Successful application of milling technology at GVB Amsterdam

The Dutch public transit agency GVB Amsterdam relied on well proven LINISINGER milling technology to maintain their subway rails.

RICHARD STOCK |
JOHANNES HAINBUCHER

Initial milling of new rails contributes to a significant rail life extension when applied at the beginning of the rail life-cycle. LINSINGER milling technology was used efficiently to do high quality initial milling of the new North-South subway line in Amsterdam within a very limited time window. The new milling train MG11, which was specifically designed for application in subway tunnels, removed 100% of surface defects and created an optimized target profile with highest precision.

The idea of having a dedicated North-South Metro line in Amsterdam was first born in the 1960ies. About 15 years ago the growing city of Amsterdam decided to start with the implementation of this line, called M52. The line starts at the "Amsterdam Zuid" station heading North underneath the center of Amsterdam to terminate at the newly built "Amsterdam Noord" station. This about 10km long double track line consists of 7 newly build stations (collaboratively designed between architects and artists) and follows the buried old river bed of the Amstel river. LINSINGER milling technology significantly contributed to a comfortable, 15 min long subway journey from end to end.

Initial maintenance to extend rail life

Initial milling of newly installed rails as part of a cyclic-preventive maintenance program contributes significantly to an optimized rail life. New rails have a so-called decarburized layer on the surface. The hot temperatures during rail production cause a chemical reaction between the oxygen in the air and the carbon in the rail surface causing some carbon to be removed from the rail surface (decarburization). This decarburized layer with a depth of typically 50-200µm shows diverging properties compared to the native rail material. To provide uniform rail properties it is recommended to remove this layer by initial maintenance right at or shortly after new rail installation. In addition, rails can be damaged during the installation process. This damage can manifest in the form of scratches, pits, grooves, imprints and these defects can act as crack starters if not removed properly. New rails also show some profile tolerances which, if combined with tolerances of the whole track construction, can sometimes lead to high stress rail-wheel contact conditions. Especially high strength rail grades with increased wear resistance can only marginally adopt their profile by natural wear. A precisely adjusted initial target profile (Fig. 1) can help to benefit from the positive features of high strength rail grades (low wear rate, high resistance against rolling contact fatigue) right from the point of installation.
Consequently, it is recommended to initially treat rails right after installation before the first train travels on track. If this is not possible no more than 3 months of traffic should pass before initial maintenance is applied. Typically 0.3mm of metal are removed during initial maintenance with some locally higher metal removal rates if damage conditions require to do so.

Milling procedures for transit systems

The well proven LINSINGER high performance milling technology can be used for all maintenance scenarios due to its variable metal removal capability. In the case of a regenerative strategy, rails can be restored to an as-new condition (complete damage removal, high precision target profile) almost independent of the original surface damage situation. On the other hand, milling can remove as little as 0.1mm from the rail surface. Consequently, it can also be applied for initial maintenance. LINSINGER high performance milling combines the milling process with a subsequent surface polishing process. This polishing unit (circumferential grinding wheel with small offset angle) is located right after the milling unit on the milling machine. With the help of these two process steps, a defined and well documented high-quality rail condition is created (damage free rail surface, precise transversal target profile +/- 0.2mm, smooth longitudinal profile +/- 0.2mm, low surface roughness < 0.5µm). Rail milling is a dust a spark free process. The generated milling chips (process by-product) are efficiently (>99.5% collection ration) collect on the machine and can be recycled later. Tunnels stay clean (no dust contamination) and subsequent cleaning activities are not required,

unlike with conventional rail grinding. Furthermore, the fire danger during rail treatment is minimized due to the absence of sparks. Finally, the high precision and high-quality rail surface finish also contributes to noise mitigation, which is especially important in urban areas.

The rail milling train MG11 (Fig. 2) was specifically designed to fit into smallest tunnel clearances and to operate in work windows of up to 2 hours of chip time. It is transported quickly and efficiently in a standard 40ft container to the work site. The machine is equipped with the latest LINSINGER high performance milling technology and has a metal removal capability of max. 1mm per pass. Contrary to rail grinding, all damage can be removed from the rail surface in as little as one pass. Only for deep defects 2-3 passes will be required. Like all LINSINGER milling machines, also the MG11 can be equipped with the LINSINGER switch processing function. Therefore, this machine can treat mainline track as well as switches and crossings. A dedicated switch treatment machine as with traditional rail grinding is not required.

Initial Milling in a challenging environment

Initial milling of the metro line M52 in Amsterdam was necessary due to its extended construction period. To ensure a safe and comfortable ride experience, the rails had to be reprofiled and all construction related surface defects (depths up to 0.5mm and beyond) had to be removed. Additionally, empty subway trains were already running on regular schedule on the track to simulate full-service conditions. These test trains also caused some minor rail wear and RCF damage development on the rails. Due to the tight project schedule and the subway testing it was not possible to stretch the initial maintenance over a longer time period. The initial milling had to be finished in a time window of 96h.

As a first step GVB did some milling tests in their depot to assess profile accuracy, damage removal capabilities and surface quality of the milling process. Due to the excellent results of these tests, GVB decided to go with the LINSINGER MG11 rail milling train for initial rail treatment. In addition, it was of highest importance for GVB to have a dust and spark free technology at hand that would minimise fire danger and would not cause contamination of tunnels and the newly built stations (Fig. 3).

Logistic challenges and solutions

As the MG 11 milling machine was designed to operate in work windows of max. 2h, LINSINGER had to overcome a number of logistical challenges in order to successfully operate at GVB.

- To enable continuous operation of 96h, the chip bunker had to emptied out every 2h. Therefore, chip containers were strategically placed at the closest tunnel exit in reference to the respective work site. This efficient empty-out process only caused minor interruptions of the work program as the MG11 train can drive self-propelled up to 50 km/h from and to the work site.
- GVB provided a dedicated workshop car, in order to index the cutting tips of the cutter heads on site in the tunnel. With this, a continuous milling operation was ensured as changing the cutterheads on the machine can be done in a few minutes.
- Refueling of the diesel electric MG11 trains was handeled by GVB directly at the work sites in the tunnel.
- All other required machine maintenance was also done on site in the tunnel.

All encountered problems could be successfully solved on site due to the seamless collaboration between LINSINGER and GVB. Although designed for short work windows, the MG 11 could smoothly master this marathon operation in the tunnel. Initial milling with some corrective spot work was finished to full customer satisfaction. Quality control was provided without the use of any measurement technology. When the subway tests continued after the milling operation, the train drivers clearly noticed better train running behavior and less noise emissions.

Just in time, the metro line was opened as planned on July 22nd 2018 with an official celebration event. Due to LINSINGER milling technology it is possible to have a smooth subway ride on perfectly maintained rails on line M52 in Amsterdam.

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