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How to Fix Ugly Rolls

■ Appearance counts. Ugly rolls of film are often rejected, even when the gauge variation of the film itself is well within specification. It is often impossible to measure the slight gauge variation that can build up over thousands of layers to produce a bump in the roll diameter. So operators must understand how to diagnose the cause or causes of deformed rolls and adjust winding for changes in raw materials, processing conditions, and equipment function.

All winders use some combination of nip pressure, web tension, and drive torque to control film winding. Nip-roll pressure controls roll hardness by removing air entrapped between layers as the film winds. Web tension controls roll hardness as well, but can cause other problems, especially when winding elastic materials like polyethylene. PE film relieves stress by changing shape over time, so roll deformity may not show until several hours after the roll is completed. Drive torque from the center is a better way to control stress as film winds.

Prevent tin canning

Rolls that exhibit a defect known as "tin canning" are softer near the middle of the roll than at the edges. The result is regular corrugations every 1 to 2 in. around the roll like ribs on a tin can. This problem occurs when extruders or dies are unable to homogenize materials of very different viscosity or density. Using materials that are more similar helps. Adjusting temperature profiles or backpressure to increase mixing of the melt before it enters the die may also solve this problem.

From a machinery perspective, the most common cause in blown film extrusion is excessive drag resistance in the collapsing frame, which can permanently stretch the film near the middle of the roll. Increasing the opening at the bottom of the collapsing frame helps. Film can also be stretched past its yield point if the film is too hot or tension is too high. So adding cooling before pulling the film past idler rollers will help.

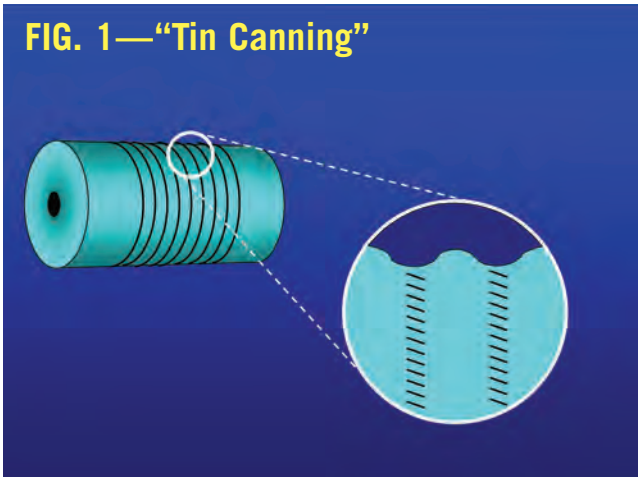
Tapering tension inside the winder helps as well. The taper strategy depends on the modulus of elasticity of the web. For thin, stretchy films, apply a negative tension taper, starting high, dropping rapidly, and flattening as the roll gets full. Heavy, stiff films need a positive tension taper, starting high on the empty roll, maintaining the higher level, and dropping off more quickly as the roll nears completion. Final tension is typically 50% to 75% of starting tension, depending on roll diameter.

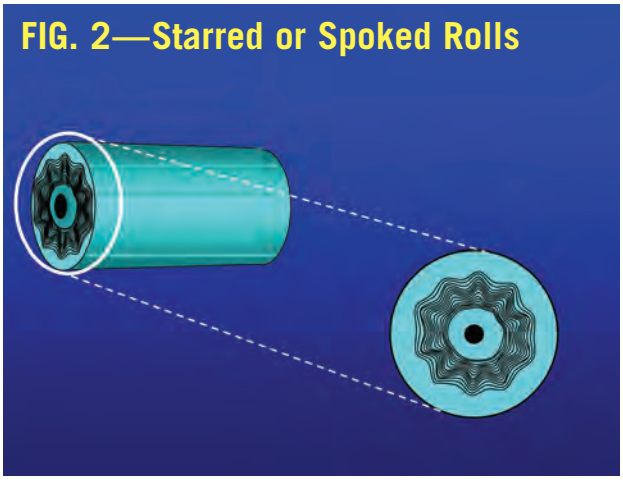
No stars, spokes, buckles

These defects are most visible at the ends of the roll, though ridges along the roll axis also may be visible at the outer surface. In "starring" or "spoking," the outside film layers compress inner layers as the roll builds. The roll deforms into a star or spoked pattern because the layers buckle when compression force is too high. Film shrinks as it cools, so this problem may not appear until several hours after the roll is completed.

The most common processing

Winding problems create roll defects like tin canning, starring, spokes, buckled cores, and tapered rolls.





causes are winding film too warm or applying too much web tension or lay-on pressure. This problem can also occur with coextruded film where the density in each layer can be very different. The film tends to curl toward the higher density layer. Selecting layers with more similar densities or changing layer ratios may reduce this problem.

Buckled rolls are a more severe case of starred or spoked rolls, where compression becomes so intense that the core itself is deformed, often making it impossible to remove the rolls from the winding shaft. Causes are identical to those for starred or spoked rolls. A core can also collapse at one end if the web overhangs the core. Just a little extra pressure at one end can be sufficient to crush the core.

Stop tapered rolls

Tapered rolls are larger in diameter at one end than the other. Blown film lines, even with rotating dies or oscillating nips, can still taper because rotating or oscillating dies only randomize TD gauge variation up to the frost line, while oscillating nips only randomize TD gauge up to the collapsing frame. MD gauge variation isn't randomized at all. The most common cause of tapered rolls is unbalanced cooling, which can be caused by air drafts; a misaligned die or air ring; misaligned haul-off nips or idler rolls; or uneven nip pressure.

The most common operator mistake is to compensate for poor roll geometry by increasing web tension. It's best to increase nip pressure or drive torque first.

Telescoped rolls have a problem of the outside layers sliding to one end. Telescoping can be caused by too much slip additive, which blooms to the surface and changes the coefficient of friction between film layers. The COF changes most during the first hour after extrusion. If idler, nip, or lay-on rollers aren't parallel to the winding core or don't apply pressure evenly, stresses will pull the web to one side.

Air trapped between layers is another cause of telescoping, so it's important to maintain either nip pressure or web tension high enough to keep air out. Entrapped air can also cause "edge wander," making roll ends ragged instead of smooth.

The most common operator mistake is to compensate for poor roll geometry by increasing web tension. The best strategy is to wind with the least tension possible because you are winding a rubber band. Instead, increase nip pressure or drive torque first, then increase web tension if a problem occurs. When winding in gap mode, increase drive torque to raise web tension. Tapering web tension as the roll increases should also be used if the winder has that capability.

Roll appearance becomes a bigger issue as converters buy larger and larger rolls to minimize waste during roll splicing. Larger rolls make any variation in roll geometry much more apparent. A temporary fix may be to wind small-diameter rolls, but ultimately the causes of non-uniform rolls need to be identified and corrected.

—Edited by Jan H. Schut

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FIG. 3—Buckled Rolls

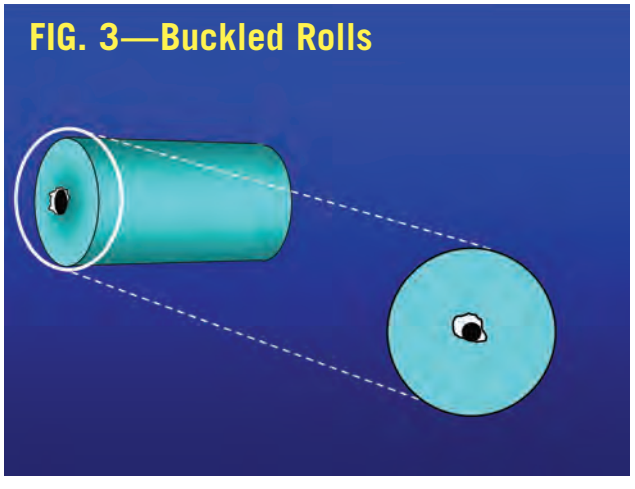

FIG. 4—Tapered Rolls