that gives somewhat better tool life, due to the differential cost of grinding finished tools from the two steels.

Special Tool Tip Geometry

Klopstock (1926) was the first to show that tool life and cutting forces could be favorably altered by restricting the contact length between chip and tool. This was done by use of a composite rake face—small positive primary rake angle of $+15^\circ$ followed by secondary rake surface having a greater positive rake angle of 30°. This was found to give a more stable BUE and hence better surface finish with HSS tools. Tool life was also improved. When applying this concept to carbide tools, the primary rake surface is usually made slightly negative ($< 10^\circ$) in order to provide a larger included angle at the tool tip for added strength. However, when this is done, the negative primary rake angle gives high cutting-forces tending to neutralize the positive effect of the controlled contact.

A compromise solution for carbide tools is shown in Fig. 14.10a. Here the primary rake angle is positive ($\sim +30^\circ$) but the cutting edge is given a large included angle for strength and thermal capacity by employing a land extending from a quarter to a half of the undeformed chip thickness in the feed direction. The rake angle of the land is usually between -5 and -10°. The contact length is controlled by providing a third negative rake surface (Fig. 14.10a).

When the rake angle of the land is -30° or more, it is called a chamfer (Fig. 14.10b). A chamfer has the added advantage of providing a very stable BUE and better surface finish.

When the cutting tool is relatively brittle and subjected to an unusually hard work material such as surface scale or to shock-loading, the very tip of the tool is frequently rounded to prevent chipping (Fig. 14.10c). This is referred to as a honed tool. Edge honing may be provided mechanically by hand stoning or by tumbling cutting inserts with shaped abrasives in a rotating basket. A lightly honed edge will have a radius of about 0.001 in (0.03 mm) while a heavily honed edge will have a radius of about 0.005 in (0.125 mm).

The purpose of the limited-contact tool is to reduce cutting forces by as much as 30 percent and hence the mean tool face temperature. In doing this, it is important to recognize there is an optimum contact length. When the contact length becomes too small, the maximum tool-face temperature will be too close to the tool tip and even though the mean cutting temperature is reduced, the tool life will then be decreased. Limited-contact cutting has been studied by Takeyama and Usui (1958), Chao and Trigger (1959), Usui and Shaw (1962), K. Hoshi and Usui (1962) and Usui, Kikuchi, and K. Hoshi (1963).

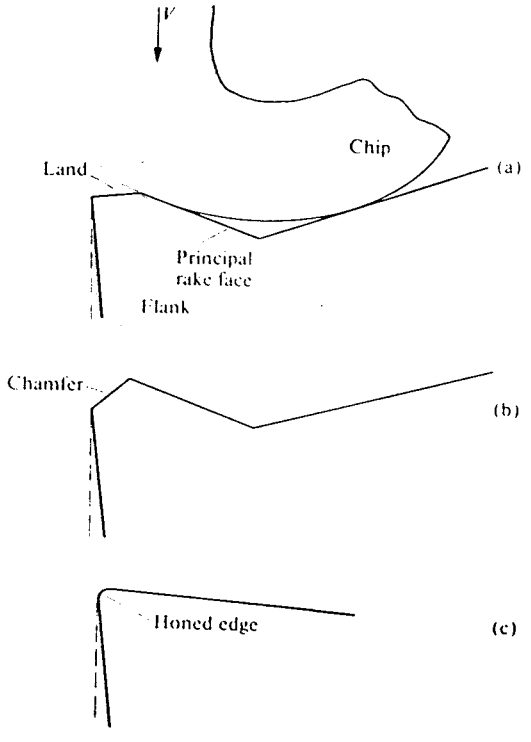

FIG. 14.10 Diagram illustrating (a) land, (b) chamfer, and (c) honed edge at the tip of a cutting tool.