

# Geared Up For Another 37 Years

**I**n 1967, MAAG Zurich Switzerland invented a heavy duty gearbox design for the cement industry, namely, planetary gearboxes for cement ball mill grinding.

The first unit was built for a 2000 kW power rating and was delivered to Holcim Belgium in Obourg. Following the production output of 30 units of this type of gearbox, a new design evolved (CPU), resulting in a further 220 units installed to date worldwide. Holcim Untervaz, Switzerland, purchased a P2U3 gearbox for 3600 kW in 1972, which was operational by February 1974.

The planetary gearbox's reputation is ranked highly worldwide thanks to the robust design and state-of-the-art gearing and toothing technology. Low cost maintenance and easy access ensure a high yield production at customer sites.

Peter Wenzinger,  
FLSmidth MAAG Gear AG,  
Switzerland, demonstrates  
how professional  
maintenance and  
service can pay off with  
this case study from  
Holcim Untervaz.

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Figure 1. First general onsite inspection of FLSmidth MAAG Gear's Planetary Gearbox P2U3 after 37 years and approximately 200 000 h of operation (first stage).



Figure 2. Ultrasonic examinations/tests (UT).



Figure 3. Original surface pattern still visible on the planet wheels of the second stage.

The company, now called FLSmidth MAAG Gear, is proud of the performance of its gearbox at Holcim Intervaz and is pleased to highlight what technical support combined with professional maintenance by Holcim provides. This year the first general revision refurbishment of the system was carried out.

## Regular services and maintenance

During the 37 years from February 1974 until 2011, FLSmidth MAAG Gear has visited the plant 38 times. Regular inspections were carried out, the alignment was checked frequently and the gear was kept in good condition. In addition, the local Holcim maintenance team carried out daily maintenance work. The combination of the delivery of a high quality gearbox together with continuous inspections, services and daily maintenance helped secure the equipment's long reliable operation.

Finally, in 2011, after approximately 200 000 operating hours, a major overhaul was carried out by FLSmidth MAAG Gear service engineers. All-encompassing tests regarding the condition of internal and external parts of the gear took place onsite and also in laboratories (Figure 1).

The first and second stages were disassembled completely. The first stage was found in a good general condition as described in detail below. Only the bearings and axles had to be replaced due to normal wear. The new bearings have been equipped with temperature sensors for more operation data and safety in the future. Fortunately, all required spare parts were on stock at the plant.

The second stage was found to be in good condition, too. Ultrasonic tests were conducted and all parts could be used again for re-assembling as they were. Input as well as output coupling were checked in detail and were found to be in an acceptable condition.

The company recommends a service intervention once per year. In combination with the regular maintenance work carried out by the maintenance team of the plant, this ensures long life and reliable operation. Hence, the cement plant can effectively schedule its own shutdown time to overhaul the gear, also considering normal fluctuations in cement demand from the market.

## Strict inspections

During maintenance work, all the relevant gearbox parts were carefully inspected, measured and checked. The service engineers inspected the whole driveline, the gearbox itself, as well as both toothed couplings and the alignment of the drive train.

External specialists using special testing equipment inspected all the toothed parts, such as sun pinions, annulus, planet wheels, planet axles, internal coupling, as well as the planet carrier. Dye penetration tests (PT), fluorescent magnaflux tests (MT) and ultrasonic examinations (UT) were carried out. PT and MT are generally used to check the surfaces for cracks (e.g. tooth flanks or white metal on bearings). Even micro cracks can be detected by these tests. UT is used to check the parts for invisible damages under the surface (e.g. toothing or planet axles), as shown in Figure 2.

All toothings were found to be without any damage. On some gears, even the surface pattern originating from the manufacture, was still visible (Figure 3). The toothing specialists also inspected the parts visually and confirmed

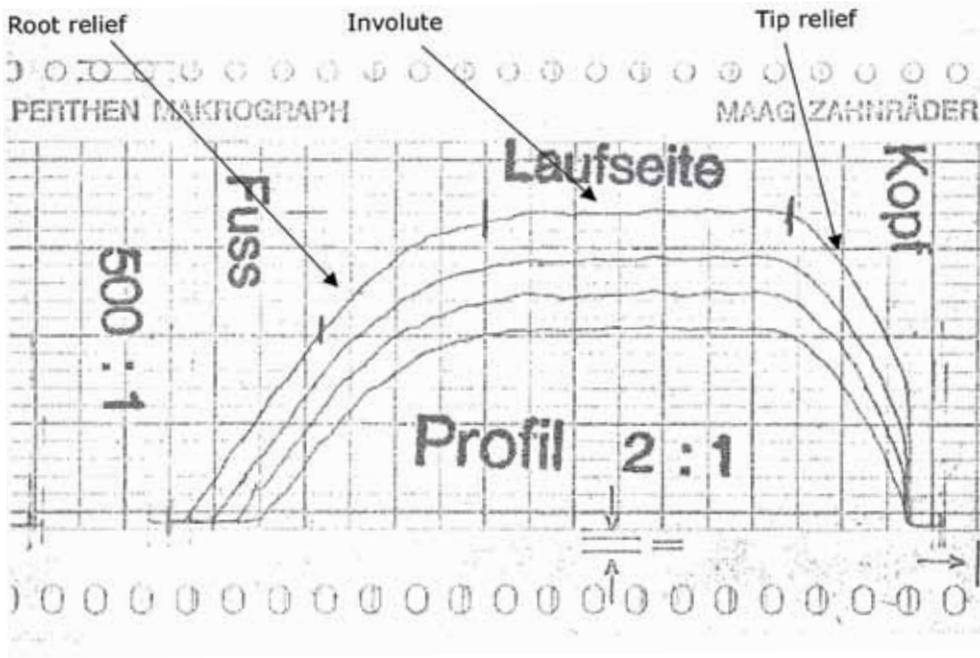
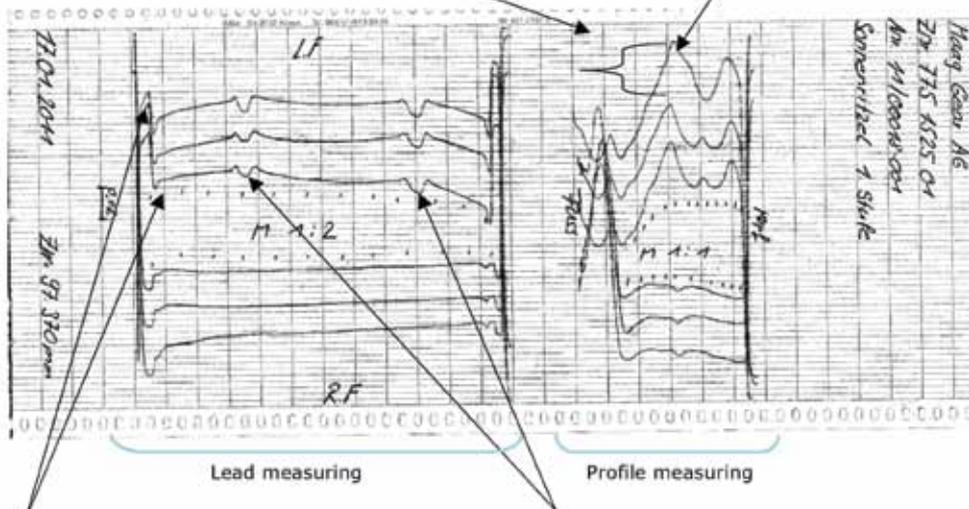


Figure 4. Profile measuring. Original measurement after the grinding process.

their good condition. This speaks for the quality of materials used, quality and accuracy of the production line, and the quality of adherence to MAAG standards. The planet axles were also checked by UT and by PT. All the second stage axles were in good condition and will be used for further operation, with only the first stage axles needing replacement.

The tooth flanks of the sun pinion (first stage) were measured in order to provide a comparison between the toothing geometry now and the geometry of 37 years ago (Figure 4). The sun pinion showed a little wear of 0.02 – 0.03 mm, which causes no problems at all. It will be used for further operation (Figure 5). The sun pinion toothing is usually the most delicate part in view of wear and tear.

Little wear on tooth flank: 0.02-0.03 mm. Such wear after long operation time is not unusual.



Tooth pattern of planet wheel is recognisable. Also the location (0.008 mm) of oil injection is well visible at the diagram.

The stripes visible on the sun pinion teeth are caused by the mill's starting process (Figure 6). During start-up, the sun pinion aligns itself between three planet wheels, causing this effect. The tooth contact pattern of the respective gear covers the whole width, which proves flawless power transmission without any canting. All in all, a surprisingly satisfactory result.

Figure 5. Lead and profile measuring after 37 years of operation.

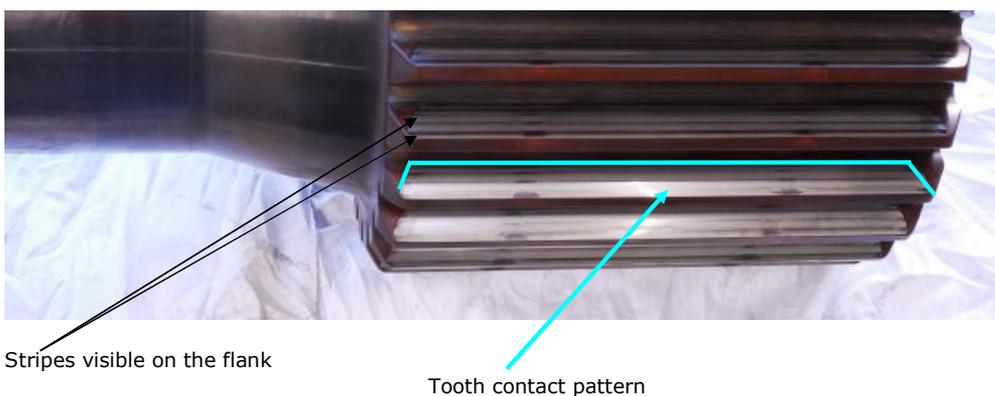


Figure 6. Sun pinion toothing.

## Built to last

After the professional overhaul and the positive assessment by the engineering department, the gearbox is geared up for the next 37 years, meeting Holcim's high expectations and proving the quality of this product. 🌐