G-class 3D Chip Breaker for Small Lathes SL Type Breaker

1. Outline

In the field of cutting small parts—small-diameter and precision parts—used in industries such as automotive, electronics, and medical parts, there is a growing need for tools that can reduce burrs, chattering, and poorly machined surfaces and improve the quality of machining. To meet this need, Sumitomo Electric Industries, Ltd. has developed the SL Type, which is a G-class three-dimensional (3D) chip breaker for small lathes that achieves high machining quality due to its superb sharpness. This article describes its features and performance.

Photo 1. G-class 3D chip breaker SL Type

2. Features

2-1 Excellent machining quality achieved by superb sharpness

SL Type features a sharpness-oriented design, incorporating a large rake angle (20° at the side cutting edge) and an inclined cutting edge to reduce cutting resistance (Fig. 1 (a)). In addition, the height of the chip breaker projection for controlling chips is small, so as to evacuate chips smoothly and mitigate increases in cutting resistance. Figure 2 presents cutting resistance measurement results, which reveal a considerable reduction in cutting resistance as compared to the conventional type. This low resistance

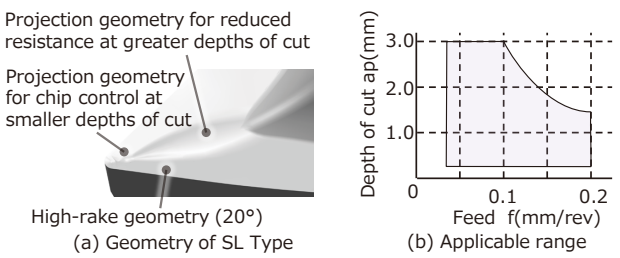

Fig. 1. Features of SL Type

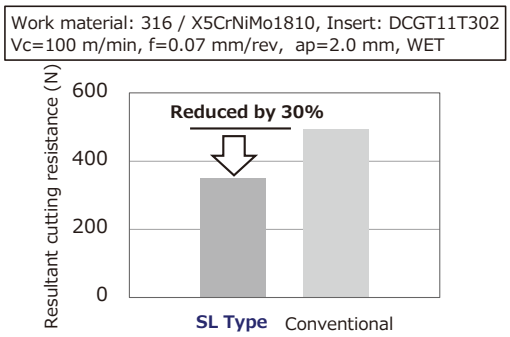

Fig. 2. Comparison of cutting resistance

is effective in avoiding machining problems such as burrs, chattering, poorly machined surfaces, and poor machining accuracy and in achieving high machining quality.

2-2 Stable treatment of chips

Sharpness-oriented chip breakers generally compromise chip treatment. In contrast, SL Type controls the shape of chips appropriately in a wide range of conditions. Figure 3 shows the evacuation of chips at different depths of cut. At the greater depth of cut with high cutting resistance, SL Type evacuates chips stably at a constant curl radius without forcing the chips to break. On the other hand, at the smaller depth of cut with low cutting resistance, which is subject to problems such as chips entangling, the very small projection located close to the insert corner acts effectively to break chips. Consequently, SL Type produces ideal chip shapes under different conditions and treats chips stably in a wide range of conditions.

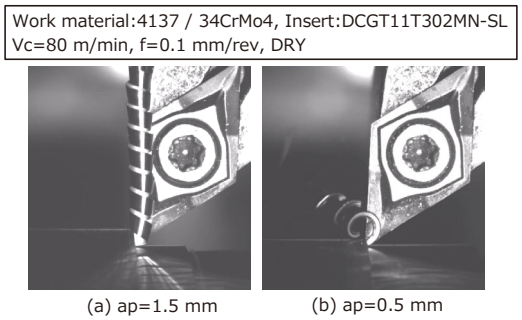

Fig. 3. Shapes of chips produced by SL Type at different depths of cut

2-3 Good for vibration cutting

In the field of small-part machining, the use of vibration cutting is spreading. Vibration cutting breaks chips by oscillating the tool feed motion so as to intentionally allow for cyclical periods of time during air-cutting. In vibration

cutting, the machine side is responsible for chip breaking. Therefore, normally, it is sufficient for the tool to appropriately curl and evacuate chips. However, in practice, if the sharpness is poor, air-cutting may become insufficient as a consequence of tool deflection, resulting in poor chip breaking. Figure 4 compares chip treatment by SL Type and the conventional type during vibration cutting. Even under such vibration conditions in which the conventional type is incapable, SL Type breaks chips properly. Moreover, vibration cutting tends to aggravate damage to the tool due to the effects of the feed rate momentarily increasing to about twice that of ordinary cutting, the duration of abrasion between the tool and workpiece being long, and other factors. In this respect, SL Type is fairly immune to these adverse effects owing to its superb sharpness and, in comparison with tools from one of our competitors, is stronger against damage and has a longer tool life, as illustrated in Fig. 5.

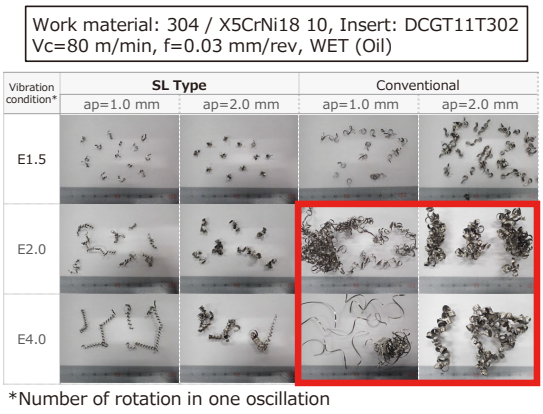

Fig. 4. Chip breaking performance during vibration cutting

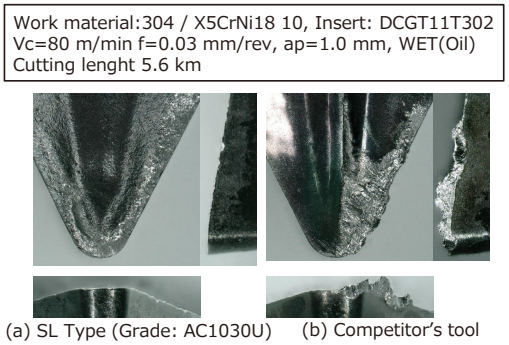

Fig. 5. Comparison of damage to tool during vibration cutting

3. Machining Examples

Figure 6 presents an example of tool life extension with SL Type. While in the machining of small medical parts, the conventional type was short-lived when used in machining titanium alloys—a class of exotic materials—SL Type, which smoothly evacuates chips, offers tool life extension by about a factor of four as compared to the conventional type, by reducing the loading to the cutting edge and, in addition, employing the AC5015S, Sumitomo Electric's tool grade for exotic materials.

Figure 7 shows an example of reduction of resistance, which helped reduce chattering during boring. While the conventional type was used at a reduced cutting speed intended to prevent vibration, SL Type permitted almost a doubling of the cutting speed, thus substantially improving the machining efficiency.

As these examples prove, SL Type with superb sharpness for maintained or improved machining quality considerably contributes to improved productivity for users due to its capability to achieve higher machining efficiency and extend tool life.

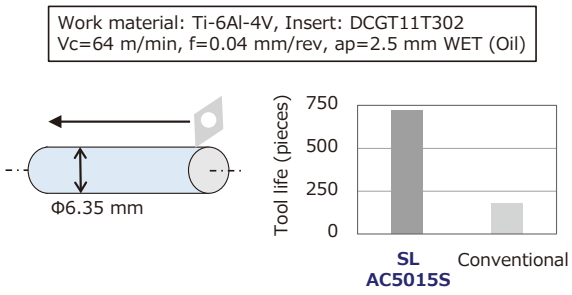

Fig. 6. Machining example (tool life extension)

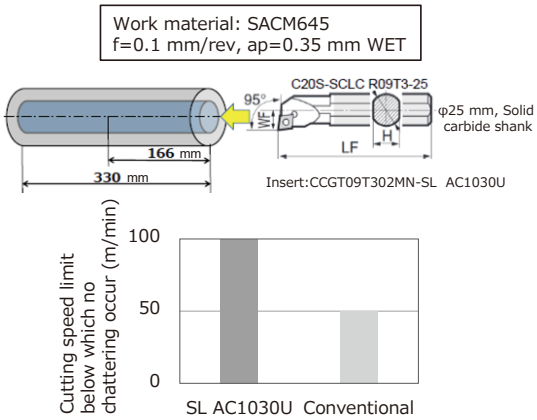

Fig. 7. Machining example (vibration control and improved efficiency)