
tablet press tooling

A TOOLING VENDOR'S ADVICE ON
AVOIDING COMMON PROBLEMS

SUSAN BRETTINGEN
SENIOR EDITOR



The idea to launch a product in tablet form begins in the marketing department, but you're ultimately responsible for producing it. Our senior editor talks with a seasoned tooling vendor to identify the keys to specifying tablet press punches and dies. Much of your success will depend on how well you communicate.

ooks aren't everything, but first impressions count. That's why it's important to consider the appearance of the product that you plan to tablet. In fact, appearance plays such a vital role in consumer acceptance that selecting the tablet's size, shape, and logo is typically left to people in the marketing department. Nonetheless,

people in the production department bear the responsibility of actually manufacturing the product that the marketing people envisioned. Your ability to do that hinges on whether you have the right tooling. Without it, a launch delay or cancellation is inevitable.

That's not to say that the marketing and production departments operate independently of each other. But the communication between the two departments is often not as robust as it should be. This article underscores the importance of communication and outlines some of the problems that can arise when communication breaks down between the marketing, research and development, engineering, and production departments.

Making a good impression

When people hold tablets in their hands or swallow them, it's unlikely that they think about why the tablets are round or pink or embossed. In fact, most consumers have no idea how the tablet presses work or about the tooling they use. Despite that ignorance, consumer perception plays a big role in marketing decisions at tablet manufacturers. And only by selecting the right tooling can you turn those ideas into tablets that will reach thousands if not millions of medicine cabinets, kitchen shelves, backpacks, and purses.

Tablet tools make a direct impression on the manufacturer and the product, which in turn eventually influences consumers' perceptions even though they don't discern the correlation between the tablet's appearance and how it was manufactured. "Tools are directly related to that consumer's scrutiny and acceptance," says Dale Natoli, who is president of Natoli Engineering, a company in St. Charles, MO., that designs and manufactures punches, dies, and other equipment for tablet presses and the pharmaceutical and confectionery industries. "They're the most important part of the aesthetic and the marketing."

Generally, a tablet starts as a concept in a company's marketing department before it becomes a formulation in the research and development (R&D) department. R&D will then commonly tablet small batches of the product, but often not in the configuration specified by marketing. That's because R&D doesn't want to bear the risk of investing in tooling that it can't use in production. "They might do their research and development with a completely different configuration," Natoli said. Besides, the engineering department is usually responsible for selecting tools for the tablet presses. That means that, in the case of pharmaceuticals, the R&D department often files the company's application for a drug patent before the engineering department orders production toolings.

Those different timetables aren't surprising when you consider that the engineers need to know the size, volume, and weight of the tablet and how those factors will affect the output of the company's tablet presses. Engineers who don't grasp these basic facts and order tools without doing their homework often encounter numerous tableting problems, Natoli said. These include excessive ejection and compression forces, which lead to

premature wear on tooling, premature press failure, and improperly compressed tablets.

For example, Natoli said, an engineering department may buy a tablet press that's rated at a speed of 4,000 tablets per minute but can only produce 2,700 tablets per minute in actual production. A situation like this can put a company in a tough spot: Speeding up the press could break the tooling, and investing in another tablet press is usually not an option. Most engineering and production departments must use the tablet presses they already have. And using that equipment most efficiently requires using the right tooling.

Selecting the right tooling depends on communication. Natoli said that failure among the various departments to communicate sparks costly delays that can bring a product launch to a complete halt. If the marketing people don't understand what's feasible in actual production and propose a complicated or unwieldy tablet design, the tablet could make it all the way to the production floor before someone discovers it will fail.

From the drawing board to the production floor

"A lot of times, marketing is so far removed from these projects and the production that they lack the understanding of the mishaps caused by a poor design," Natoli said. While no one expects the marketing people to get into the nitty-gritty of tooling, they should understand how their actions can reverberate into the production process, he said.

Natoli suggests that marketing people and people from engineering and production meet with tooling vendors early in the design phase. That way, everyone can share their ideas and concerns. "Use the experience and the resources of the tooling manufacturer," Natoli said. "We're a valuable resource, and they don't always think to use that resource." Sometimes, Natoli said, people are intimidated. Failure to tap into a vendor's expertise probably stems from the fear of crossing boundaries of responsibility or expertise, he said. "Their corporate culture makes them afraid to stand out by speaking up. They don't want to have their head chopped off."

"We all have our own expertise," Natoli said, "and because we all have our own expertise, that's what we need to bring to the table. Marketing isn't asking engineering to know [marketing's] job, and vice versa. But if we leave one of those parties out of the equation, then we're going to fail. And when that happens, you've got the ugly finger pointing going on. You've got poor production, you've got poor tablet quality, you don't meet deadlines, and you don't meet launch dates."

That's decidedly true at pharmaceutical companies, Natoli said. In contrast, companies in the confectionery industry have long recognized the importance of meeting with tooling vendors to develop economical production methods. "They're a big one for doing this simply because they have to be more cost-effective than the pharmaceutical companies," he said. While a candy

maker might make one-thousandth of a cent profit on each tablet, a pharmaceutical manufacturer might make \$10 of profit on each tablet. Without the right tooling from the start, the candy maker has a hard time recovering its already razor-thin profit margin.

Asking the right questions

Natoli said his company urges tablet manufacturers to send people from all departments to a meeting with his people *before* designing the tablet. "This way, we're going to design a tablet that's going to take the pressures that they anticipate this product is going to require [in production]," he said. "They're going to get the proper ejection force, they're going to get good tooling [service] life, and they're going to get good tablet quality at the end. If everyone's got input, then everyone's going to work harder to make sure it's a success. If we leave a department out of the equation, that department now has an excuse for why a tablet isn't a success. They can say, 'I didn't know that. They didn't tell me that.' And that's very common. It leaves a hole in the system."

Here are some questions to ask yourself and tooling vendors before making any decisions:

1. What is the intended tablet shape and size?
2. What tooling configuration and size will the tablet require?
3. How will the configuration of the cup (the depression or cavity in the punch tip) affect the compression force required to make the tablet?
4. Is the product prone to sticking and picking?
5. Is the product sensitive to the heat of standard operating temperatures?
6. Is the tablet abrasive or corrosive?

If you don't ask these kinds of questions, be prepared for problems. Natoli remembers one case in which a customer planned to manufacture a multivitamin tablet shaped like an elongated ball, giving it the appearance of a two-piece capsule. The company had numerous production snags, Natoli said, "because [the multivitamin] was a very poor design. They had a lot of expenses in tooling."

When Natoli learned that the customer planned to reformulate the product, he urged his client to come up with a new shape for the tablet, too. The manufacturer's marketing firm even invited Natoli to suggest some design changes, which included flattening the ball shape, enabling the company to use punches with a flatter cup. "The flatter the cup, the more compression force you get and the easier it is to make the tablet," Natoli said. "There's less pressure needed to make the tablet." The marketing firm approved the change, which was also accepted by the manufacturer. That was the end of the company's tableting problems.

Not long ago, a nutraceutical manufacturer asked Natoli's company to help it make a triple-strength chondroitin tablet. A look at the formulation showed that it would require a tablet that was too big and too thick to swallow comfortably. Six months later, the manufacturer returned to Natoli with a design for a smaller, easier-to-

swallow tablet with a formulation that still allowed for the original triple-strength dosage. Natoli praised the company for taking the time to put so much thought into its tableting process and coming up with a distinctive product rather than rushing something out just to get it on the market.

While these cases illustrate potential glitches, they aren't typical, Natoli said. In most instances, he said, manufacturers say, "This is what we want. This is what we've got to do. Make it work." Even in those cases, however, Natoli may notice the potential for problematic tablets. In those cases, he may tell the manufacturer, "Customers aren't going to want to take it. Your machines aren't going to want to make it. And with those two in mind, you don't have much of a product."

Keep the basics in mind

Natoli mentioned the American Pharmaceutical Association's *Tableting Specification Manual* (TSM) as a good source of information about tooling specifications, design options, and tool steels.[1] Here are some factors that tablet manufacturers should consider when choosing tablet press tooling:

Quote forms. This is one of the most helpful documents that a tablet manufacturer can provide to a tooling vendor. The quote form provides detailed information

FIGURE 1

When designing your tablet, take into account how its size and shape will determine the tooling for your tablet press.



about the tablet's size, shape, and profile, along with punch and die specifications. A sample of a quote form appears on page 91 of the TSM. Natoli said he advises companies to create this form because it will prompt the tooling manufacturer to ask questions about the tablet.

Compression force. Compression force is the amount of pressure that the tablet press must apply to the tooling to form the tablet. It's the most common concern that tablet manufacturers have, Natoli said. Marketing people may design a tablet that looks good but that also limits the compression force that production uses to make the tablet.

For example, Natoli said, you may want to manufac-

ture a tablet shaped like a modified ball. Based on punch tip tabulations on page 73 of the TSM, if you're working with a punch tip that has a 0.438-inch diameter, you'll need a 0.133-inch cup depth. Based on punch cup compression forces for TSM round tooling, found on page 80 of the TSM, your punch tip can only withstand 13.5 kilonewtons of compression force, an amount too small to produce the tablet.

Natoli said this is an all-too-common scenario that results in broken punches. In short, there are limitations to tablet designs. "Marketing doesn't know these limitations," Natoli said. "They're not experts in the field of tablet design or tablet manufacturing." That's why marketing should ask its tooling vendor for suggestions before getting too far along into the production process.

Tooling design options. If you discover during production that you simply can't make the tablet, there are tooling options that can help. The *Encyclopedia of Pharmaceutical Technology* and the TSM include sections that discuss tooling options and requirements.[2] One oft-used option is domed punch heads, which may reduce the amount of concentrated stress inflicted on the head, which is the end of the punch that guides it through the press's cam track. A domed punch head may prolong the service life of your tools. Other options include punch-barrel chamfers, mirror-finished heads, short upper-punch tip straights, and carbide-lined and ceramic-lined dies.

Tool steels. Naturally, you want your tablet press tooling to last as long as possible. "Steel selection is very critical in enhancing tablet quality, as well as in getting the

most from your profit margins," Natoli said. While one steel is adequate for making analgesic tablets, it may not be right for making vitamins or salt tablets. Or the new tablet may require so much pressure that the press breaks the punches. Confer with your tool vendor: Not all steel is created equal.

Conclusion

Many tablet manufacturers produce a multitude of tablets. Consequently, a production run for one kind of tablet may be completely different than the run for another. "Every [tablet] product is different," Natoli said. "There are basically no two products that are alike. They don't run the same. They don't act the same under compression forces." Likewise, when choosing tooling for tablet presses, tablet manufacturers need to know that one size does *not* fit all. "There are standards for tools," Natoli said, "but you can't always expect the standard tool configuration to be the optimum configuration for your product." Therefore, you need to be inquisitive. Don't be afraid to ask tooling vendors lots of questions, and ask them early. "Your vendor should be more than happy to assist in helping you make the right decisions," Natoli said.

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References

1. *Tableting Specification Manual* (Washington, DC.: American Pharmaceutical Association, 2003).
2. James Swarbrick and James C. Boylan, *Encyclopedia of Pharmaceutical Technology* (New York: Marcel Dekker, 1997).