

# Low Stress Abrasion and Sliding Wear of High Speed Steel-Ceramic Composites

M G Gee and A Gant  
National Physical Laboratory  
Queens Road  
Teddington  
Middlesex  
TW11 0LW  
Tel +44 20 8943 6374  
Fax +44 20 8943 2989  
E-mail : mark.gee@npl.co.uk

## Abstract

Tool steels are materials that are widely used in applications where abrasive- and sliding wear resistance are required. In this case zirconia and titanium diboride have been added to a standard high speed steel composition with the intention of improving wear resistance and also cutting performance in applications such as gear cutting. This paper describes the results of tests that were performed using a modified ASTM dry sand rubber wheel test system and those from a reciprocating sliding wear test rig on tool steels with and without particulate ceramic additions. It was found that although there was only a small increase in wear as the relative speed increased, a sudden increase in wear of two orders of magnitude was observed as the load was increased for the tool steels. It was also interesting that under most test conditions the tool steel materials wore at the same rate as the WC/Co hardmetal of equivalent hardness.

For all the materials the most noticeable difference was that under high applied load there was significant macroscopic grooving of the worn surfaces. By contrast the worn surfaces were dull but smooth under all other test conditions. When examined at high magnification, there was little difference in the appearance of the wear surface from one test condition to another; decohesion fracture frequently occurred at the trailing edge of carbide particles. Under abrasive wear conditions the ceramic additions conferred little improvement in high speed steel wear resistance. This was also the case under low frequency sliding wear. However, the addition of small quantities of zirconia and titanium diboride to the high speed steel considerably improved wear resistance at higher frequencies.

These results are complemented by examination of sub-surface damage through cross-sectioning.