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High-performance end milling of aluminum alloy: Influence of different serrated cutting edge tool shapes on the cutting force

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ABSTRACT

The article presents the results of experimental studies in high performance milling of AlZn5.5MgCu aluminum alloy. The tests were performed with the use of end mill cutters with different serrated shapes of the cutting edge. End mills with continuous, interrupted and wavy with varied profile radius were used. The tests were conducted on a DMG's DMU 100 MonoBlock machining center with cutting force components measurement in workpiece system capabilities. The experimental tests were carried out using varied radial depth of cut a_e and feed per tooth f_z parameters according to applied three-level full design of experiment. The relationships between a_e and f_z parameters and cutting force components for various cutting edge shapes were determined. A continuous cutting edge was adopted as a reference shape. Based on the results of the tests, cutting force components models for analyzed cutting edge shapes were determined. A comparative analysis between the developed models and relationships was conducted. The study proved that when adopting end mills with serrated cutting edges, lower cutting force components are obtained, in comparison with cutters with continuous cutting edges. The results also showed that for end mills with serrated cutting edges radial depth of cut a_e has a negligible influence on the feed force component F_f. The results proved, that end mills with serrated cutting edges should be used in high performance machining, where high values of a_e and f_z parameters are adopted. Furthermore, machining of thin-walled workpieces can be a potential application of these end mills, as lower values of cutting force components reduce the risk of deformation of milled thin walls.

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