

RPM-Synchronous Non-Circular Grinding: An Approach to Enhance Efficiency in Grinding of Non-Circular Workpieces

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Abstract : The production process grinding is one of the latest steps in a value-added manufacturing chain. Within this step, workpiece geometry and surface roughness are determined. Up to this process stage, considerable costs and energy have already been spent on components. According to the current state of the art, therefore, large safety reserves are calculated in order to guarantee a process capability. Especially for non-circular grinding, this fact leads to considerable losses of process efficiency. With present technology, various non-circular geometries on a workpiece must be grinded subsequently in an oscillating process where X- and Q-axis of the machine are coupled. With the approach of RPM-Synchronous Noncircular Grinding, such workpieces can be machined in an ordinary plung grinding process. Therefore, the workpieces and the grinding wheels revolutionary rate are in a fixed ratio. A non-circular grinding wheel is used to transfer its geometry onto the workpiece. The authors use a worldwide unique machine tool that was especially designed for this technology. Highest revolution rates on the workpiece spindle (up to 4500 rpm) are mandatory for the success of this grinding process. This grinding approach is performed in a two-step process. For roughing, a highly porous vitrified bonded grinding wheel with medium grain size is used. It ensures high specific material removal rates for efficiently producing the non-circular geometry on the workpiece. This process step is adapted by a force control algorithm, which uses acquired data from a three-component force sensor located in the dead centre of the tailstock. For finishing, a grinding wheel with a fine grain size is used. Roughing and finishing are performed consecutively among the same clamping of the workpiece with two locally separated grinding spindles. The approach of RPM-Synchronous Noncircular Grinding shows great efficiency enhancement in non-circular grinding. For the first time, three-dimensional non-circular shapes can be grinded that opens up various fields of application. Especially automotive industries show big interest in the emerging trend in finishing machining.

Keywords : efficiency enhancement, finishing machining, non-circular grinding, rpm-synchronous grinding

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