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ATTENTION – Requires immediate attention!

Tooling Research and Application Department
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Part and Feature: XXXXXXXX

Tool: Two-flute carbide drill XXXXXXXXXX

Problem: Excessive machine power

Failure mode: Excessive tool wear

Preliminary Information

Figure 1 shows the failed tool and its tool tag. Tool is new. As can be seen, the tool made 2,350. The tool life set for this tool is 2,500 cycles, i.e., the tool almost made the tool life. Figure 2 shows the tool drawing. As can be seen, a standard brad point straight flute drill with coolant-trough holes with the outlets on the tool flank drill is shown. Unfortunately, no particularities of the tool geometry and tool material are indicated on the drawing.

Figure 1. Failed tool and its tool tag

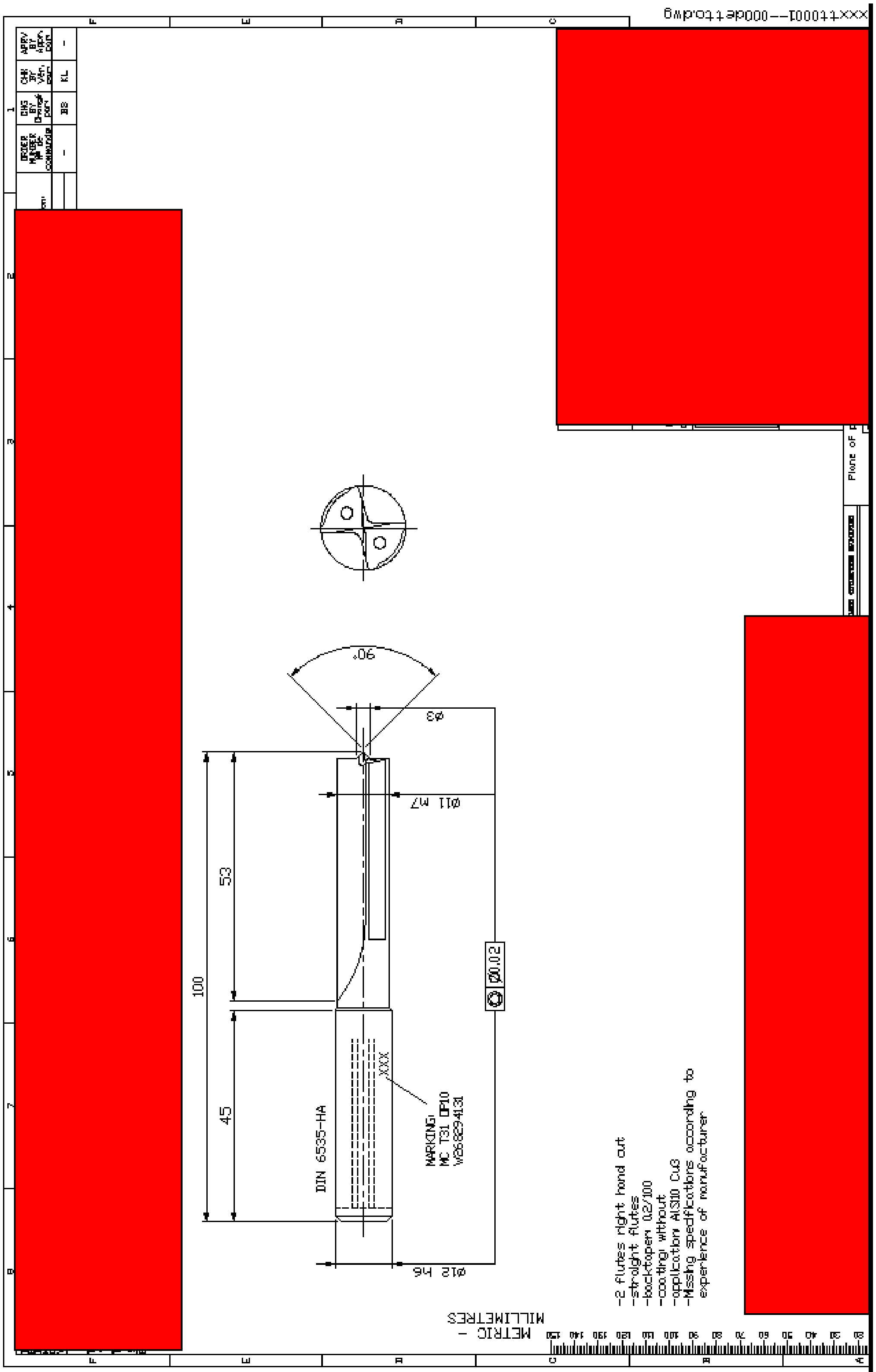

Figure 2. Tool drawing

Executive summary of the analysis: Although **the root cause** of tool failure is a direct result of insufficient relief angles of the major cutting edges (lips) combined with the dry cutting condition (as the coolant does not reach the machining zone) that both cause the excessive tool flank temperatures, the problem is that this not suitable for the application at all as it machines two cored hole. Instead, a four-flute PCD reamer with side coolant hole outlets is recommended for the application.

Short analysis

Figure 3 shows the wear pattern. As can be seen the corners of the drill failed (Figure 4). However, although the tool made 2,350 cycles which stands for 4,700 holes, no visible wear marks and built-up edge are observed on the rest of the drill. The first thought is that XXXXX found some good tool material (carbide grade) that performs very well. Therefore, the cooling and lubricating conditions at drill corners should be improved to make this tool better. Moreover, such a carbide grade should be used for all other carbide drills.

The measuring of the chisel edge angle shown in Fig. 5 indicates that this angle is almost 80^o so that the normal flank (clearance) angle applied to the major cutting edges (lips) is nearly 3^o which is not nearly enough for high-penetration rate drilling. As a result, severe rubbing at the drill corners took place that resulted at high temperature (see temperature profiles as black discolorations in Fig.4), and thus tool failure.

However, the first impression about the good carbide grade used for the tool was deceiving. Although **we do not have tool layouts for TCH**, it was decided to complete the analysis by analyzing what this tool is actually does in the shop floor. This results in a number of surprising discoveries. First, it was found that this tool is used for TCHs for high-feature V6 transmissions. As such, it BORES two short through cored holes removing about 1.3-2 mm per side. It explains why the central part of the tool does not have any wear marks **– it simply NEVER touches the work material**. As the holes are cored and trough, the coolant holes outlets as shown in Fig. 2, are of no use as the coolant goes through the hole and has no chance to reach the machining zone.

It appears that XXXXX made modification to the coolant holes – two side coolant holes were made as shown in Fig. 6. However, as the outlets of the coolant holes on the tool flanks were not plugged, these additional two side coolant hole did not make any difference.

It is interesting to note that when the tool is re-sharpened, the brad point is religiously reproduces although it drills nothing but the air.

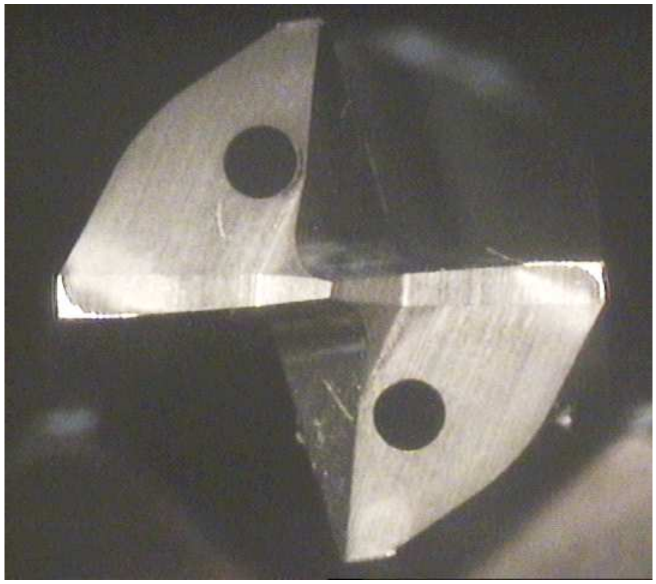

Figure 3. Worn drill

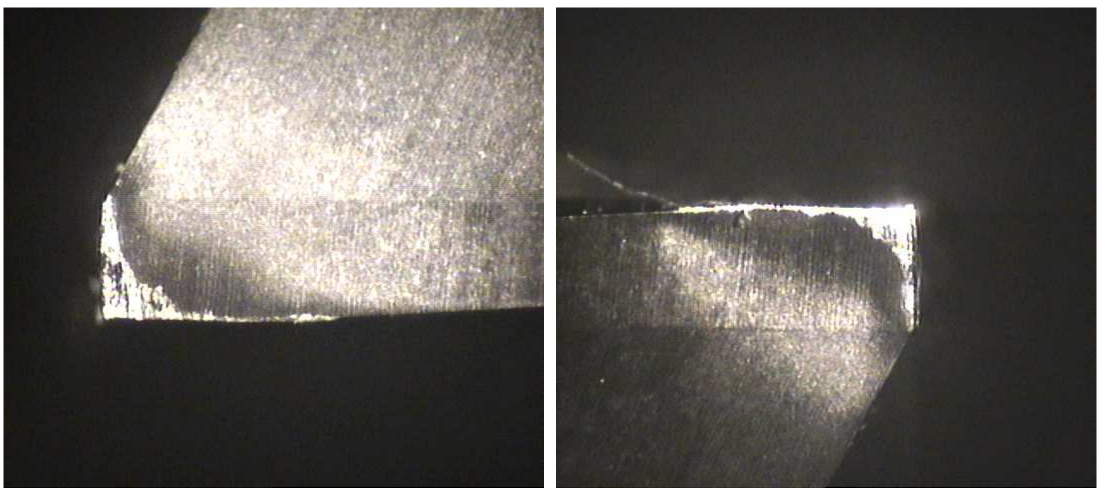

Figure 4. Wear pattern

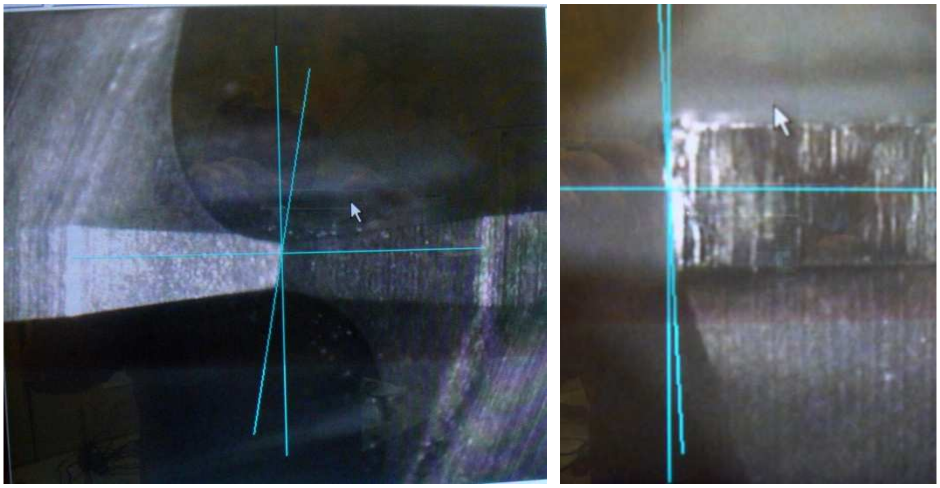

Figure 5. Chisel edge angle and small flank (relief) angle of the major cutting edge

Figure 6. Coolant hole outlets location

Suggestions:

1. Redesign the tool making it as a four-flute PCD reamer
2. Increase the feed rate correspondingly
3. Install the tool into the machine and forget about it for a few years.