PSMi Production Services Management inc.

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Tooling Research and Application Department
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Part and Feature: XXXXXXX XXXXXXX

Problem: Three prematurely failed tools due to oversize.

Observations:

Figure 1 shown three prematurely failed tools. As can be seen, the first tool made 1 cycle, the second – 472, and the third – 1 cycle of 20,000 cycles set as tool life. Another observation can be gained from Fig. 1 – the third tool is not the same as the first two. The first two are veined drills standard for XXXXXXX while the third tool is a PCD-tipped g-style drill. Farther investigation showed that this third drill was originally manufactured by XXXXXXX and then re-tipped (repaired) by XXXXXXX

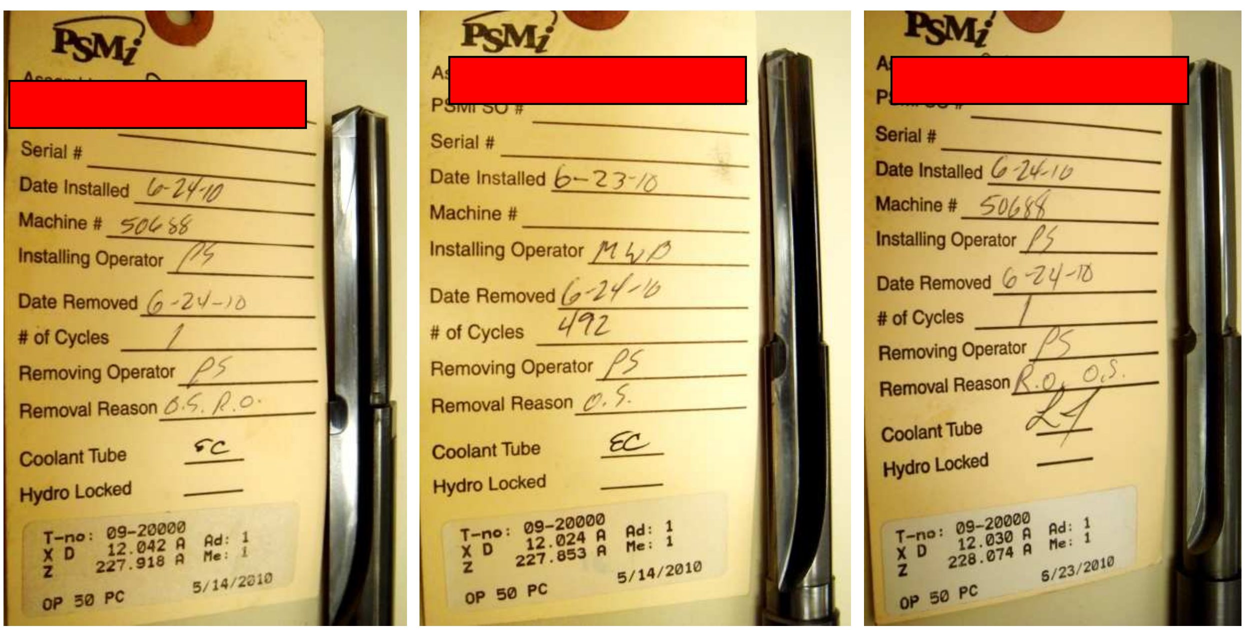

Figure 1. Three prematurely failed tools

Analysis:

Microscopic analyses of these three tool showed that the root cause of the problem is asymmetrical location of the cutting edges and supporting parts with respect to the axis of rotation. Figure 2 shows the problem for the first drill and Fig.3 shows the issue for third drill. It was found that the second drill has the least asymmetry which explains why it survived 472 cycles.

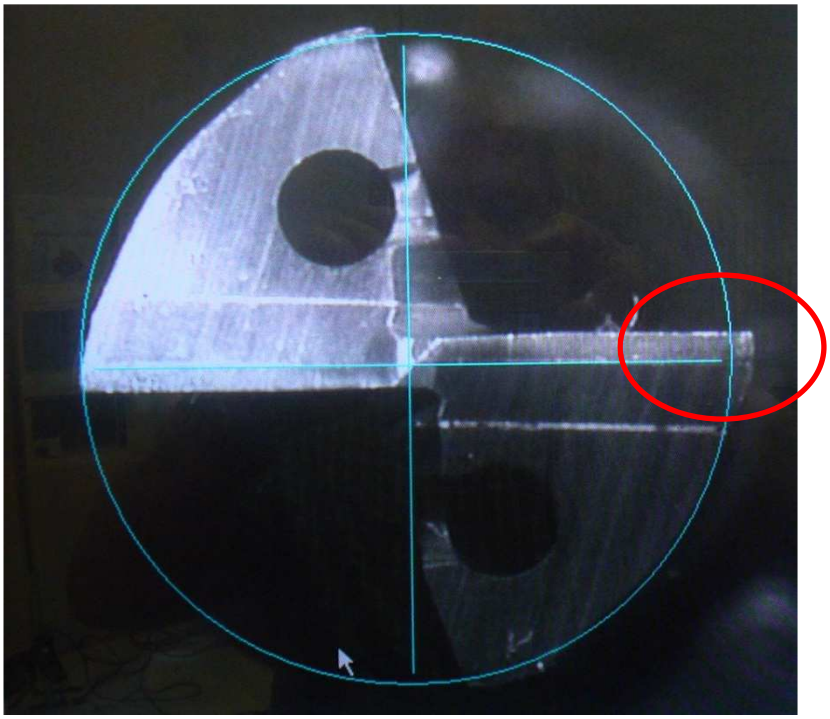

Figure 2. Asymmetrical grind of the first drill

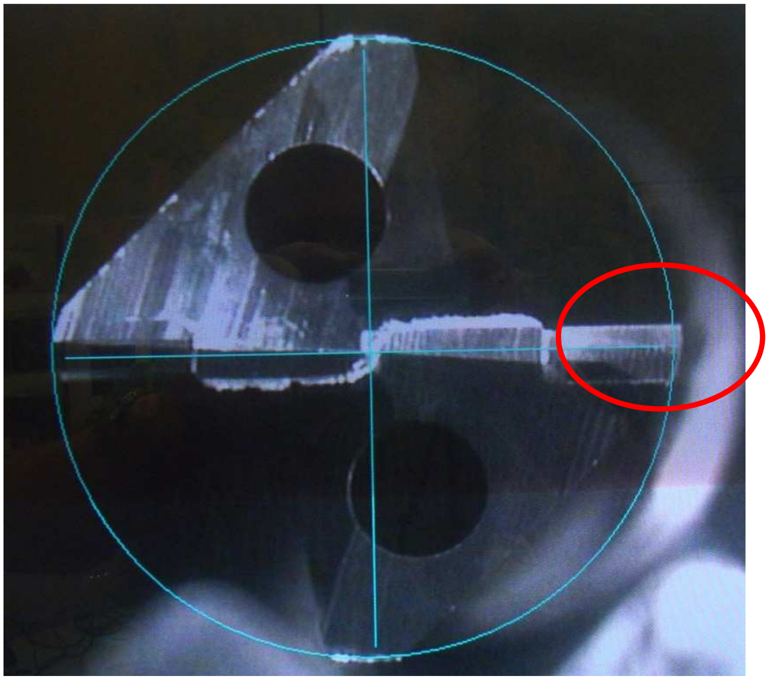

Figure 3. Asymmetrical grind of the third drill

All the drills from a fresh supply were checked for symmetry to prevent the reoccurrence of the issue. Figure 4 shows one of the checked drills and Fig. 5 shows that it is reasonably symmetrical.

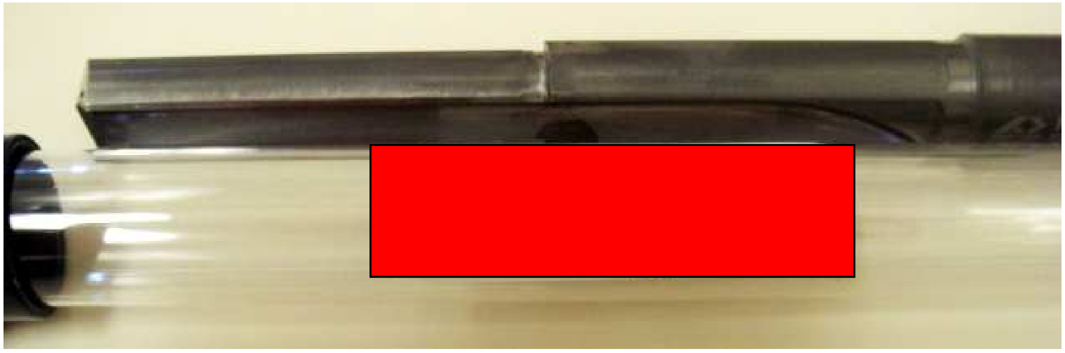

Figure 4. Drill from PSMi inventory

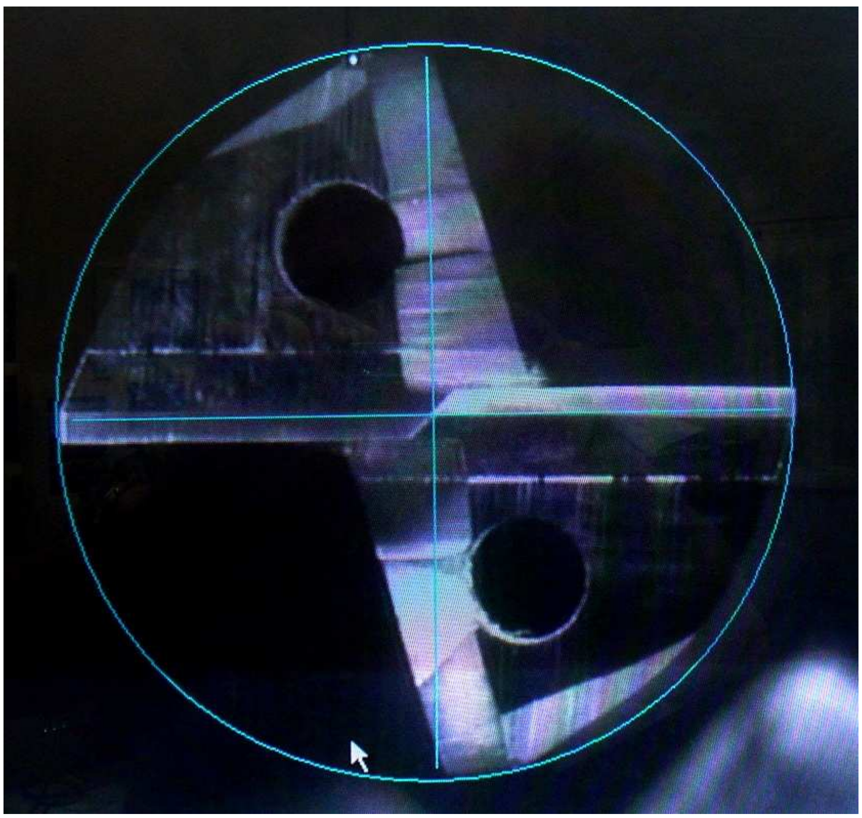

Figure 5. Symmetrical (proper) grind of the drill from PSMi inventory

Figures 6-10 show that the third (PCD-tipped) drill was not properly manufactured. Figure 6 shows that an excessive built-up edge formed on the drill's carbide portion due to rough surface finish. Note that this drill made only ONE CYCLE. As the chisel edge of the drill is completely covered by this built-up edge, the drill lost its self-centering ability on the first cycle.

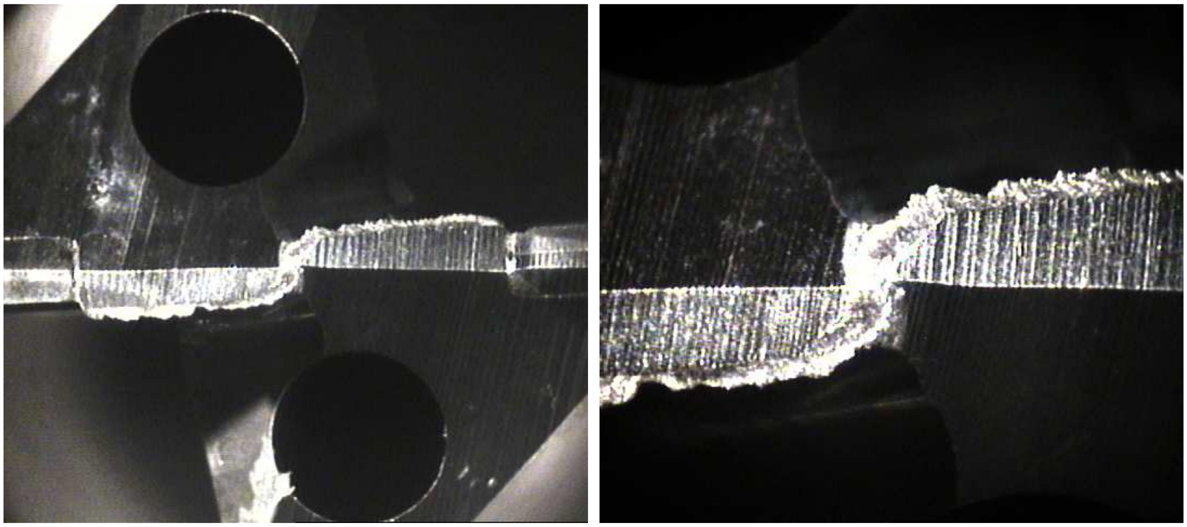

Figure 6. Excessively course grind of the flank (relief) faces of carbide part of the drill.

Figure 7 shows an excessive gap between the PCD insert and carbide body. On drilling, this gap is filled out by aluminum that sets drill out of the force balance, and thus cause drill wandering. Normally, there should be NO GAP and the thickness of brazing filler should not exceed 0.1mm.

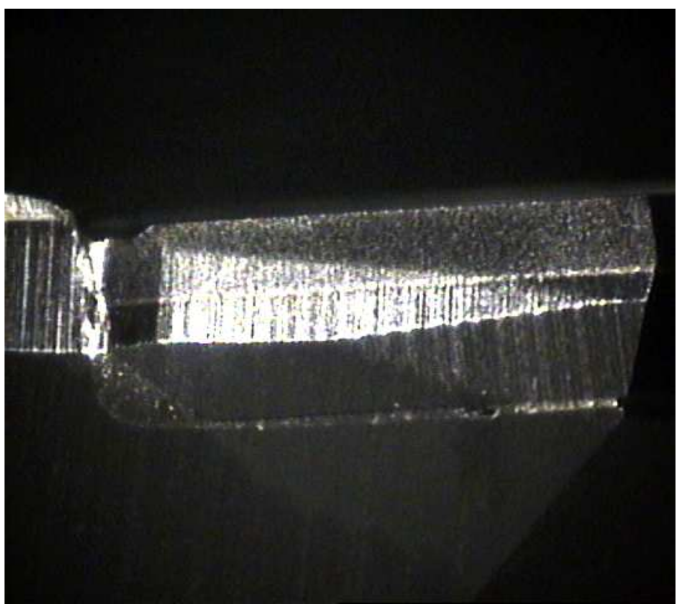

Figure 7. Excessive gap between the carbide body and a PCD insert filled by aluminum

Figure 8 shows that PCD insert is not aligned with the rake face of the flute that adds additional cutting forces and causes chip accumulation.

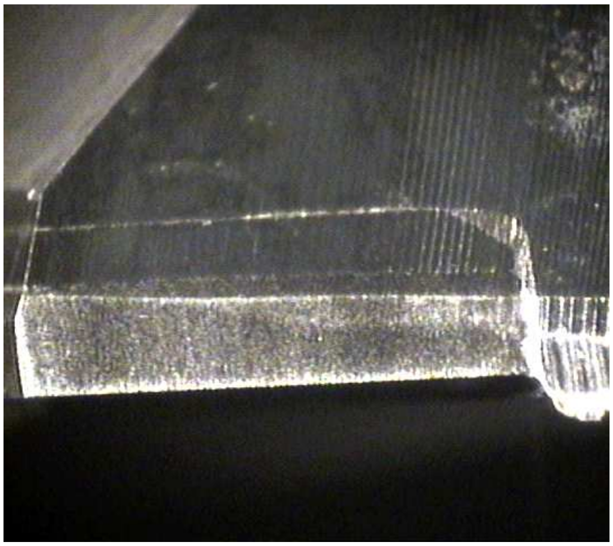

Figure 8. Step on the tool rake face as the PCD insert is not aligned with the rake face of the flute

Figures 9 and 10 show inferior brazing of the PCD inserts into the carbide body with voids and gaps. The lack of backtaper and body clearance caused rubbing of the body margins that ruined the surface finish of the machined holes.

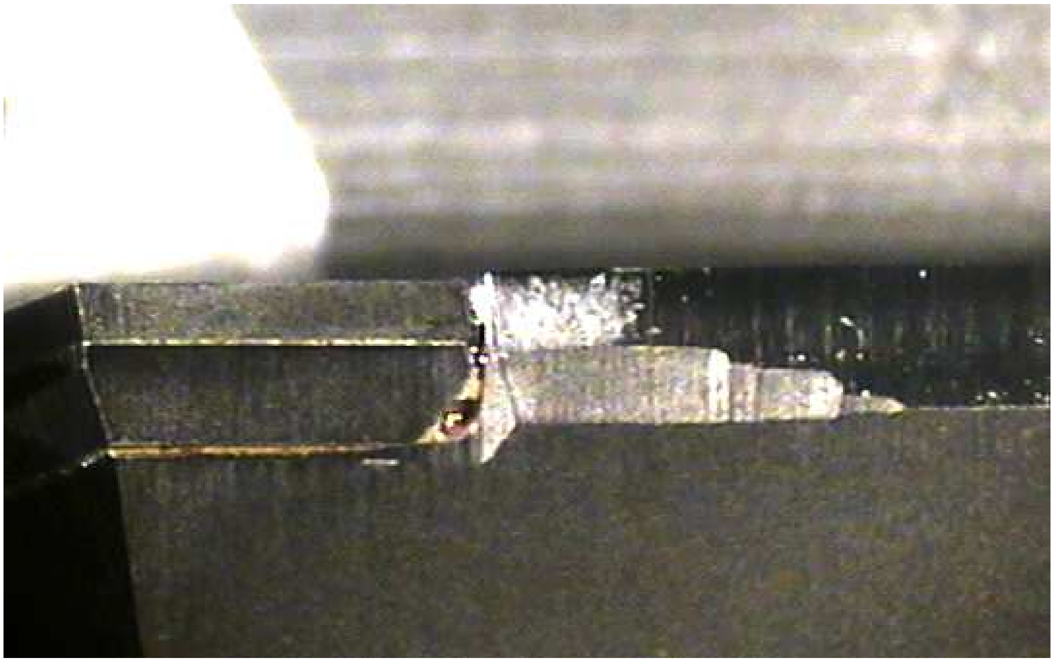

Figure 9. Inferior brazing with voids and rubbing marks on the margin of the carbide body due to lack of backtaper and body clearance (the first PCD insert)

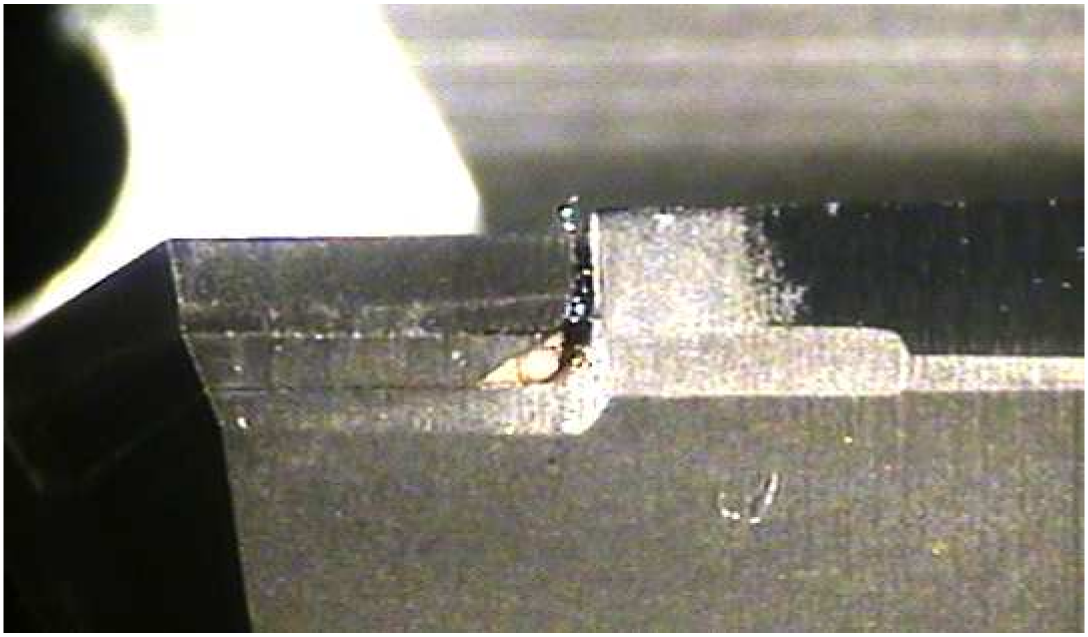

Figure 10. Inferior brazing with excessive gap between the PCD inserts and the carbide body. The edge of the body served as an additional cutting edge that cut microchips. Rubbing marks on the margin of the carbide body due to lack of backtaper and body clearance (the second PCD insert)

Figure 11 shows aluminum deposit or built-up edge on the supporting pad due to drill's asymmetry as drill was wandering on the hole being drilled due to asymmetry and violation of its force balance.

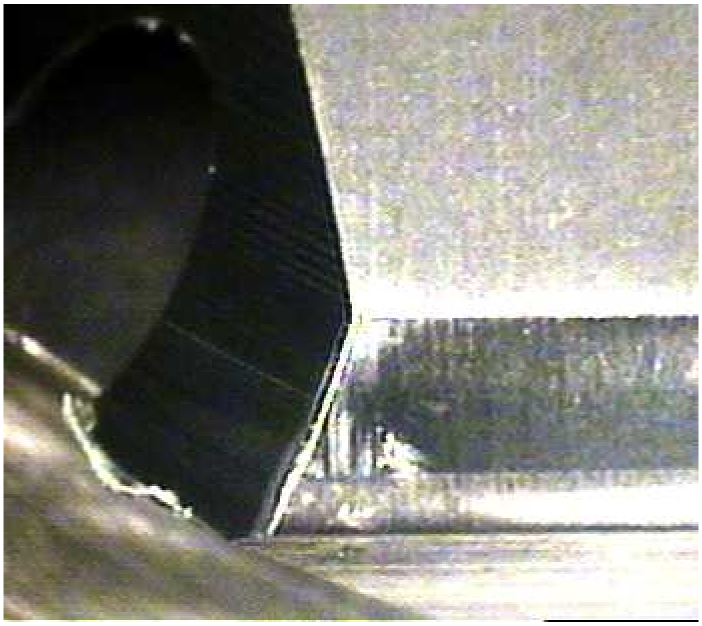

Figure 11. Aluminum built-up edge on the supporting pad due to drill's asymmetry

Recommendations:

1. Provide the proper tool drawing where the components of cutting tool geometry, symmetry (axial and radial runouts) of the major cutting edges, surface finish on all ground surface, coating information (composition, thickness, etc.), tool material (type, grade and make), proper dimensions including these of the chip flute and coolant holes), dimensional and shape tolerances are clearly indicated.
2. Provide the INSPECTION report with each tool where the actual values of the parameters critical to tool performance are shown.