

Here are three additional areas to examine when troubleshooting.
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Avoiding Dimensional Instability

PART 2



THE TYPICAL DIECUTTER HAS NUMEROUS POWER TRANSMISSION POINTS. BACKLASH CAN QUICKLY BECOME A SIGNIFICANT FACTOR IN CONTROLLING SIZE.

Size variation, or fluctuation within an order, is typically not caused by the cutting die, as I discussed in the first part of this series. However, the die is more times than not blamed for the variation. The importance of developing a comprehensive knowledge of the variables that influence dimensional stability in order to enhance troubleshooting skills and efficiency was also stressed.

Part 1 defined five areas of focus and stated that a good rule of thumb when troubleshooting is to start with the most accessible components and work to the more complex. In following our strategy we started with the cutting surface and die construction.

Now let's take a look at the three remaining areas, the product (design and material), operational (procedures and operator habits) and finally, mechanical (the machine components).

The Product

As an industry we run about every product or combination of products imaginable. Many converters run everything from solid fiber or miniflute to triplewall corrugated and kraft to heavily coated clay-coat liners. All have their own handling characteristics and may behave very differently during diecutting.

A GOOD RULE OF THUMB WHEN TROUBLESHOOTING IS TO START WITH THE MOST ACCESSIBLE COMPONENTS AND WORK TO THE MORE COMPLEX. OPERATORS ARE PERHAPS THE MOST IMPORTANT VARIABLES IN THE EQUATION. MAKE SURE THEY ARE PROPERLY TRAINED.

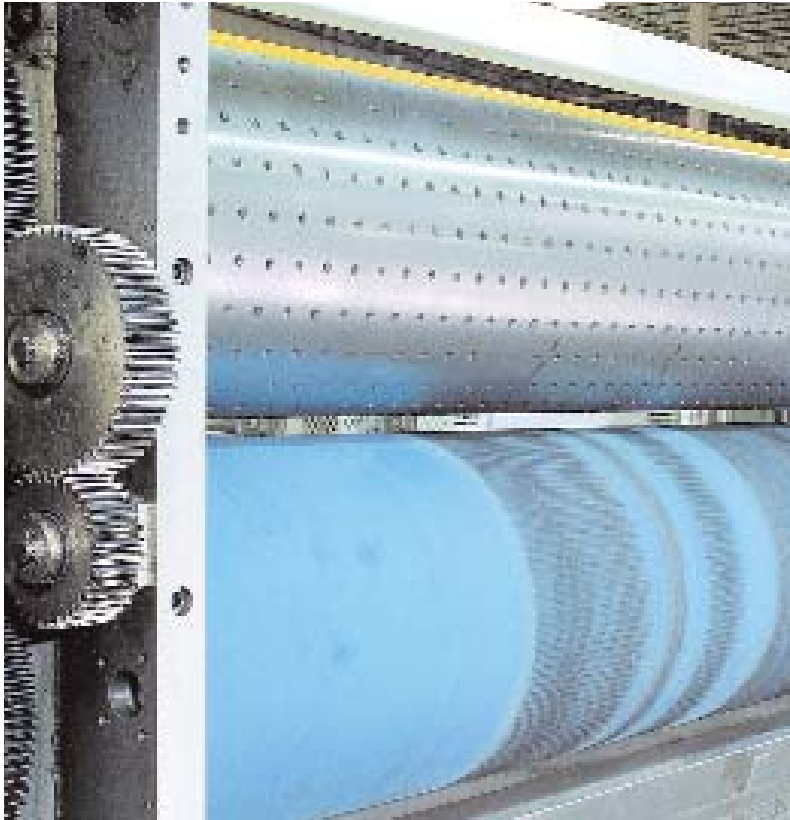
Flute profile and liner weights — All things being equal, E-flute will cut longer than doublewall.

Flute orientation — Cross corrugation will usually cut longer than board with a typical "feed direction" corrugation.

Hydroexpansivity — This is the ability of paper (or board) to shrink or expand as moisture is added. A humidity change from 30% to 70% doubles the moisture content of paper. As moisture is released paper will shrink, so cutting board with a high moisture content, or that has not completely cured from the corrugator, can result in shrinkage and shorter dimensions later in both the through and across directions. This can be as much as six tenths of a percent. Doesn't sound like much? Consider this. A 50-inch dimension could shrink five-sixteenths of an inch, or more, to become $49\frac{11}{16}$ inch. Acceptable? Could be, but probably not.

Sheet size — If it is less than the distance between transfer points (nip to nip) on the press

Diecutting for Results



THE CONDITION OF THE DIE DRUM, CUTTING SURFACE AND PULL ROLLS CAN HAVE A DRAMATIC EFFECT ON DIECUT SIZE.

you have lost control of the sheet travel. All bets are off and you will be fighting a losing battle. With warped sheets there is even greater potential for loss of control resulting in dimensional instability. Try to give yourself at least a one-quarter inch buffer over the nip to nip dimension. This will ensure that the sheet remains in control of at least one nip point at all times.

With vacuum transfer machines this distance would be from where the vacuum control stops to the nip of the diecutter or print station. This point is not necessarily where the belts or rollers stop, but where there is no longer sufficient vacuum to control the sheet. On some designs the belts can run past the vacuum chamber. Keep this in mind.

Operator's Role

Now, what's the chance that an operator's practices or habits can influence the dimensional

accuracy or stability? The operator is perhaps the most important variable in the equation. An operator's habits, practices and experience can mask other causes or be the cause of stability issues. And, it may not be their fault. You must make sure they are properly trained to begin with.

Often formal training is overlooked and operators, and diemakers, are often educated by the on-the-job method. A combination of both methods is probably the best, but be careful that bad habits or procedures are not handed down with the knowledge.

Secure the die to the drum — Make sure operators use all available bolt holes in the die. Start tightening in the center and work to the ends.

Mounting two-piece dies — Make sure the two pieces are aligned properly and that the lead edge of the second shell butts tight and square against the trail edge of the first shell. Also check the mating edges for protruding rule. Often if a die has been repaired on a "half shell repair cylinder," the rule may overhang the die board and prevent the two halves from joining tightly and correctly. This results in a dimension that is longer than the design requires.

Housekeeping — The underside of the shell should be clean and free of grease, paper dust, scrap and other debris. Anything under the shell can change the diameter and therefore the surface speed of the die leading to other diecutting problems and damage the die itself.

No patch-up — Patch up is a practice frequently used in flatbed diecutting for the purpose of alleviating pressure competition. Building up the back of dies to overcome pressure competition is not recommended for rotary dies. Adding tape or other materials to "shim" the die can actually cause flexing that can lead to a broken shell or broken rule.

Feed roll pressure — Non printing diecutters often have a feed roll directly before the diecut section. Improperly setting the nip pressure can result in dramatic dimensional variation. This is particularly evident on thicker flute profiles such as doublewall.

WHEN A PATTERN OF CONSISTENCY IS IDENTIFIED, APPLY IT TO THE CUTTING DIE DESIGN AND YOU WILL IMPROVE RESULTS DRAMATICALLY.

Machine Components

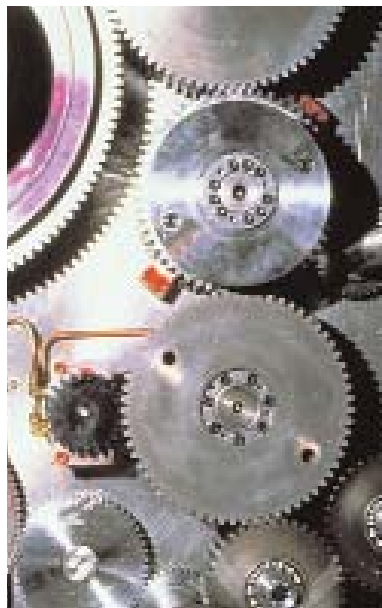
Most certainly the condition of the components of the diecutter can dramatically impact (no pun intended) dimensional stability. Because these variables are not as visible and operators may not understand the mechanical aspects of the machine, they may often be the reasons for many misdiagnoses of the tooling issues.

Operators should always be watching for things that are out of the ordinary, but the items that are most likely to affect the dimensional stability are slightly more complicated to check and should be done by the maintenance crew as part of their scheduled maintenance program.

Gear backlash — This is perhaps the largest contributor to instability. Complex gear trains link transfer rolls, printing and diecutting cylinders with numerous mesh points. Even a slight bit of backlash passing through numerous mesh points can add up to a substantial error. When the lead edge rule or any long horizontal cutting rule strikes the anvil, substantial force is transmitted through the gear train and backlash causes the gears, and subsequently any component attached to them, to momentarily slow down. If part of the sheet is in the print section, gripped by pull collar shafts or vacuum transfer as the lead edge is cut, the sheet can be pulled back causing the trail knife to strike the sheet at a point ahead of the desired position. Therefore, the blank will be smaller than required. The opposite can also be true as the inertia of the drum can cause the sheet to be pulled through the printer. The depth of rule penetration into the anvil can have a dramatic effect on this variable.

Keyway wear — Keys generally are made of a metal slightly softer than the shaft and gear they protect. The idea is to sacrifice the key instead of the gear or shaft. As the key wears, more motion results and therefore more backlash. See above. Some machines have ringfedders instead of keys. The ringfedder bolts must remain tight to prevent slippage. Make sure these are on the maintenance checklist.

Roll diameter — On pull roll machines, material is transferred by several sets of pull collars and



RINGFEDDERS ARE OFTEN USED IN PLACE OF KEYS AND KEYWAYS ON SHAFTS.

rolls. These are smaller in diameter and can turn three and a half revolutions for each diecut revolution. Roll or collar wear, or ink build up, of only .010-inch thickness can drastically change the speed of the sheet as it enters the diecutter.

Frame locks — Worn frame locks must be repaired or replaced. If you can see the diecutter and print station frames separate on impact of the lead edge knife, this indicates worn frame locks and has the same affect as, and can contribute to, backlash.

Floor tracks — Misaligned, worn, or damaged floor tracks can contribute to issues similar to that of the frame locks and can also masquerade as worn locks.

Discharge belts — Layboy belts on stackers and particularly folding belts on flexo folder-glueers can pull the sheet through or out of the diecutter. Make sure that the speed or pressure of the discharge belts is not so different from the speed of the press that the blank is being pulled or held back before diecutting is complete.

Paralleling shafts — Make sure the shafts are keeping the diecutter square

within .010-inch drive side to operator side. Check from the front edge of the diecutter frame to the fixed stop or press section. On fixed diecutter machines check parallel between the last down section (print, transfer, slotter, etc.) and the front of the diecutter frame. Out of parallel situations can cause skewing which can lead to dimensional instability.

I have identified 30 variables contributing to dimensional stability issues. Many are outside of the diemaker's and operator's control. Advancement in machine technology has helped tremendously in eliminating or reducing the effect of many of these variables. Yet older machines still exist and laser cutting only cuts the die board where you tell it.

It is safe to say, using only one shrink factor is not recommended. Chart and study the results you get in the plant. Learn and understand what may be influencing dimension such as material characteristics, machine capabilities and environmental elements. When a pattern of consistency is identified, apply it to the cutting die design and you will improve results dramatically.

Also keep in mind that if a machine is rebuilt you will most likely change the characteristics of the machine. If dies in the past have been made to compensate for stretch or shrinkage that may have been a characteristic of the machine, they may cut differently after the rebuild.

Lastly, think of dimensional tolerance as a relative percentage instead of dimension. It's much easier to hold a tolerance of one-sixteenth inch on a 20-inch sheet than a 50-inch sheet, particularly when cutting a natural product such as paper.

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