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Vacuum-Hydrostatic Shoe for Centerless Grinding

The objective of this study is to design an innovative vacuum-hydrostatic shoe to solve the workpiece lobing and shoe wear problems in centerless grinding of bearing raceways so as to improve workpiece quality and dimensional accuracies and reduce the machining cost. The shoe combines a vacuum pocket to a hydrostatic bearing, thus providing a non-contact, high stiffness and good load-carrying capacity workpiece support. Based on the kinematics and mechanics in shoe centerless grinding, the study provides theoretical analyses to systematically reveal the workpiece holding and rotating mechanisms of the planar frictional drivehead. It addresses workholding stability issue for the first time from the viewpoint of driving capability and constraint capability, which are the two contradictory sides of centerless grinding. Dynamic modeling is performed to correlate the lobing and chatter with machine setup parameters and process parameters. A methodology is advanced for the design of vacuum-hydrostatic shoe. A computer model is presented to demonstrate the effectiveness of the vacuum-hydrostatic shoe in improving workpiece roundness through lobing control. Experimental results show that with the vacuum-hydrostatic shoe, the geometric and workholding instabilities are effectively eliminated or suppressed, which in turn improves workpiece geometric accuracies and surface finish. The shoe has made possible high speed, wear and thermal damage free workpiece support for shoe centerless grinding due to its non-contact support mechanism. With the application of the vacuum-hydrostatic shoe, the shoe centerless grinding process becomes insensitive to the critical parameters, such as offset and shoe setup angles. As a result, the roundness error of a typical bearing raceway of 42 mm in diameter is significantly reduced from the current level.

Thursday, September 27, 2007
4:00 - 5:00 PM
1013 HH Dow Building

For more information, please call Kathy at (734) 764-3312 or email at kbishar@umich.edu
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