The Elimination of Gear Noise in a Six Speed Gearbox for Passenger Cars

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Abstract The article deals with analysis of the noisiness sixth gear and determination of correction of cogs, which could remove negative cogs noisiness.

Keywords Gearbox · Helical front gears · Noisy gears · Modification of gears

1 The Initial Situation

At the start of production in Mlada Boleslav of the new 6-speed gearbox type for passenger cars, there was an identifiable noise in load mode from the engine when the sixth gear was engaged in the 2,100 RPM to the 2,900 RPM range (see Fig. 1). The limitation of top rotations are based on the speed limit on the roads in the Czech Republic.

1.1 Analysis: Quality of Gears

The first step in the analysis was the measuring of the gears. No anomalies were identified (errors during the production of parts—Fig. 2) which could have led to increased noise from the gears.

Following on from the above, the next step in the analysis of produced noise was the testing of changes under load in the gearbox.

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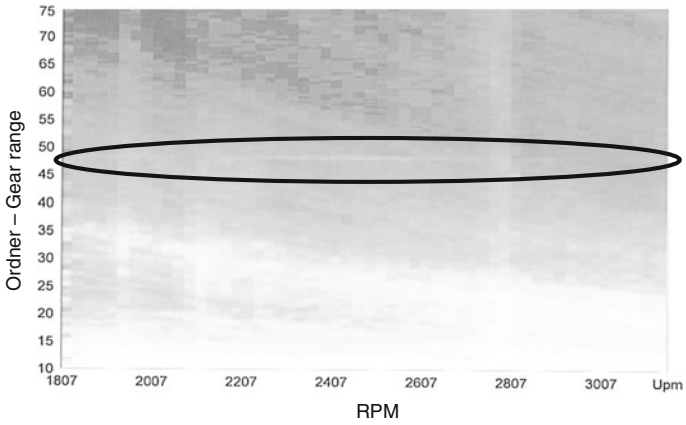

Fig. 1 The recorded sound from a microphone in the vehicle whilst in sixth gear—the area marked in blue reflects the increased noise from the gears

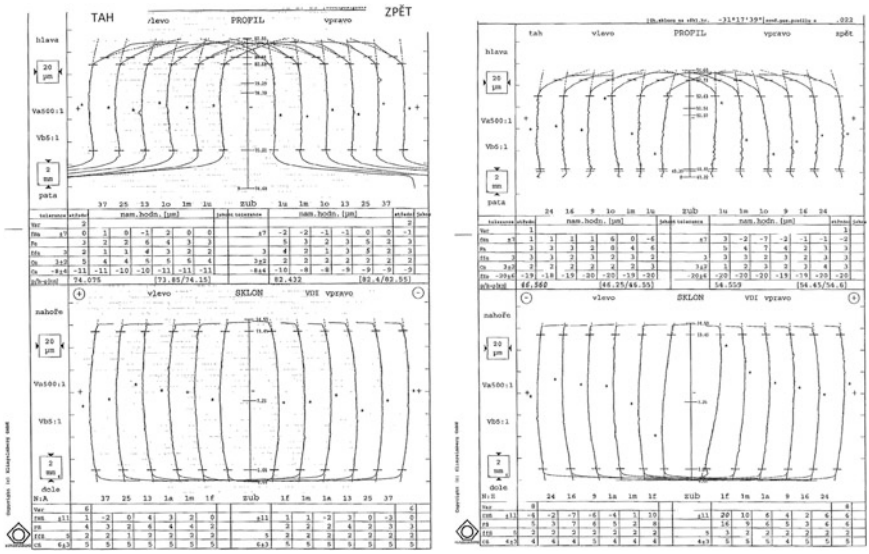

Fig. 2 Gear drive deviations

1.2 Analysis: Track Frame

The entire gearbox was placed on a text bench simulation an installed on in a car under a gear torque load as required. In our case it was a load of 1, 41 and 100 % of the maximum load transmitted torque (Fig. 3).

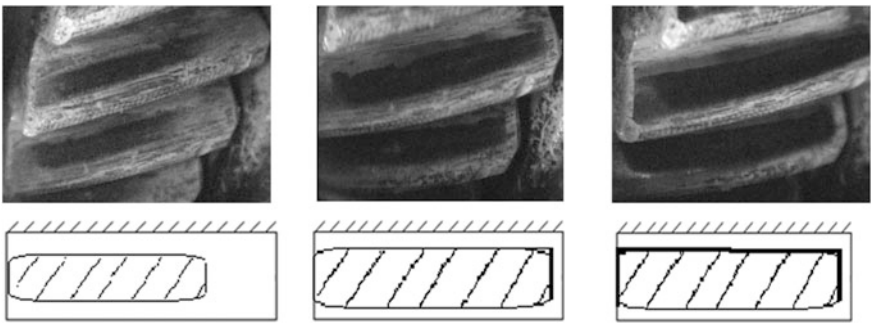

Fig. 3 Track frame of 1, 41 and 100 % of the load torque—the strong line shows the *sharp edge* of the gear frame

From this track i tis obvious that at a low load there is no contact with the sharp edge, whilst edge contact becomes visible during a larger load. It is therefore apparent that as a result of deformation of the entire system gear tracks need to be adjusted from the left to the right gear. This could compensate for deviation of the helix angle.

2 Optimization

The adjustment described above could compensate for deviation of the helix angle under a load (Linke 2010).

2.1 Optimization: The Examination of Optimized Gearing

On the basis of these observations the gears were made with the corrected cog helix angle to compensate for the displacement of the track under load (see Fig. 4).

2.2 Optimization: Track Frame

Newly corrected gears were tested again on the track frame under the same load levels.

In Fig. 5 it can be seen that the correction of angle deviations of the helical bolt at about 10 µm, eliminated the sharp edges of the frame at a load of 41 %.

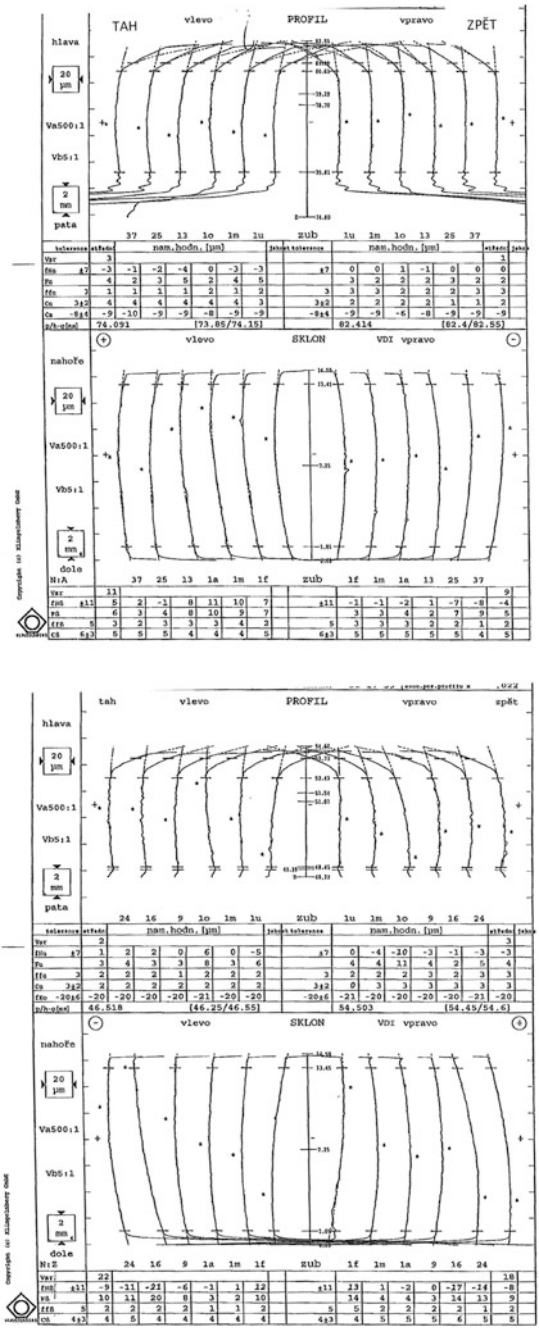

Fig. 4 Optimized gear drive deviations

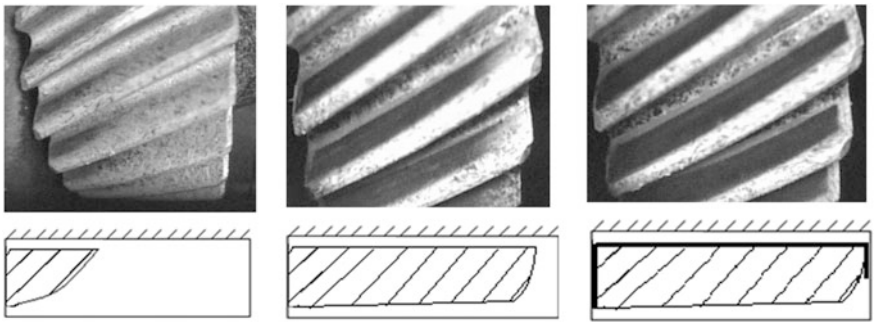

Fig. 5 Track frame of 1 %, 41 % and 100 % of the load torque—the strong line shows the *sharp edge* of the gear frame

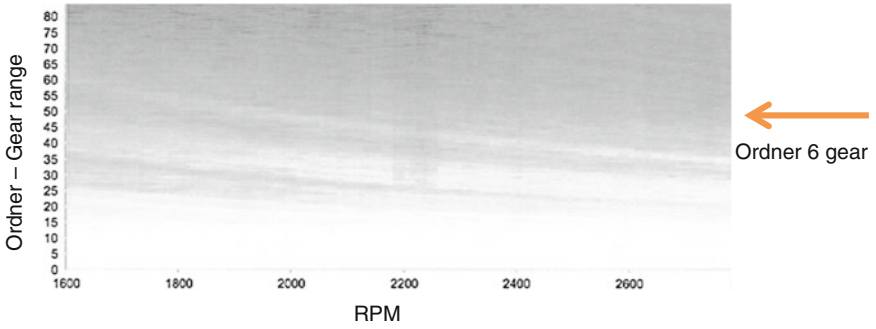

Fig. 6 The recorded sound from a microphone in the vehicle whilst in sixth gear—the area indicated by the *arrow points* to the activity of the sixth gear

2.3 Optimization: Verification of Noise in the Car

The optimized gears that were made based on the results of the stop were tested in the car (Moravec 2009).

No noise from the sixth gear in the car was recorded in the car throughout the test speed range (Fig. 6).

3 Conclusion

The tests in the car revealed that a change of 10 μm of the helix angles removed the noise from the 6th gear. This modification was successfully implemented into gear production.

References

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Moravec V, Dejl Z, Němček M, Folta Z, Havlík J (2009) Čelní ozubená kola v převodovkách automobilů. VŠB-TU Ostrava