Chapter 10: Wear testing

10.1 Techniques

Wear performance was evaluated by a cutting test with a commercial lathe. The test material was a standard rod of so-called 'Siffer'[†]. The samples were shaped to the required dimensions with commercial tool sharpening equipment. Again the commercially available Toshiba LX11 was chosen as reference material. Ideally the wear performance of alumina -diamond should approach the performance of LX11 as LX11 is also an alumina composite, albeit an alumina-zirconia composite. LX11 also proved useful to set the conditions for the wear tests. Of the possible dimensional wear measurements illustrated in fig. 5-3 (page 38), only maximum flank wear V_{max} was measured.

Parameters for the test were as follows (terminology is illustrated in fig. 5-1, page 34).

Surface speed:	$15\ ^{+0.5}/_{-0}$ m/min.
Depth of cut:	2 mm.
Tool nose radius:	0.8 mm
Tool nose clearance:	6°.
Approach:	45°
Rake angle:	0°
Feed rate:	0.1 mm/revolution

Although it may not appear so from fig. 10-1 to 10-4 (showing the progress of wear), the precise boundaries between the flank wear scar and the unworn face were unclear (lighting conditions for fig. 10-1 to 10-4 were not the same as for wear scar observation). Furthermore, distinction between flank wear zones and notch wear zones were open to individual interpretation. The length of maximum flank therefore depended on (possibly subjective) visual inspection. To eliminate at least some experimental variation, only the measurements of one observer, A. R. Ravenhill[‡] are quoted.

10.2 Results

Wear followed the trend illustrated in fig. 5-5 (page 40) but samples were not tested up to failure and the setlling-in behaviour was not observed in any samples. This meant that wear rate and apparent starting wear (fig. 5-5) was not observed. Wear rates and apparent starting wear were therefore determined by simple linear regression and are noted in table 10-1. The complete set of wear test data are presented in appendix A5.

[†] 'Siffer' is an in-house testing material used exclusively by De Beers.

[‡] Synthesis Division, Diamond Research Laboratory, Industrial Diamond Division, De Beers, Johannesburg, South Africa.

The progress of the wear for sample 0◊-α-Pα-H1200 is shown in fig. 10-1 to 10-4. Although this is a non-diamond containing sample the wear progress shown is typical of both diamond containing and non-diamond containing samples. Note that wear measurements were made with measuring toolmaker's microscope on site and not on the micrographs themselves, with the result that the length of maximum flank given in table 10-1 would not exactly correspond to the flank wear length visible in the given micrographs (fig. 10-1 to 10-4).

***Table 10-1**: Average wear rates and apparent starting wear.*

Reference no.	Wear rate (µm/s)	Apparent starting wear (µm)
LX11	0.5	90
0◊-α-CP-H1400	6.0	208
15◊-α-CP-H1400	19.3	301
15◊-α-CP-H1350	12.9	135
0◊-α-Pα-H1350	7.0	110
0◊-α-HP-H1300	2.0	76
15◊-α-pH-H1300	1.5	190
15◊-α-HP-H1300	4.4	186
15◊-α-HP-H1250	13.0	-107
15◊-α-pH-H1250	7.7	147
15◊-α-CP-H1250	7.4	174
0◊-α-Pα-H1200	2.5	108
15◊-α-CP-H1200	8.9	104

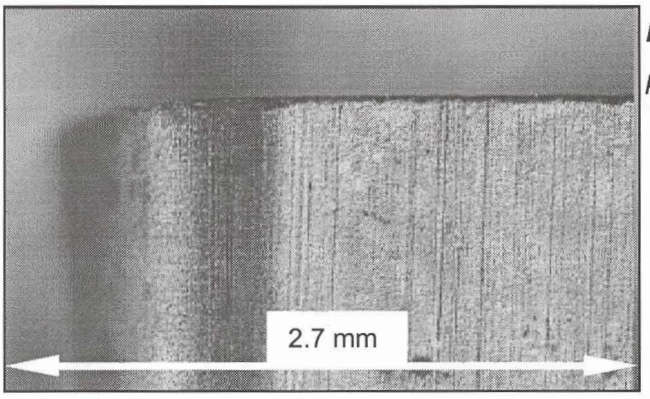

***Fig. 10-1**: Sample 0◊-α-Pα-H1200 as prepared for cutting test.*

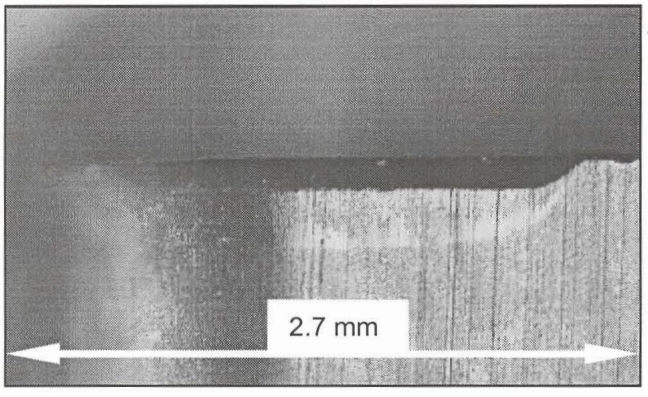

***Fig. 10-2**: Sample 0◊-α-Pα-H1200 after 10 seconds' cutting of cutting Siffer.*

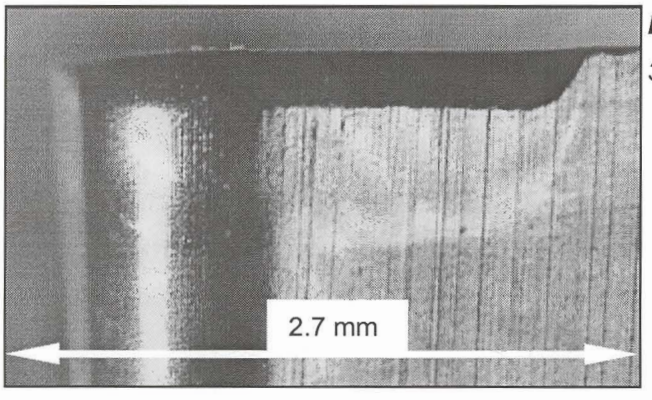

***Fig. 10-3**: Sample 0◊-α-Pα-H1200 after 30 seconds' cutting of cutting Siffer.*

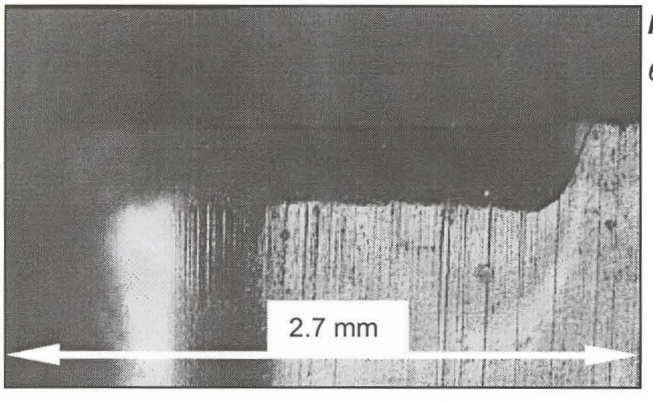

***Fig. 10-4**: Sample 0◊-α-Pα-H1200 after 60 seconds' cutting of cutting Siffer.*