	mm
Bore Diameter	6,489	mm
Shield Diameter	6,476	mm
Length of TBM	10.6	m
Length of Back-Up	70.4	m
Weight of TBM (including Airlock)	348	tonne
Weight of Back-Up	163	tonne

Tunnel Lining

Type	Segment	
Segments (tapered)	6	No.
Outside Diameter	6,250	mm
Inside Diameter	5,750	mm
Length	1,500	mm

Trapezoidal/parallelogram universal with EPDM gasket.

Cuttinghead

Structural

Cantilever Type

Cuttinghead and Chamber Features

Abrasion Resistant Plating on Cuttinghead Face and Rim

Spokes (Cantilever Structure Design)	4	No.
Face Injection Port Assemblies (Ground Conditioning, independent operation)	5	No.
Opening (Protected by Grizzly Bars)	>30	%
Face Isolation Doors	8	No.
Wear Indicator Rippers (oil pressurized, 1 face and 1 gauge)	2	No.

Cutting Tools

Soft Ground		
Ripper Teeth	44	No.
Gauge Cutters	9/11	No.
Centre Nose Cone	1	No.
Copy Cutter	2	No.
Scraper Tools	56	No.

Rock

Centre Quad Disc Cutter Assembly (394mm Diameter)	1	No.
Centre Twin Disc Cutters (394mm Diameter)	4	No.
Twin Tip Cutters (394mm Diameter)	23	No.
Scraper Tools	56	No.

Main Drive – Variable Frequency Electric Drive

General

Clockwise and Counter-Clockwise Rotation

Variable speed

Inching function for maintenance

Planetary Gear Boxes

Quantity:	6	No.
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Water Cooled

Electric Motors

Quantity	6	No.
Water Cooled		
Individual Capacity	200	kW
Total Available Power to Cuttinghead	1,200	kW
Operating Voltage	600	V

Torque Limiters

Quantity	6	No.
Mechanical type		

Main Bearing

Triple Roller Bearing

Lubricated by an independent pressurized oil lubrication system

Sampling Points for monitoring of lubrication oil quality

Cuttinghead Drive Speed / Torque after Efficiencies

Maximum Continuous Torque	6,199	kN•m
Speed at Maximum Torque	1.8	rpm
Nominal Torque	3,369	kN•m
Speed at Nominal Torque	3.2	rpm
Peak Start-Up Torque	7,748	kN•m

Main Drive Oil Sealing System

Multi stage type

Inner and Outer Diameter Sealing System

Single Lip type Seals

Sealing System “Fail-Safe”, malfunction initiates shutdown of Main Drive

Positively Pressurized Automatic Sealing System controlled by the PLC

w/input from Earth Pressure Sensors

Maximum pressure (dynamic & static)	5.1	bar
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Forward Shell

Earth Pressure Sensors in Cuttinghead Chamber	6	No.
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Injection Ports in Cuttinghead Chamber (2 no. also for Probe Drill)	4	No.
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Personnel Access Hatch into Cuttinghead Chamber	2	No.
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Material Access Hatch into Cuttinghead Chamber	1	No.
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Rotary Fluid Joint (Swivel)

Fluid transfer to the Cuttinghead Chamber and Face

Penetrations through Pressure Bulkhead for Utilities

Articulation System

Active

Connection between Forward Shell and Stationary Shell

Articulation Cylinders	12	No.
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Individual Cylinder Capacity	2,500	kN
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Combined Capacity	30,000	kN
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Articulation Angle	0 to 1.8	°
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Articulation Cylinder Stroke	203	mm
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LDTs – One for each Quadrant	4	No.
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Articulation Seal – Dynamic	1	No.
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Passive

Articulation Cylinders	16	No.
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Individual Cylinder Capacity	834	kN
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Combined Capacity	13,344	kN
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Articulation Angle	1.5-2	°
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LDTs – One for each Quadrant	4	No.
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Stationary Shell

Consolidation / Injection Ports on Stationary Shell Periphery	12	No.
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Rear Support

Support for Forward Facing Probe Drill

Automatic Tilt Control

Electric Level Switches

Trip point adjustment range between	0.5 to 6	°
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Propulsion

Quantity of Cylinders	16	No.
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Maximum Capacity of Cylinder	2,500	kN
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Total Maximum Thrust	40,000	kN
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Operating Pressure at Maximum Thrust	341	bar
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Nominal Operating Pressure	241	bar
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Propulsion Stroke	2,250	mm
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Maximum Retraction Speed – All Cylinders	450	mm/min
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Maximum Extension Speed – All Cylinders	100	mm/min
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LDTs – One for each Quadrant	4	No.
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Soft Mode for Segment Erection

Self-Aligning Shoes

Operators Station

Cabin located on Gantry 1

Controls for TBM mining functions

Controls for TACS tunnel guidance system

Programmable Logic Controller (PLC)

The TBM is equipped with a PLC (Programmable Logic Controller). The PLC is used to control the machine and record information from sensors. Any information in the PLC is sent to and displayed with HMI software (Human Machine Interface). The HMI software, which is run on an Industrial PC located in the TBM or Operators Cabin, can also record the information.

Laptop Computer for PLC System Interface and Diagnostics

A Laptop Computer (Software include) will be supplied for interfacing with the TBM PLC System for diagnostics and troubleshooting.

Industrial Work Station (Located in the TBM)

LCD Color Display

Windows HMI Program for information display and recording

Industrial Work Station (Located on the Surface)

LCD Colour Display

Windows HMI Program for information display and recording

Integrated Data Logging System

The data acquisition and logging system will monitor and record information from the following points/systems of the TBM:

- Cuttinghead RPM
- Cuttinghead Torque
- Cuttinghead Direction
- TBM Advance Rate
- Articulation Cylinder Extension
- Propulsion Cylinder Extension
- Propulsion Cylinder Pressure
- Centre of Thrust
- Screw Conveyor RPM
- Screw Conveyor Torque
- Screw Conveyor Internal Pressure
- Hydraulic Oil Temperature & Level
- Main Drive Motor Electric Current Draw
- Total TBM Electric Current Draw
- Main Bearing Lubrication Flow & Pressure
- Sealing Systems Lubrication Flow & Pressure
- Earth Pressure Sensor Output

Ground Conditioning System Output
Gas Monitoring
Grout Injection Pressure & Flow
Guidance System Output

CCTV Monitoring System

Colour Camera, c/w: Sealed Housing	3	No.
High Resolution Colour Monitor	3	No.

Communication System

Intercom Phones	7	No.
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Phone Locations:

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|------------------------|---|-----|
| • Operators Cabin | 1 | No. |
| • Stationary Shell | 1 | No. |
| • Material Handling | 2 | No. |
| • Mucking Station | 2 | No. |
| • Ventilation Cassette | 1 | No. |

Trailing Shield

Sectional Design (Dowel and Bolt Flange at Springline)

Injection Ports, fitted with valves	6	No.
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Tail Seals

Rows of Wire Brush Tail Seals	3	No.
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Invert Grout Flap on Last Row	1	No.
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First two rows replaceable from within tunnel

Grout Lines

Grout Lines – Active	6	No.
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Grout Lines – Passive	6	No.
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Grout Line Area	1,940	mm ²
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Grout Type	A/B	
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Replaceable from within the TBM

Muck Removal System

Screw Conveyor

Tube Inside Diameter	852	mm
Overall Length	13.45	m
Tube Wear Protection – Invert Only, Entire Length		
Auger Wear Protection – Pulling Side, Entire Length. Edge hardfacing, entire length		
Available Power	225	kW
Maximum Speed	22	rpm
Bi-Directional Operation		
Replaceable Auger Tip		
Capacity at 100% Filling	425	m ³ /hr
Injection Ports (Ground Conditioning)	2	No.
Earth Pressure Sensors	2	No.
Retractable from Cuttinghead Chamber		
Inspection Hatches – located at Auger Joints	3	No.
Emergency Closure System for Guillotine		
Rear Discharge		
Guillotine Doors ahead of Rear Discharge		

Trailing Belt Conveyor

Nominal Width	914	mm
Length (no. sections)	48.6	m
Capacity	630	m ³ /hr
Belt Speed	0 to 96	m/min

Rollers

Available Power 30 kW

Rubber Lagging on Drive Rollers

Sections

Limber Rollers

Rigid Rollers

Belt Scrapers

Frame Mesh Guard on Bottom of Conveyor

Cowling/Hopper to control muck flow

Emergency Stop Pull Cord along entire length of conveyor – both sides

Mechanical Belt Weigh Scales 2 No.

Laser Volumetric Scanner 1 No.

Segment Handling and Erection Systems

Segment Unloader

Single Segment Ring Capacity

Hydraulic Operation

Controls located at First Gantry Section

Unloading Arms

Segment Transport Beam

Single Segment Lift Operation

Delivers Segment to Erector

Hydraulic Operation and Controls

Vacuum Type Pick Up System

Segment Erector – Ring Type

Vacuum Type Pick Up System

Rotational Speed – Fully variable	0 to 2	rpm
Inching Function		
Hydraulic Powered		
Hydraulic Control of all Functions		
Warning Lights and Sirens for Operation		
Safety Guards		
Fixed Operator Station in TBM		
Pendant Operator Station		
Lock Out to prevent operation from multiple stations		
Controls based on Dead Man system – automatically locks in place in case of power loss or release of controls		
Powered Degrees of Freedom	5	No.
Non-powered Degrees of Freedom	1	No.
Fail Safe Brake in case of power loss		

Trailing Gantry

Structural Steel, c/w: welded and bolted connections

Railing Up

Gantry Sections	8	No.
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Structure Type	Open
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Support Type	Bogie Wheel
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Support of TBM Ancillary Equipment

Walkways

Electrical

Transformer: Non-Explosion Proof	2250	kVA
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Primary Voltage	13.8	kV
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Secondary Voltages

600 & 480 V

Gas Monitoring System

Monitoring points at the Screw Conveyor Discharge and in the TBM working area

Gas monitoring system for the following gases:

- Oxygen (O₂)
- Hydrogen Sulfide (H₂S)
- Sulfur Dioxide (SO₂)
- Methane (CH₄)
- Nitrous Oxide (NO)
- Nitrogen Dioxide (NO₂)
- Carbon Monoxide (CO)
- Carbon Dioxide (CO₂)

TACS Automatic Tunnel Guidance System

Industrial PC

Video Target

Motorized Total Station

'acs' Software and DTA Calculation

Segmental Ring Module

Video Target Software

Theodolite Communicator

PLC Communicator

Data Communication Software

Ground Conditioning System

System Capacity (Measured @ Atmospheric Pressure)

3,167

l/min

Polymer Injection Rate	100	l/min
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Includes:

- Flow Meter for main water
- Pressure Meters for main water and air line
- Water pumps 7 No.
- Foam dosing pump 1 No.
- Polymer dosing pump 1 No.

Two-Component Grout Injection System

A Component Injection Capacity	20	m ³ /hr
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B Component Injection Capacity	2	m ³ /hr
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A Component Tank c/w agitator and level sensor	5000	L
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B Component Tank c/w level sensor	500	L
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Total Injection Points	12	No.
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Includes Local Controls and Pressure Sensors

Transfer Pump (from Buyer supplied Grout Car to TBM mounted tank)

Ventilation

Main

Ventilation Cassette Lifting System

Cassettes	2	No.
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Auxiliary

Capacity	450	m ³ /min
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Electric Fan, uni-directional, single speed

Silencers	2	No.
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Fire Suppression

ANSUL Fire Suppression System for Hydraulic Power Packs

Gas Motor Actuator

Dry Chemical Extinguishing Agent

Nitrogen Filled Cartridge

Remote Actuator – manual

Manual Fire Extinguishers (Class A,B,C Fires)	8	No.
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Emergency Generator

Installed Power	150	kVA
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Output Voltage	600	V
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Electrical Frequency	60	Hz
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Systems Powered:

- Control System
- Lighting
- Auxiliary Vent Stages 1 & 2
- High Voltage Cable Reel
- Hose Reels
- De-Watering Pumps
- Flood Door Powerpack

(Not all systems can operate at 100% capacity simultaneously)

Bentonite Injection System

Injection Ports on TBM Shield	12	No.
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Injection Ports to Cuttinghead Chamber	6	No.
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Pump Capacity	200	L/min
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Agitator Tank Capacity	3000	L
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Dewatering System

Settling Tank – Capacity	3000	liter
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Discharge Pump	600	liter/min
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Suction Pump	100	liter/min
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Water piping on gantry from suction pump to tank

Air Compressor for GCS and Tools

Power	30	kW
Maximum Air Delivery (FAD)	5.75	m ³ /min
Maximum Pressure	0.8	bar
Air Receiver	1,500	liter

High Voltage Cable Reel

Capacity	300	m
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Water Hose Reel

Capacity	25	m
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Rewinding & Automatic Tensioning

Cooling Water Inlet Requirements

Required Inlet Flow	583	liter/min
Maximum Inlet Temperature	25	°C
Minimum Inlet Temperature	17	°C
Maximum Inlet Pressure	7	bar