Abstract

The dissertation concerns the manufacture of spiral bevel gears by grinding from solid in single-unit and small-batch production. The aim was to determine the grinding process parameters that ensure the required performance and functional properties of the gear set and, indirectly, to develop a design and manufacturing methodology for such production. The thesis states that integrating the design of tooth geometry and topography with the experimental selection of grinding conditions and process correction enables the designed state of the gear set to be reproduced technologically to a degree that ensures agreement between its measured functional properties and those predicted by calculation.

Using KISSsoft and KIMOS, twelve variants differing in cutting method (5-CUT and DUPLEX), shaft angle (90° and 100°) and grinding wheel diameter were analysed, considering V-H assembly deviations, ease-off topography synthesis and TCA/LTCA analyses. Four configurations with a 5″ wheel were verified experimentally on a Klingelnberg G27 grinding machine according to a central composite design. In plunge grinding, the effects of wheel peripheral speed, plunge feed rate and generating speed were investigated, in finish grinding, those of wheel peripheral speed, generating speed and dresser speed ratio. Signals from the Sinumerik 840D control system were analysed with a dedicated script.

For the generating phase, a spindle load threshold of approx. 6.2 kW was determined, below which no grinding burns occurred, for the plunge phase, the limit values depended on the machine–fixture–tool–workpiece system configuration. Generating speed dominated the topography deviation after rough grinding, and wheel dressing conditions dominated roughness after finish grinding (R_a reduced by up to approx. 52%). In-process measurements and machine setting corrections brought the manufactured topography closer to the design. All ring gears met the geometric criteria without burns, for DUPLEX pinions, a satisfactory concave flank topography was not achieved. For the 5-CUT gear sets, contact pattern inspection in the two positions confirmed the predicted direction of contact pattern shift and the agreement between calculated and measured backlash, confirming the thesis for the fully verified variants.

Keywords: spiral bevel gears, grinding, grinding burns, ease-off topography, contact pattern, V-H assembly deviations