New paths in track maintenance

Cyclical preventive mechanised reprofiling of rails: milling, grinding, measuring and documentation with one system

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Disruptions caused by defects on rail surfaces result in damage to the whole rail system, not just to the track but also to rolling stock, with adverse consequences for network operation and huge noise exposure. The cyclical preventive mechanised reprofiling of rails has by now become firmly established worldwide for increasing the service life of rails and improving the economic efficiency of maintenance. This type of maintenance requires machines that re-establish the rail profile within the shortest of time windows while meeting standards and process safety at the same time. Robel's first product from the range of rail processing meets these requirements and is state of the art: ROMILL (image 1) is a two-part vehicle for preventive and corrective maintenance. The system performs milling, grinding and measuring tasks and documents the achieved optimum condition of the rail.

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Technical specifications of ROMILL system

Length	max. 32 m
Width	max. 3 m
Height	max. 4,100 m
Weight	< 120 t
Axle loads	< 15 t
Max. transiting speed	60 km/h
Max. hauled speed	60 km/h
Min. curve radius	150 m incl. guard rail sections
Max. permitted superelevation	160 mm
Max. negotiable gradient	38/1000
Drive	Diesel EU exhaust emission level 5 (approx. 600 kW)

Technical specification of milling unit

Milling wheel diameter	1445 mm
Material removal	0,3 mm – 2,0 mm
Infeed accuracy	0,05 mm increments
Residual corrugation after milling	0,0009 mm (calculated value)
Working speed	400-1200 m/h
Tool life per assembly	max. 5000 m depending on material removal and rail damage

Technical specification of grinding unit

Number of grindstones	max. 6 per side
Material removal	max. 0,02 mm
Working speed	max. 1200 m/h

ROMILL Rail Reprofiling System

Precise milling eliminates rail defects early and so avoids costly and time-consuming rail replacements. The removal of material by milling has considerable benefits compared to grinding methods:

- Working without flying sparks reduces the risk of injuries and fires to a minimum
- Can be used in sensitive environments, tunnels and in areas without water supply
- Dust- and residue-free reprofiling of rails for a clean working and track environment
- No structural changes from thermal loading of the rail.

The milling system reprofiles the rail with a calculated removal of material in only one pass, without any environmental pollution from residues and to a standard-compliant surface quality. At the same time, the process speed and thus the network availability are increased: The train formation gets to the worksite swiftly, works at maximum output and after automated maintenance support directly in the unit is available straight away for the next deployment.

The work unit: precisely controlled removal of material

The milling unit accurately adjusts the rail transverse profile to new condition. The vertical cutting plates (image 2) are arranged to customer specification and after pre-measuring with material removed in 0.05 mm increments. If the actual condition of the rail requires removal of material that deviates from the preliminary setting, the vehicle driver will make the necessary adjustments.

The two milling wheels are positioned on the inside of the rail via a contact-based

Image 1: The two-part ROMILL rail milling system is Robel's first product for reprofiling rails.

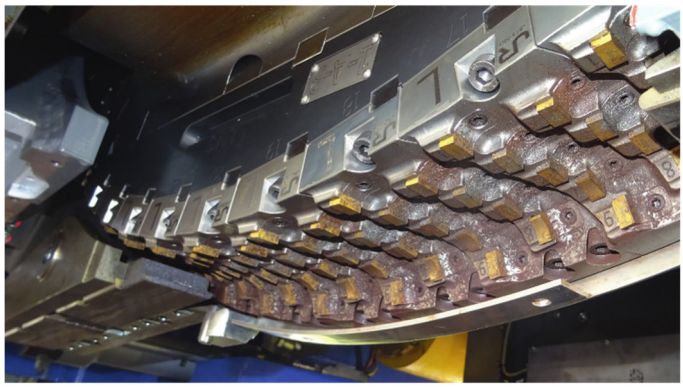


Image 2: The cutting inserts positioned vertically on the milling wheel allow for an increased number of cuts for even more effective milling.

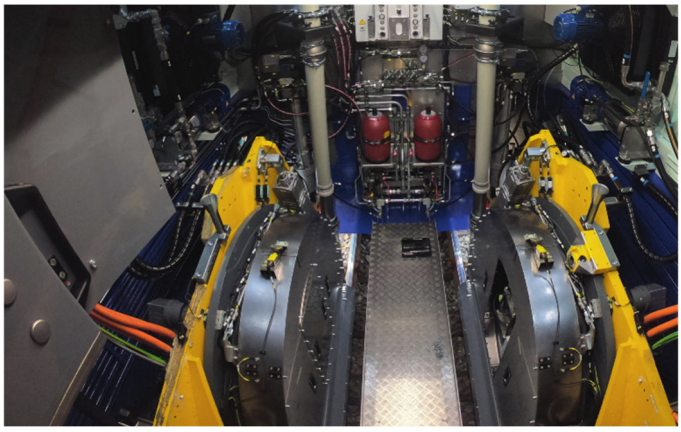


Image 3: The milling unit room allows protected access to the milling wheels and extraction pipes inside the machine.

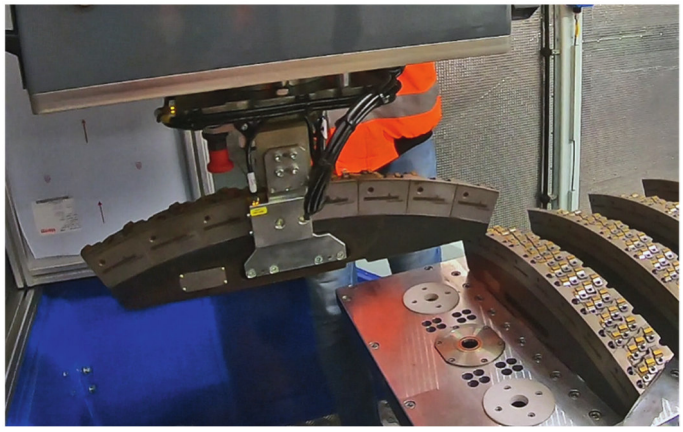


Image 4: Semi-automatic segment change inside the maintenance room

Image 5: A collaborating robot tightens and loosens the cutting inserts.

Image 6: View of the track and machine: Inside the cab are the displays for (left to right) measuring system, milling and grinding unit and outside cameras as well as the controls for grinding unit, extraction and measuring.

system with a mechanical scanning finger to avoid excessive milling.

Furthermore, an intelligent milling control system detects, for example, rail joints that are too big, and through an automatic emergency lift protects both the milling system and the rail.

A new, highly accurate drive solution allows for jerk-free driving during milling, the air-conditioned electrics room provides cooling for the whole drive technology and consistent operation, even at high temperatures.

The design of the vehicle interior (image 3) paid special attention to working comfort and operator safety: All maintenance work is performed semi-automatically with optimum ergonomics from inside the vehicle and can be controlled by just one operator. The maintenance room of the work unit accommodates

- a work bench with prepared replacement segments
- the semi-automatic changing system for individual segments of the milling wheel (image 4)
- a collaborating robot with torque wrench for tightening and loosening the cutting inserts (image 5).

In addition to the working conditions, environmental aspects also play a significant role: The swarf produced is extracted almost completely by a suction/pressure blower directly at the milling wheel and discharged into a container for recycling. Extendable hoses open up further possibilities for flexible and space-saving discharge of swarf. During the swarf discharge, the machine already starts its service operation - segment change, cutting insert change and concentricity measurement: This is measured directly at the milling wheel, the data is displayed on a screen in the service room (image 6) and can be stored on a USB stick. This enables quick troubleshooting and adjustment of the individual cutting inserts.

The supply unit: clean finish

The post-treatment of the rail surface is carried out in the second part of the vehicle, the supply unit:

The residual corrugation after milling and oscillating grinding corresponds to the quality requirements of EN 13231-3 in all wavelength ranges. The grinding unit (image 7) works quietly, spark-free and clean with minimum material removal in longitudinal grinding:

- Long contact surface and large grinding area for an even work result (image 8) with minimum rolling noise
- No impact on temperature of rail surface
- Use of digital and analogue grindstone segment monitoring
- Through the use of constant parameters for frequency and grinding pressure there is no longer a need for height adjustment, eliminating any operating errors.
- During the oscillating dry grinding process, the sediment and rail profiling residues are picked up into the filtering system by the new blower and extraction system directly at the grindstone segment and cleaned in an environmentally friendly manner.
- The remaining and filtered residues are stored in a sliding container for later disposal.

Image 7: A blower and extraction system picks up the residues of the oscillating dry grinding process into the filtering system directly at the grindstone segment.

Image 8: Rail surface after one pass of the rail reprofiling system

Image 9: The sensor head of the RMF 1100 measuring system captures the longitudinal corrugations of the rail after grinding.

The grinding unit is designed optionally for dry and wet grinding procedures, depending on the local conditions, such as obstacles on the track, switches and crossings or ambient temperatures in the area of deployment.

An integrated measuring system for transverse and longitudinal corrugations of rails that is located behind the last bogie of the supply unit (image 9) carries out the final measurements. A laser measuring system captures the transverse profile contactless at maximum precision, either during a pre- or post-measurement.

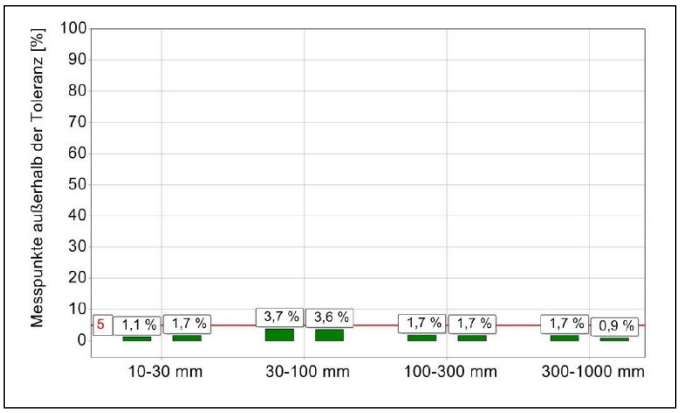
The longitudinal corrugation (images 10a+b) is measured using the "RMF 1100" measurement system by Vogel & Plötscher which works to an accuracy of one thousandth of a millimetre. The results of both measurements are combined, displayed on the operator's screen and output in a log.

Business Case for the use of ROMILL

In the maintenance management of international network operators, the cyclical reprofiling strategy is of great importance for extending the service life of a rail and thus to ensure low life cycle costs. In recent years, rail reprofiling by grinding and milling has become the norm. Therefore, an optimum strategy includes the use of grinding and milling machines on tracks and in switches and crossings depending on capacities and available work intervals based on reliable annual cost planning.

Cost factor availability

During the available possession times, the ROMILL rail reprofiling system processes a maximum of 1,200 metres of track per hour,



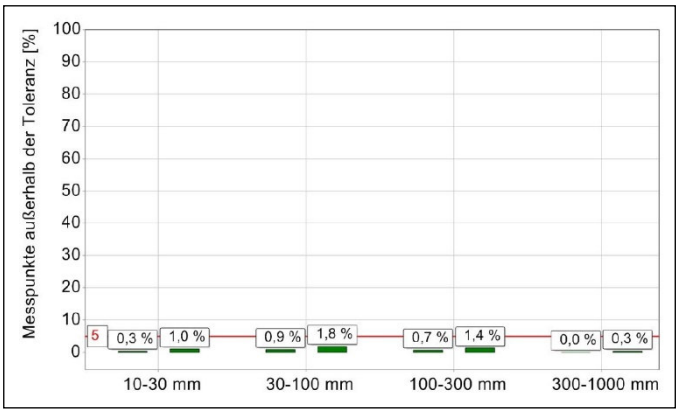


Image 10: Data evaluation of longitudinal profile measuring as per EN 13231-3 after milling and grinding.

depending on the condition of the track system and progress of rail defects. Thus, the cutting insert set achieves a durability of up to 5,000 finished metres of track. In addition, the cutting inserts can be turned and re-used four to eight times, depending on their profiles. A second replacement set of segments for the milling machines is already prepared in the setup room. After the segments have been replaced, the machine will be ready for deployment straight away.

Cost factor workforce and verification management

Only one operator is required for setting up and shutting down the milling system, grinding unit and measuring system on straight track and in curves with superelevation. The operator has a good view of all the systems as well as the rail before and after reprofiling thanks to several high-resolution Ethernet cameras. Via video screen he also monitors the final grinding work carried out by the oscillating grinding unit. The measurement verification is performed by integrated measuring systems and is available for the network operator in digital or analogue format.

Cost factor service

The machine can be fully serviced on site and from within the machine:

- Servicing of the milling system can be carried out safely and swiftly in the assembly room of the work unit.
- The grindstones are replaced in a few simple steps using the tensioning system on a grindstone holding device.
- The grindstone filtering system is emptied easily via the collecting vessels.

Cost factor environmental protection

The ROMILL rail reprofiling system transfers the removed swarf directly from the milling wheel into the swarf container of the supply unit. There is almost no contamination of the track and therefore no additional cost for cleaning the track. The swarf is discharged via a radial fan, either into a special container or a drum discharge system.

The first metres of track

As the first machine of a new product line for rail reprofiling, Robel is launching ROMILL for the international market. One of three rail reprofiling systems ordered is already being tested in Japan, with a view to starting operation in the second half of 2021. Robel is offering virtual machine demonstrations to any interested parties.
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