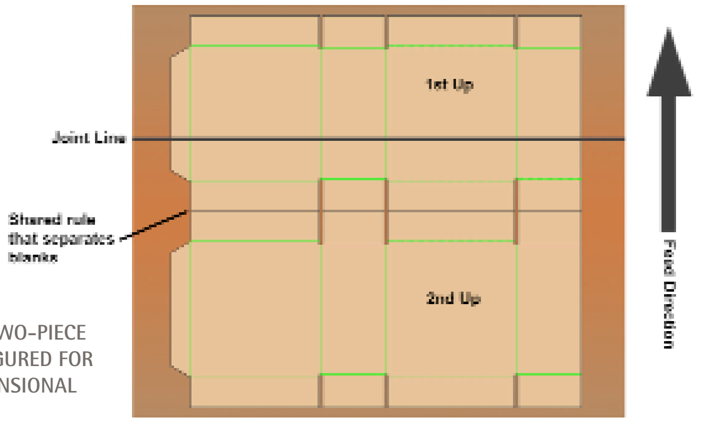
There is usually more than one cause for dimensional variation, and it may not be the die. By Richard Putch, Dicar Inc.

Avoiding Dimensional Instability

PART 1

SMOOTH, EVEN AND FIRM ANVILS REQUIRE LESS IMPRESSION AND DELIVER HIGHER QUALITY DIECUTS.



TWO-UP, TWO-PIECE DIE CONFIGURED FOR BEST DIMENSIONAL CONTROL.

The challenges of converting corrugated board while maintaining strict dimensional tolerances is an issue for all types of finishing equipment, particularly soft anvil rotary diecutters.

Often the cutting die is held responsible for size variations because it is perhaps the most "visible" part of the process. Also, operators feel they have more control and understanding of the die than the mechanical aspects of the equipment. However, when dimensional variation is evident within an order, (and this does happen), we are faced with the challenge of finding the real cause. While it is possible for the die to be at fault, this typically won't cause size fluctuations during the order.

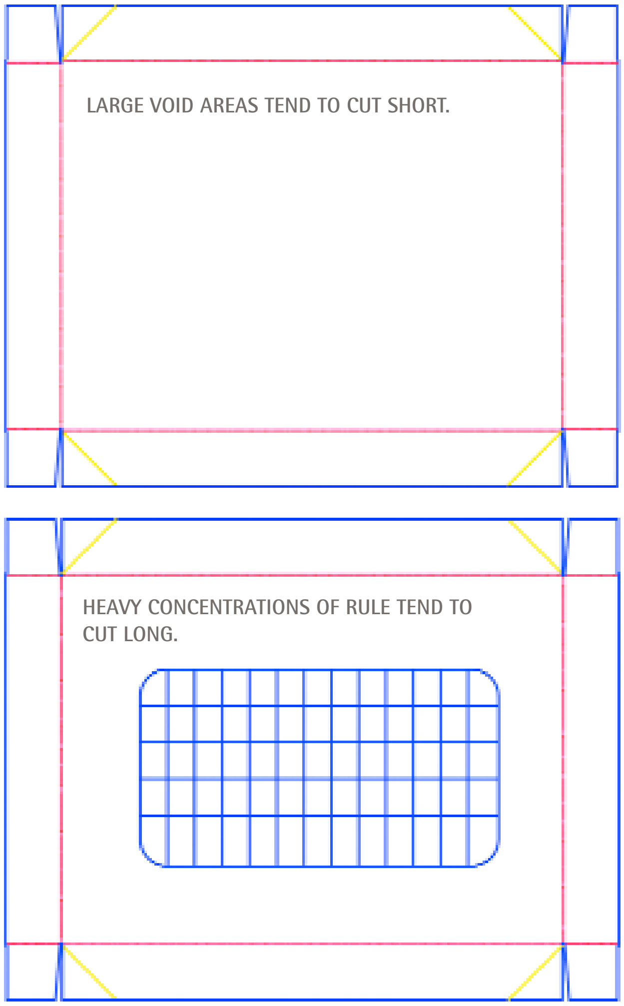
I have learned from many technical articles and field experiences over the years. Recognizing and accepting that there is more than one cause of dimensional instability, and it may not be the die, is essential if you are ever going to be able to understand, correct and control the variation.

The more we understand what can influence dimension, the more comfortable and efficient we will become at controlling it. Identifying where the problem can occur helps isolate the search for the root cause.

Where to Start

Looking at the entire process there are five areas of focus that can influence the stability of the diecut blank. These include the cutting surface (anvil), mechanical (the machine components), operational (procedures and operator habits), die construction and the product (design and material).

When a mechanic troubleshoots a miss in your car he starts with the component that is easiest to access or diagnose and works to the more complex items — spark plugs to ignition module. The same process should be used when diagnosing a diecutting issue. Start with the easiest to access and simplest to diagnose and work to the more complex. This is perhaps why the cutting die is often misdiagnosed as the culprit of dimensional instability. On most diecutters it is eye level, right in your face, and it is easily unbolted and made "someone else's problem."



The Cutting Surface (Anvil)

The typical troubleshooting process should start with the cutting surface (anvil). The anvil can be the cause of many diecutting issues and is by far the fastest and easiest to check. The anvil surface should be smooth, even, firm and within the proper thickness. In most cases a visual inspection is all that is required.

Check for:

- **Even wear** — A quick look can tell you if the wear is even both across and around the cylinder. Also the surface should be smooth, not ragged or "chewed-up." Depending on the severity, the covers may need to be rotated, surfaced (trimmed or ground), or simply replaced.
- **Anvil firmness** — A firm, even surface requires less impression and provides greater dimensional control. Anvil firmness is influenced heavily by proper/even wear and rule penetration depth. Good anvil rotation and surfacing practices and proper oscillation operation will help maintain firmness.
- **Anvil thickness** — New covers are, of course, thicker than used covers. Thicker covers also have a larger circumferential dimension and therefore, increase the surface speed of the board as it travels through the diecutter. If a diecutter does not have some type of anvil speed compensation device, such as an Equalizer® type free anvil bearing system or a variable speed anvil, it will cut longer blanks on new covers and shorter on older, used covers.

Buying thicker covers to maximize cover life is not recommended. Not only can improper covers have a negative effect on the dimensional stability, they can also lead to damaged dies, poor product quality, and in some cases, advanced wear.

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The Cutting Die

Next, let's look at the die. Again, this is one of the easier components to see and perhaps less, or more, understood by many operating crews than the internal works of the machine. In either case, being the easiest to make someone else's problem to solve may lead to undue blame for the cutting die. However, the die can still be the cause of the problem. Here are some things to consider when looking at the die.

• **Knife height** — Taller cutting rule can cut longer. It is the same principle as too much impression or oversized covers. The "arc" of rotary cutting or circumferential dimension is greater and therefore the distance between two knives will be farther.

• **Rule concentration** — When all aspects are equal, a dense collection of rule will cut longer. Rubber alone has nowhere near the influence of knife and rubber together. Rubber alone can compress and deflect. When used in close grouping with knife, the rubber may not have the freedom to displace. Concentrated knife may also present more of a driving force on the anvil and therefore, have a tendency to pull the sheet through the diecutter.

• **Large open areas** — Voids within the die can cause shorter blanks. The sheet controlling force of the die and anvil can be lost and the sheet can slow down and therefore make a false, shorter distance between the lead and trail knife.

• **Perf or zipper rule** — A design with 90° perforation or zipper rule tends to cut longer. The constant contact of 90° aggressive rule profiles may have a greater influence on sheet speed.

• **Multiple — Ups** (piggy backing) designs tend to create longer trailing blanks, the second blank in a two blank design. Gear train backlash is a major contributor to this issue.

To minimize the dimensional influence of backlash, place the joint line (the division of the two shells) inside the first blank. This puts the knife that separates the two blanks on the second shell helping to minimize the "differences" and control the blank size. Remember, the rule can only "spread" apart when mounted. I have also found that placing the joint line inside the second (trailing) blank will have the tendency to compound the difference creating an even longer blank.

Independently driven diecut sections and free anvil bearing systems have dramatically helped reduce this problem. Other things to consider include:

• **Bolt hole placement** — Your diemaker should place the bolt holes as close as safely possible to the rule. This will greatly help make a secure, tight mount and stabilize the cutting rule. However, bolt hole placement may be of no consequence if the operator does not use the holes. Remember to properly secure the die. There should be a bolt on every bolt hole.

WHEN A MECHANIC TROUBLESHOOTS A MISS IN YOUR CAR HE STARTS WITH THE COMPONENT THAT IS EASIEST TO ACCESS OR DIAGNOSE AND WORKS TO THE MORE COMPLEX ITEMS...THE SAME PROCESS SHOULD BE USED WHEN DIAGNOSING A DIECUTTING ISSUE.

• **Saw kerf perpendicularity** — This is very Important for diemakers. Bent or worn blades or poor guide foot alignment of the saw can cause the tips of the cutting rules to be out of position in relationship to the base. Even when "cutting on the line" during die construction, the "tip" can be out of position creating any number of size issues when the rule is installed.

• **Rule bevel** — Center bevel vs. side bevel. Most cutting rules are four-point thick. That's nearly one-sixteenth of an inch. Center bevel, identified by being beveled on both sides of the rule, will cut in the center of the saw kerf, if the kerf is perpendicular. Side bevel, on the other hand, cuts on the side or edge of the knife. These rules are often installed with the bevel facing away from the finished blank. Should they be installed backwards the result can be a difference of as much as one-eighth of an inch.

• **Second generation layout** — Be very careful here. When designing a die from an existing carton, seldom do you end up with a result that is superior to the original. You may in fact inherit the issues and errors that were responsible for your plant winning the job from a competitor and required a new die to begin with. If you are not familiar with the carton's function, or have critical dimensions to hold, you are better to create from scratch.

• **Shrink factor** — The Seinfeld version is much funnier but does not help us in diecutting. Our version helps us calculate the position of rules within the die shell to yield the correct design dimensions. This is certainly the cornerstone of all dimensional accuracy variables and a complex one as well that can be a worthy article in itself. In brief, it is a reduced percentage of full scale determined by dividing the drafting surface of die shell into the print repeat of the machine. Matching the cutting repeat with print repeat is recommended. However, as mentioned earlier, one can achieve a longer dimension than print repeat by using taller knives. Wood thickness, cutting rule height, and "expected" impression depth contribute to this calculation.

• **Wood thickness** — Natural products such as wood are not stable and can vary as much as .040 inch (1mm in thickness). This is a crucial part in the shrink factor calculation and can have a dramatic effect on the finished blank size should it be eliminated from the calculation.

Remember, this is only two of the five areas of focus I mentioned earlier. The next part of this series in the September/October issue will discuss the material, operator and equipment and how each can affect the size of the finished product.

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