Optimization of Precision Grinding Process

Michael Nanlawala & Dr. Ali Manesh, P.E., ITT Research, Chicago, IL
& Pankaj Patel, The Purdy Corporation, Manchester, CT

Gear-teeth grinding of spiral bevel, a costly and inexact science, is perhaps one of the most difficult of all grinding processes. Process development is usually a trade-off between achieving maximum material removal rate without damaging the part. The material removal rate is selected at its lowest possible to avoid any grinding burns. Much longer cycle time and higher percentage of scrap are characteristics of this process. Because the finish grinding is usually the last manufacturing step, any scrap will be relatively costly and takes a heavy toll on the overall manufacturing cost and delivery time. The outcome of grinding process depends upon factors such as materials of the grinding wheel, speed, feed, and in-feed. In this US Army Manufacturing Technology project sponsored by the Aviation and Missiles Command (AMCOM) through the INFAC program at IIT Research Institute, the goal was to improve the outcome of the grinding process, from a quality and cost point of view. The approach involved the utilization of an experimentally proven and well-documented body of knowledge relating to the various parameters involved. A design of experiment (DOE) was established that involved the pertinent variables, the practical value of these variables, how the variables interact, and how they effect the outcome of the grinding process. Based on the DOE, experiments were conducted to better understand the cross functional reactions between the variables. Experimental results showing as much as 50 percent reduction in grinding cycle time can be achieved. This paper will discuss the DOE, grinding, testing, and evaluation of results.

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For more information, contact:
Dr. Ali Manesh
IIT Research Institute
10 W. 35th St.
Chicago, IL 60616
Phone: 312/567-4201