

# ADVANCED ADHESIVES REPORT

Your Corrugating Newsletter from HarperLove

## CRUSH OR NO-CRUSH...THAT IS THE QUESTION. HERE IS THE ANSWER!

By Tyler Haggard

Urethane wheels with flexible spokes are a valuable aid in preventing caliper loss caused by crush in combined board. They are usually known as “No-Crush” or “Zero-Crush” wheels. They are used on the corrugator in several places. On the bridge, they can be used as guides to align the web before it enters the triple stack preheaters. On the cutoff knife, they have become popular as pull rolls; at the stacker they control the shingles of sheets and their transition into the stacker.

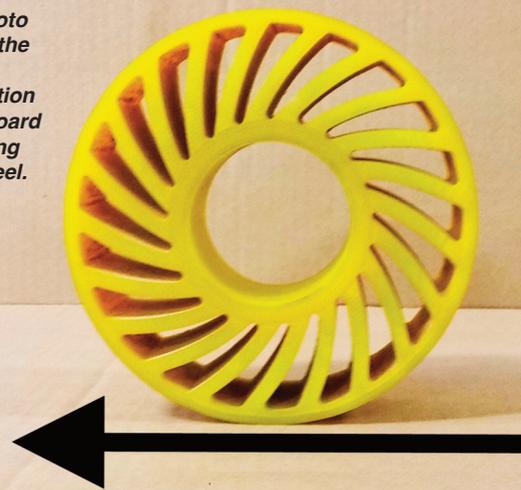
The name “No-Crush Wheels” can put the thought into someone’s mind that these devices cannot crush combined board. They do work well in reducing crush; however, the truth of the matter is that No-Crush wheels can and will crush board. One likely place they can crush is where the board passes through the cutoff knife.

### **There are a few things to consider about No-Crush wheels.**

**Troubleshooting** - The same rules that apply for finding the cause of any crush apply to isolating crush caused by No-Crush wheels. Take the caliper of board samples before and after the wheels to see if the crush is being caused there. Just because they are called No-Crush wheels, doesn’t mean you want to overlook them as the cause of the crush!

**Wheel Orientation** - As we can observe in the images below, the spokes of these wheels are angled relative to their radius and thus can be installed in two different orientations. There is a correct and incorrect way for the No-Crush wheels to be installed. The proper direction of the spokes depends on whether the wheel has power applied to it and it drives the paper, or the wheel is idle and is driven by the paper.

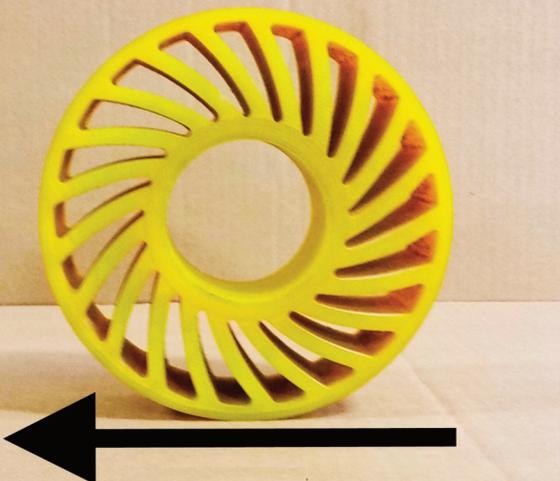
*The photo shows the correct orientation if the board is driving the wheel.*



If the wheels are driven by paper, the spiral of the spokes should run counter to the direction of the paper. If the wheels are driving the board, then the spiral should run with the direction of the paper. The reason for this becomes clear if we think about how the spokes bend and which way requires less force to bend them. The spokes have to point away from the force being exerted so they will flex more easily. When pointed the other way, they will become self-energizing and try to dig in, potentially causing crush. Most No-crush wheels on today’s corrugator are idle and are driven by the board. On any rolls which are motorized and therefore pull the board, the wheels should be mounted in the opposite orientation.

**Alignment of the Wheels** - No-Crush wheels can also crush if they

*The photo shows the correct orientation if the wheel is driving the board.*



**Drive side pull roll No-Crush wheels**



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## CRUSH OR NO-CRUSH...THAT IS THE QUESTION. *HERE IS THE ANSWER!*

are not aligned correctly. At the cutoff knife, they should be paralleled to the pull and exit rolls. Adjust them using the smallest flute produced on the machine, ensuring the flute can be controlled through the knife and vacuum section of the stacker.

The pictures show the upper pull roll and No-Crush wheels are out of parallel. The drive side No-Crush wheels are actually touching the pull roll with a narrow run of double wall traveling through the knife. The operator side is showing a large gap between the No-Crush wheels and the pull roll. This noticeable out of parallel situation will cause board crush even with the No-Crush wheels. In this case there was a .005" to .008" loss of caliper due to incorrect alignment.



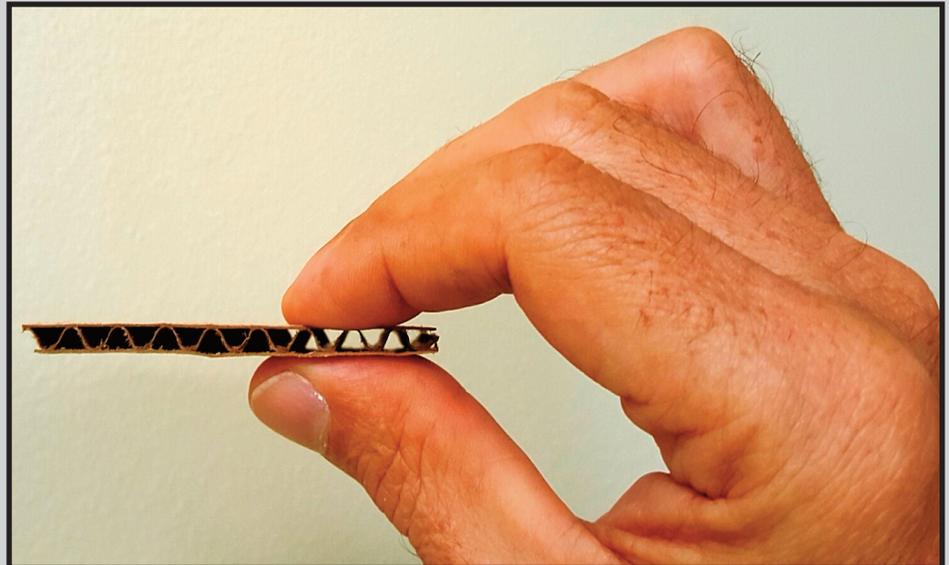
**Replacement.** The service life of No-Crush wheels can vary and will depend on the amount of board produced. Their physical appearance will give you the best indication when they need to be replaced. If any of the spokes are broken or if the spokes become visible on the outer diameter of the wheel (there will be small depressions between each spoke) the wheel should be replaced. Periodic visual inspections are the best way to monitor the condition of No-Crush wheels.

**Wet Board.** A less obvious issue which can obscure the troubleshooting process is wet or soft board. Since wet/soft board is more susceptible to crush, intermittent crush problems can sometimes be associated with it. There can be mechanical conditions on the machine which are marginal and don't cause crush all the time but will appear when board moisture is high. Excessive adhesive application is a common cause for wet board as is improper paper temperatures. Soft board is also susceptible to being crushed as it travels through multiple pinch points and narrow gaps.

No-Crush wheels can do a lot to reduce caliper loss. However, as with any mechanical feature, they have to be properly installed and maintained to do their job. Ensure that the wheels are mounted in the correct orientation for each application, check them periodically to confirm they are in parallel and replace them when they are worn. These steps will allow you to take full advantage of this useful technology.

## Flat Crush Test (FCT)

The Flat Crush Test measures the strength of corrugated board in a direction perpendicular to the liners. If you were to squeeze a piece of board between your fingers, you would feel its resistance to flat crush. Most board would not be too difficult to crush this way since typical values for flat crush are in the 30 to 40 psi range.



Box users are typically more concerned with top to bottom compression because this relates directly to stacking strength. Both the Box Compression Test (BCT) and Edge Compression Test (ECT) measure the board's strength in this direction. These days, the flat crush test is not used very often. Detractors often point out that it really only tests the medium. For example, two board samples 35-26-35 and 42-26-42 made with the same medium on the same singlefacer will have the same flat crush values, even though their ECT values would be very different.

Board that has been crushed, even if it doesn't have measurable caliper loss, will have lower flat crush resistance. Additionally, singlefacer issues such as improper flute formation or fractured medium will also yield lower FCT values.

Knowing the resistance of the board to flat crush is useful because it gives us a very good idea of how resistant the board will be to crush throughout the corrugating process.

# COMBINED BOARD CALIPER

By Rex Woodville-Price

**M**aintaining combined board caliper through the corrugating process is an important element in producing quality sheets. When corrugated board is crushed, its integrity is compromised and its mechanical strength is diminished. Even localized crush, such as a streak of lower caliper down the length of the sheet, can significantly weaken a box and reduce its stacking strength (BCT).

**Determining Caliper.** To determine if the board is losing caliper through the corrugating process, you first need to establish what its caliper should be. “Perfect Caliper” is the name given to the caliper the machine is capable of producing. It can be calculated by adding the flute height of the corrugating roll to the thickness of the liners and a bit extra for the medium. I say “a bit extra”, because with a typical pressure roll single-facer using 30 to 33 lbs. medium, the contribution of the medium is only one thousandths of an inch. Make sure you actually measure the caliper of the papers and have maintenance measure the flute height of the actual corrugating roll in your singlefacer. I often discover plants using some “written in stone” caliper standard hanging in the QC lab. It is often outdated because the corrugating rolls have been changed and have a different flute height.

**Crush.** In the opening paragraph I use the word “maintaining” because that is really the best we can do to caliper in the corrugating process. During classes on corrugating defects, I often compare the concept of board caliper to carrying a water filled bucket to the end of the machine. You are trying to arrive without spilling any of the water, but the amount you started with is the most you will ever have – you can only lose caliper from then on.

It doesn't take much force to crush corrugated board, about 30 to 40 psi depending on the medium. Corrugated is optimized for stacking strength (ECT), sometimes at the expense of flat crush resistance. Since paper is somewhat resilient and has memory, if crushed, it will spring back slightly. Often the crush we measure is the result of a greater “squeeze” and more damage has been done to board strength than would be indicated by the amount of caliper lost. This emphasizes the importance of eliminating crush.

**Finding the Source of Crush.** The basic technique for finding the source of crush is to stop and take samples along the machine. The goal is to determine where the crush begins. For example, if there is no crush before the cutoff knife but crush is present after it, the cause must be something in the cutoff knife such as a feed roll. Sometimes, forcing an emergency stop is the only way to isolate the source as the cause is dynamic and doesn't appear during

a normal stop.

The double-facer is often the source of crush. Hotplates out of level, beltlifters not going down completely or improperly adjusted hold down

systems are the primary suspects. Don't forget to check for things like debris accumulated on the rollers in the doublefacer. Also, the lower rollers in the traction section are easy to overlook since they are almost completely out of sight.

**The Singlefacer.** Not all low caliper is caused by crush. Singleface web with defects such as leaning or malformed flutes will have less-than-ideal caliper.

The Singlefacer can also be the source of low caliper. The gap between the glue roll and the corrugating roll should be set to the caliper of the medium being run (half a thousand less is acceptable). If it is too tight the medium will be crushed. Medium is particularly susceptible to crush at this point because it is wet and soft due to the presence of ungelled adhesive. Keep in mind that medium caliper can change from one roll to another. Automatic gap control goes a long way towards reducing this defect.

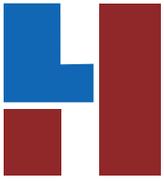
If the pressure roll is set with too much pressure, it will crush the medium and the liner at that bond site resulting in caliper loss and reduced board strength. One of the benefits of belted singlefacers is that this problem is almost eliminated.

When troubleshooting caliper loss, it is wise to start your diagnostic process by checking the caliper of singleface web in order to rule out the singlefacer as the source of the caliper loss.

Board caliper exiting the corrugator must be the best possible, because the downstream process such as printing and die-cutting may cause additional caliper loss. Producing board off the corrugator with ideal caliper is the best way to ensure optimum board performance.



*Wear on the surface of a hotplate can cause crush because the board is forced to bend as it conforms to the curve.*



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