

tablet tools

WHERE AND HOW TO MEASURE PUNCHES AND DIES

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This article clarifies how to measure punches and dies and describes how worn dies can impair production of high-quality tablets.

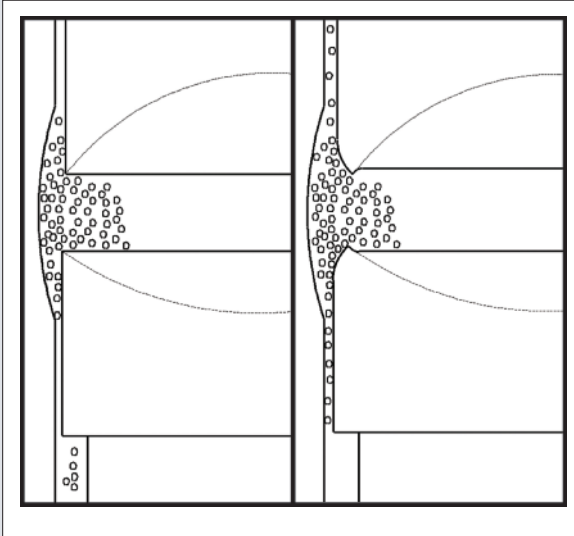
But that can lead to errors because the tolerance for cup depth and for overall punch length is ± 0.003 inch, much looser than the ± 0.002 -inch tolerance for punch working length. Thus if you calculate working length as described above, some tools will appear to be out of spec when in reality they are not.

The correct method is to measure the working lengths to see how much they deviate within the set of punches (not between upper and lower). Start by selecting a datum (reference punch) from the set you're measuring. Then compare its dimensions to those of the other punches to see whether they are within 0.002 inch from

When it comes to inspecting new and in-process tablet tools, most people focus on the punches. Typically, they use a digital indicator mounted on a granite stand to measure overall punch length and cup depth. Next, they subtract the cup depth from the overall length to arrive at the critical dimension: the punch working length.

FIGURE 1

Excessive clearance between a worn die and a new punch creates flashing and prematurely wears the punch tip (right)



shortest to longest. Replace the punches that fall outside that tolerance.

Punch-tip wear

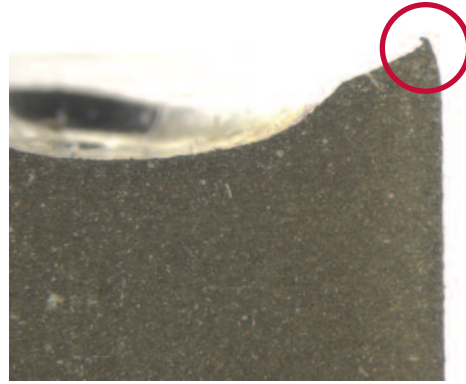
Next, look for wear patterns in other critical areas, such as the punch tips, which can cause tablet defects when worn. Common causes of punch-tip wear include

- Combining new punches with worn dies;
- Worn die pockets leading to misaligned dies; and
- Worn punch guides and keyways leading to misaligned punches.

When a worn set of dies is used with a new set of punches, it's nearly impossible to obtain the proper clearance between the punch tip and the die wall because the gap is too large. That allows powder to slip into the void and create "flashing" during compression (Figure 1). This wayward powder also creates friction and heat, causing the upper punch tip to wear prematurely. That, in turn, can cause the upper punches to bind, which will lead to premature wear of the upper raising cam.

If the die pockets, punch guides, or keyways are worn and cause the punch and die to misalign, a j-hook can develop on the punch tip—especially if the cup is deep and there is little land. A j-hook is a small curl or burr that forms on the edge of the punch (photo). This deformation can create capping, in which the top portion of the tablet separates partially or completely from the remainder, and lamination. J-hooks are easy to identify. Using your fingernail, pick at the inner edge of the punch cup to feel whether it has a curled edge. If so, it has a j-hook and the punch must be repaired before you can return it service.

The best repair method is to lightly polish the surface of the punch cup and then use an unsewn cotton buffing wheel and a white rouge polish to finish the job. Do not attempt to repair j-hooks using a drag finisher. Not only is



A worn die pocket can lead to a j-hook on the punch tip.

that unnecessary, it's counter-productive: You'll over-polish the tool and dull the sharp corners that the punch needs to make good tablets, including the punch-tip relief.

Assessing the dies

Die-bore wear is a normal result of compressing powders in and ejecting tablets from the die. Abrasive powders, such as those used in some dietary supplements, exacerbate the wear. While you cannot eliminate die-bore wear, you can drastically reduce it by using complementary steel types, tapering the die bore, and/or lining the die with a carbide



To remove a j-hook, lightly polish the surface of the punch cup and then buff it using a white rouge polish.



The wear pattern in a die is often visible to the naked eye, but you need a tool to determine the extent of wear. This die shows similar wear patterns at the top and bottom, indicating that it was flipped over in the die pocket to extend its service life.

or ceramic. (Ask your tooling vendor to recommend ways to combat troublesome products.) These options can also reduce the amount of force required to eject tablets from the die, which will reduce friction, minimize premature cam wear and, most importantly, improve tablet quality by reducing sticking to the lower punch cup, chipping at tablet take-off, and tablet lamination.

Inspecting the dies begins with a visual check for wear rings (photo). While you can unusually see a wear pattern with the naked eye, you'll need a tool to determine the extent of wear. Options include a split-ball bore gauge connected to an indicator and a digital handheld gauge.

The amount of allowable deviation within a die bore depends on the characteristics of the powder, which varies from product to product. If, for example, you know that a wear ring of 0.004 inch doesn't prevent you from manufacturing a quality tablet—perhaps with a bit of flashing but no negative effect on the tablet press—then you may deem that amount of wear acceptable. However, if a split-ball gauge shows that the wear exceeds that tolerance, then the best option is to replace the die.

Should wear occur high enough in the die, it's possible to flip it over and compress tablets in its other half. Keep in mind, however, that if the die has a single taper, flipping it

over either won't work or will lead to tablets of poor quality and/or other production problems.

Last, don't wait for problems. By checking punch and die wear regularly, you'll spend less money replacing tools and less time fighting production issues. For the best results, write your inspection procedures into your SOPs so that everyone inspects the tools in the same way and uses the same criteria to make decisions about repair and replacement. *T&C*

Further reading

1. Understanding the importance of punch length and cup depth. Dale Natoli. *Tablets & Capsules*, July 2006, pp. 40-3.
2. Maintain tablet quality by inspecting these critical points. Stephen Natoli. *Tablets & Capsules*, April 2014, pp. 33-5.
3. Cup depth and tablet consistency. Dale Natoli. *Tablets & Capsules*, July 2015, p. 44.

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