THIRD WAVE AdvantEdge™
TECHNOLOGY FOR MACHINING SOLUTIONS

Case Study #30
Improving Chip Flow Control

Problem:

An effective chip breaker is needed to break or tightly curl long chips in a turning operation on 316 stainless steel.

Why is Third Wave *AdvantEdge*™ needed?

To determine characteristics of chip formation under the specific cutting condition so that the most suitable tool design can be selected quickly and intelligently while minimizing any and all production interruption.

Objective:

1. Eliminate costly and time-consuming testing methods of insert selection and performance comparison.
2. Provide an off-line capability that will significantly lower risk, speed time to solution, and increase implementation confidence and success.

Project Setup:

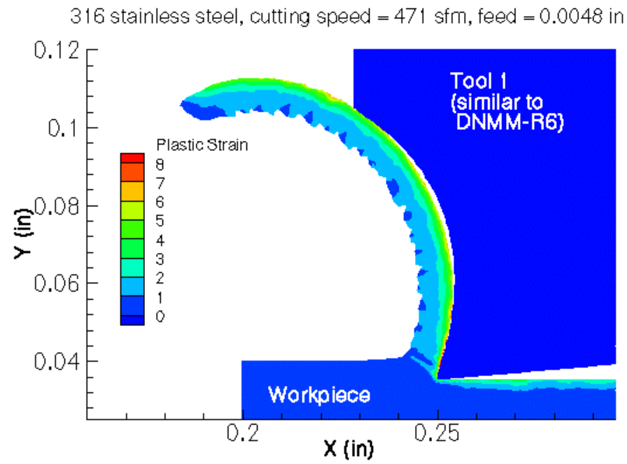
First, the chip flow in the turning operation using a typical tool, insert 1, is modeled and analyzed. Based on this analysis, a new tool, insert 2, is selected. The cutting process is modeled again with the new insert to verify its chip breaking performance. The profiles of tool inserts 1 and 2 can be found in Figure 1.

1. Cutting speeds:	471 sfm
2. Feed:	0.0048 in.
3. Depth of cut:	0.080 in.
4. Rake angle:	15° & 20°
5. Clearance angle:	8°
6. Cutting edge radius:	0.001 inches
7. Tool insert material:	Tungsten carbide
8. Workpiece material:	316 SST

Results Analysis:

1. **Chip flow control:**

   The simulations show that Insert 2 curls the chip more tightly than Insert 1 (Figure 1). The higher tendency to break the chip using the new insert



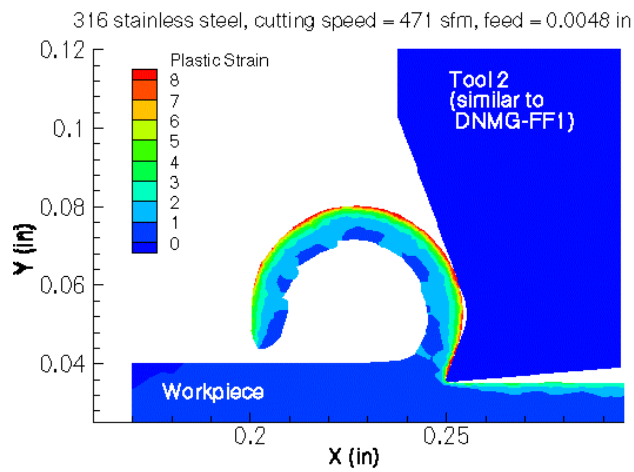


Figure 1: Two inserts are modeled and compared under identical process conditions. Predicted plastic strain in chip and workpiece material is shown. The plastic strain on the back of the chip formed by Insert 2 is higher than that formed by Insert 1, indicating Insert 2 can break chip more effectively.

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is indicated by the higher strain in the chip as compared to the chip formed by Insert 1. Insert 2 is expected to break off the chip more effectively. Insert 2 can form the chip into curls of diameter less than .08 inches.

Although tool manufacturers provide general guidelines for selecting tool inserts, chip form and chip-curling behavior are very sensitive to the cutting conditions (speed, feed and depth of cut) and specifics of the cutter geometries. Third Wave *AdvantEdge*™ can provide valuable information specific to the cutting condition that enables the user to select the most suitable tool, and gain understanding into its' performance characteristics.

2. Tool life:

The modeling also indicates that tool/chip interface temperature will remain the same when cutting with the new insert (Figure 2). Tool life is expected to be similar for these two inserts under the current cutting condition, because tool temperature is the predominate factor affecting tool life.

Conclusions:

1. Tool inserts similar to Carboloy's type DNMG-FF1 can curl chip more tightly than insert similar to Carboloy's type DNMM-R6 under the current cutting condition, therefore it can break off the chip more effectively.
2. The tool life is expected to be similar for these two inserts.

Recommendations:

Third Wave *AdvantEdge*™ is a valuable tool to determine:

- Chip control effectiveness of inserts without expensive testing,
- Effects of process and/or geometry changes with no impact on production process,
- possibilities to increase material removal rate, and
- work hardened surface layer as it relates to surface integrity.

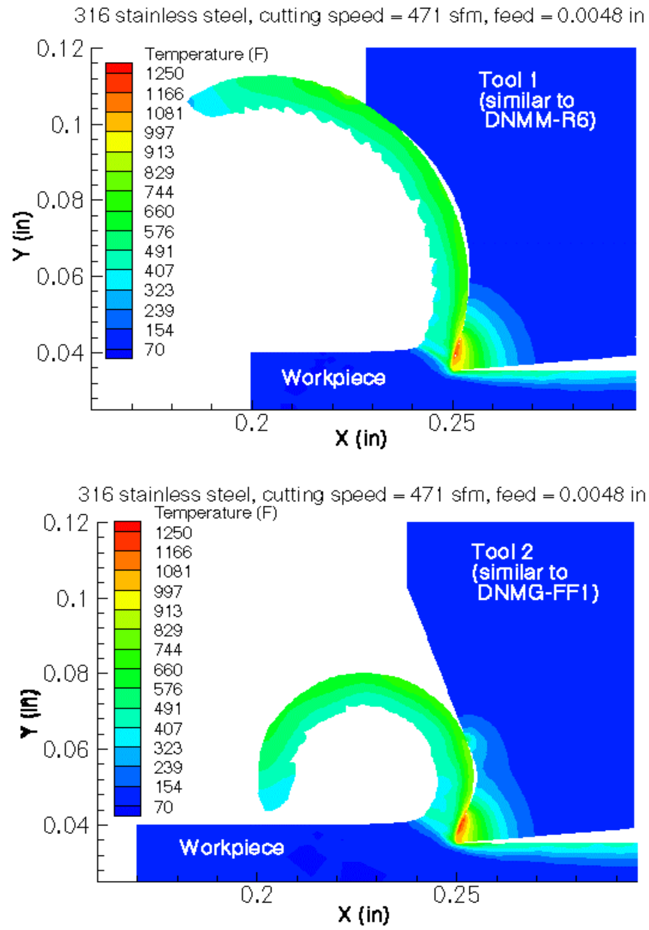

Figure 2: Predicted temperature distributions using Third Wave *AdvantEdge*™. The plots show that the tool/chip interface temperature is comparable when cutting with these two inserts.

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