Precision Alignment of Winders

Winder speeds must increase to keep pace with higher operating speeds of paper machines. At high speeds, any misalignment of the winder can have a detrimental effect on operation and production rates.

MYRON SMITH and ROGER CROSS

The alignment of winders within stringent tolerances is necessary to achieve optimum operating speeds while minimizing roll defects and web breaks. Precision two dimensional optical and three dimensional metrology tooling and alignment techniques are both very capable of achieving the tolerances required for faster, more efficient winder operations.

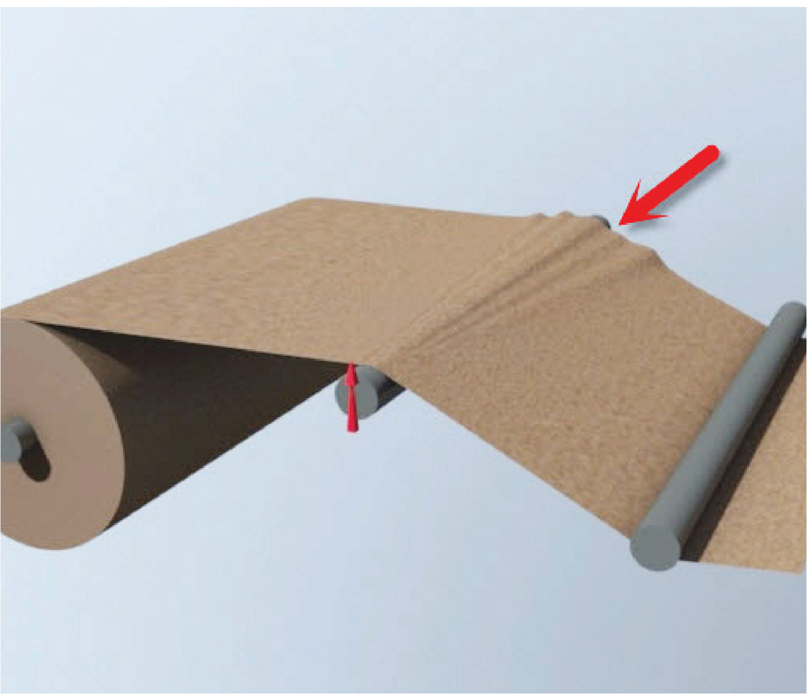
Optical tooling and the techniques specific to it, has a long proven track record of providing positive results with respect to inspections and realignment efforts on winders. However, newer three dimensional metrology tooling, such as laser trackers and the techniques specific to it, will provide identical results with the added capabilities of providing three dimensional documentation of the actual, to scale, geometry of the rider roll/core chuck relationship to the winder drums. Likewise, it can detail the actual, to scale, geometry of the sectional rolls to the slitter section components.

Using either of these types of equipment, specialized inspection techniques can provide considerable speed increases while significantly reducing waste and roll winding defects.

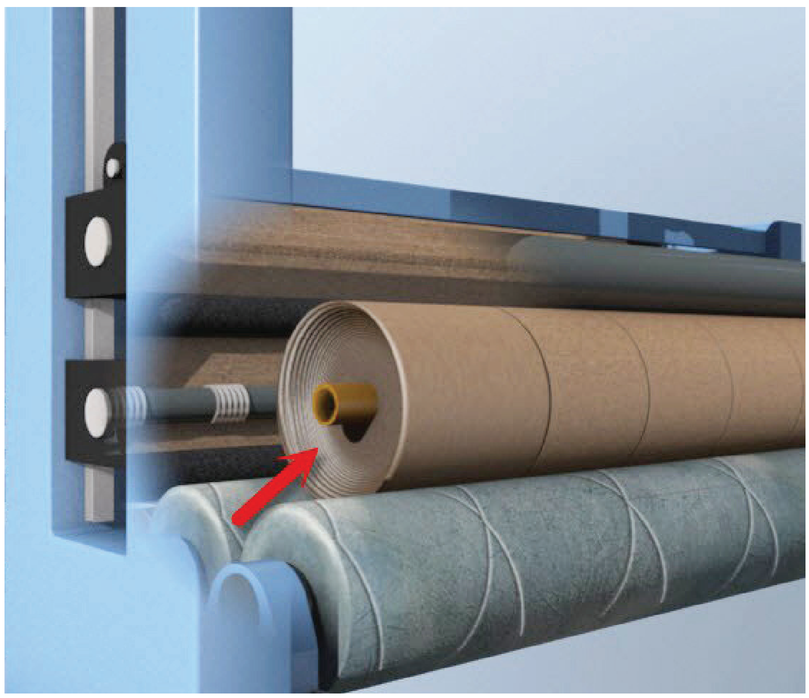
MISALIGNMENT AND QUALITY

The following examples illustrate how misalignment can adversely affect product quality and contribute to roll defects:

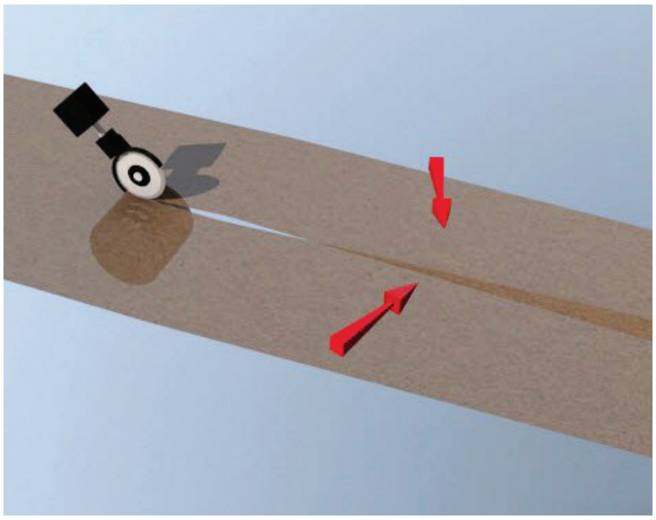
- Misaligned winder components often produce the baggy edges shown in Figure 1, wrinkles, web tracking problems and frequent web breaks.
- Dishing, shown in Figure 2, can occur when rider roll, winder drum, or core chuck misalignment causes the product to move incrementally in the axial direction. This continuous movement creates dish-shaped ends on the roll.
- Interweaving, shown in Figure 3, is the result of misalignment in the rolls following the slitters. Here, two adjacent strips of the slit web overlap during winding so that the adjacent rolls intertwine. This often can't be separated and such rolls must be scrapped.
- Offsets, shown in Figure 4, are "steps" in the edge of the roll formed by rider roll misalignment that produces non uniform nip loads. They can also be caused by tension variations in the web, causing the web to shift due to the guiding action of the misaligned rolls.



▲ Figure 1. Baggy edges.
Source: OASIS Alignment Services, Inc.

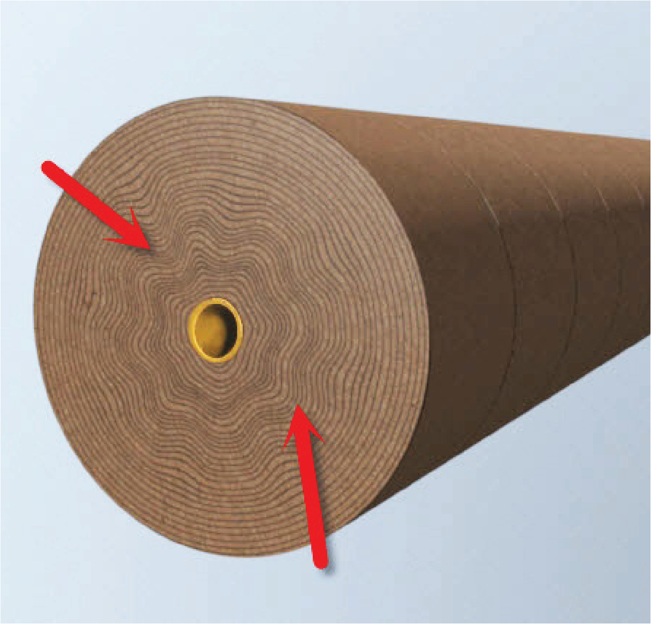


▲ Figure 2. Dishing.
Source: OASIS Alignment Services, Inc.

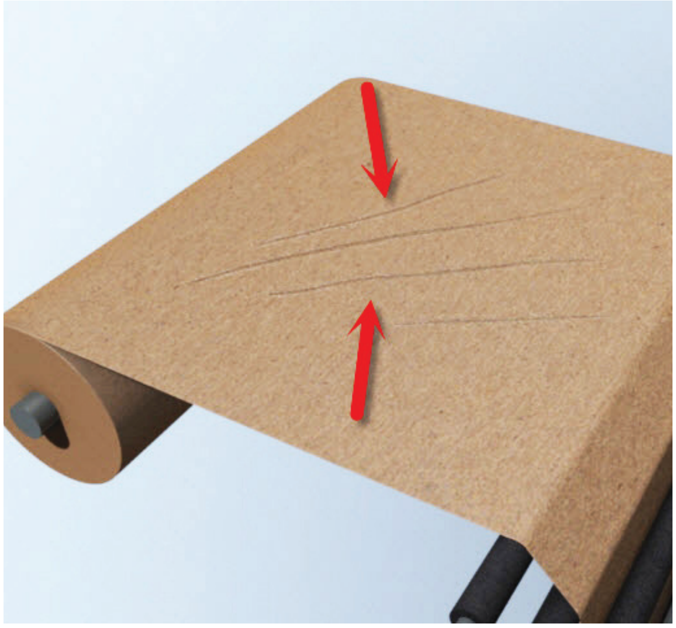


▲ Figure 3. Interweaving.
Source: OASIS Alignment Services, Inc.

▲ Figure 4. Offset.
Source: OASIS Alignment Services, Inc.



▲ Figure 5. Starring.
Source: OASIS Alignment Services, Inc.



▲ Figure 6. Wrinkles.
Source: OASIS Alignment Services, Inc.

- Starring, shown in Figure 5, may be an indirect result of misalignment. Rider roll or way misalignment contributes to a soft start. The softer inner layers collapse under the pressure of the more tightly wound outer layers which produces a star-shaped pattern on the end of the roll.
- Wrinkles, shown in Figure 6, can form if roll misalignment leads to unequal tension in the web. If wrinkling is severe enough, they can fold over and cause a permanent crease to form.

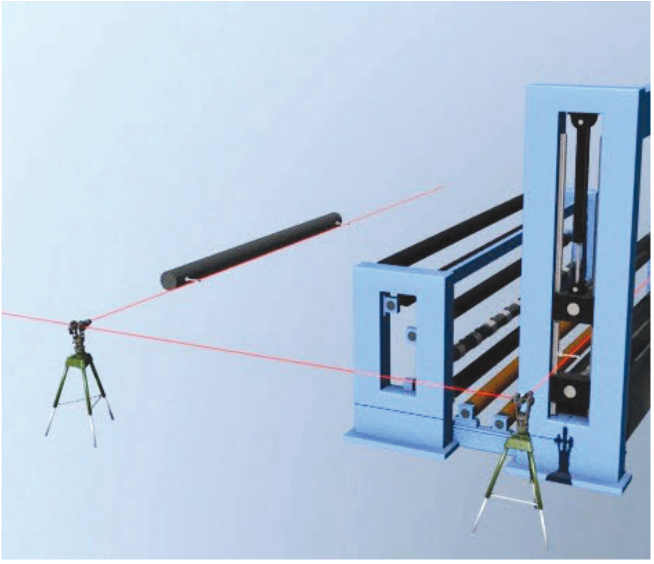
COMPONENTS

Several component problems can occur from misaligned rolls, drums, ways and drives:

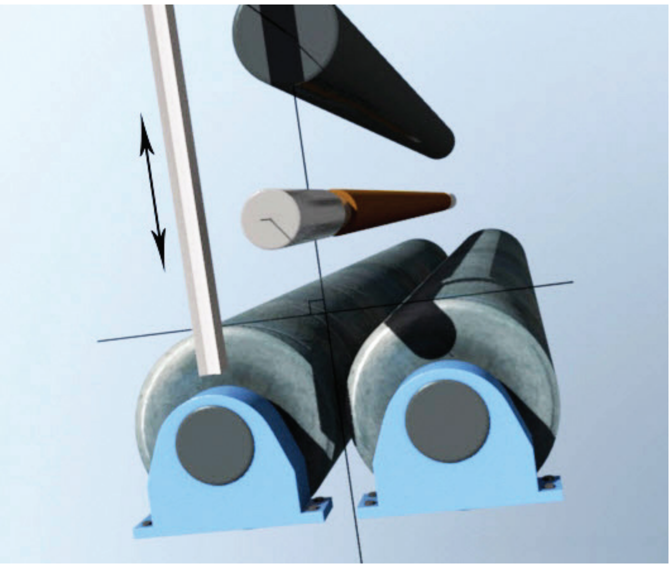
- The winder drums and rider roll nip the product during windup. Parallel misalignment of the rider roll, drums or core chucks can lead to uneven forces in the nip, producing vibration.
- Misalignment of the winder drives can also lead to excessive vibration which in turn can lead to premature bearing and coupling wear.
- Stresses produced by misaligned rolls lead to excessive wear of bearings, bushings and other mechanical components.
- Binding of the rider roll and core chucks can occur if the ways do not have proper alignment.

INSPECTION AND ALIGNMENT

Alignment references. Most winder component alignment occurs in two directions: vertically and horizontally or “level” and “square.” Vertical inspections determine a



▲ Figure 7. Horizontal.
Source: OASIS Alignment Services, Inc.



▲ Figure 8. Perpendicular.
Source: OASIS Alignment Services, Inc.

component's level condition. To complete horizontal inspections, however, it is necessary to establish a reference line-of-sight or datum. In general practice this datum line-of-sight is created parallel to the bottom of the rider roll fixed ways. This is the reference for all horizontal inspections, as Figure 7 shows. Depending on a particular winder's configuration, it is possible to use an alternate datum, such as the rear drum.

Initial survey/inspection. Winders typically operate at high speeds with short web draws and varying amounts of roll wrap. As such, it is important to obtain a good picture of total winder alignment before making any adjustments. A thorough survey or inspection will obtain this information. Analysis of the data then reveals the best action for correcting the winder's misalignment problems.

Unwind and lead-in rolls. Before completing the inspection of the unwind stand and its associated brake and clutch, a new spool (or one that is known to be in good condition) should be loaded into the unwind stand. If a new spool is not available, the following precautions are necessary:

1. Ensure that the spool has no surface defects at inspection points
2. Verify spool diameters at the inspection points
3. Evaluate the spool's journal and unwind saddle conditions
4. Repeat inspections after rotating the spool to check for run out

The spool is then inspected to determine the vertical and horizontal alignment of the unwind stands. The stands should then be adjusted as necessary, keeping in mind that the drive side end of the spool should remain relatively coincident with the unwind clutch assembly. Lastly, the clutch, brake, and unwind drive motor are then aligned to the spool.

Lead-in rolls are usually adjustable for their vertical attribute to compensate for parent roll non-uniformities. Sometimes operators improperly use this adjustment to compensate for gross misalignment between the unwind and slitter sections. This produces uneven stresses on the sheet.

It is recommended that these lead-in rolls are inspected and aligned as needed. A scribe line or other match mark should be placed on the adjustment mechanism to show when the roll is level. This reference mark should be used as a starting point to compensate for varying parent roll characteristics.

Slitter section. Inspections in the slitter section are necessary on the blade and band ways, on spreader assemblies such as bowed rolls and D-bars, and on sectional rolls. Based on inspection results, adjustments are performed to align the components to precise OEM tolerances and to insure that the slitter band penetration into the web is correct.

Slitter sectional roll alignment can be a lengthy process. Both ends of each segment must be inspected to determine overall misalignment and any offsets between the segments. Misalignment exceeding the OEM's recommended tolerances and profiles will require correction. Care must be taken as aligning one segment of the roll can affect alignment of adjacent sections. Care is also necessary during adjustments to prevent roll binding in the bearings and/or between the shells of adjacent segments.

Rider roll ways. Inspection of the rider roll ways will determine whether or not they are parallel to each other and plumb in both the machine and cross-machine directions. If the ways are not parallel, the feasibility of adjusting the ways to improve the parallelism should be explored.

If the ways are not parallel in either direction, rider roll misalignment will be present at various points of the building of the sets. Likewise, ways out of parallelism can cause rider roll beam binding and/or looseness and result in uneven nip pressures on the sets. Any adjustable cam followers on the rider roll beam and core chucks should undergo adjustment for proper clearances to best fit the conditions and alignment of the ways.

Winder drums. Besides aligning the winder drums for the vertical and horizontal attributes, the elevation of the drums is important. For proper operation of the

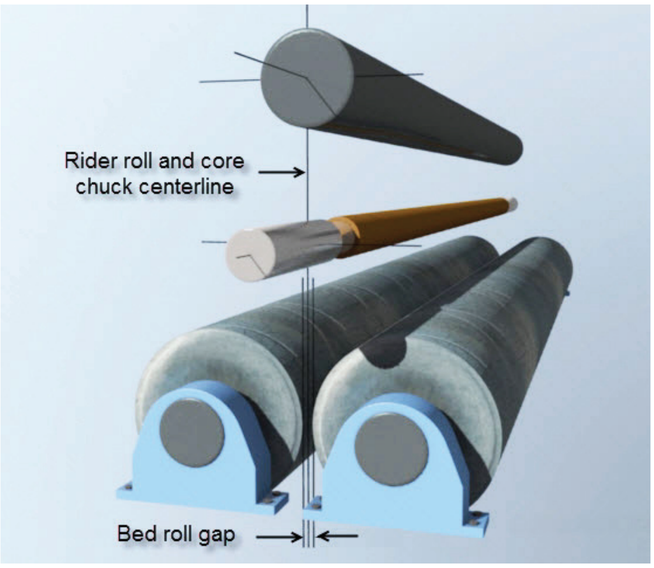


Figure 9. Centerline.
Source: OASIS Alignment Services, Inc.

Component	Tolerance
Drums	Parallel to each other within 0.003 in.
Sectional rolls	Adjacent sections within 0.002 in. ± 0.005 in. total
Core chucks	Aligned to each other within ± 0.005 in. Centerlines coincident to drum roll gap centerline within ±0.010 in.
Rider roll	Adjacent sections within 0.002 in. ± 0.005 in. total Centerline coincident to drum roll gap centerline within ±0.010 in.
Ways	0.005 in. for plumb cross-machine 0.015 in. for plumb machine direction
Intermediate rolls	± 0.005 in.
Motors and gearboxes	Aligned to respective drum within ± 0.002.

Table 1. Tolerance guidelines for aligning winder components.
Source: OASIS Alignment Services, Inc.

rider roll and core chucks, the plane formed between the top surfaces of the drums should be perpendicular to the ways, as Figure 8 shows. For vertical ways, this would involve aligning the drums at the same elevation. For angled ways, the drums are set at different elevations, but the top surfaces form a plane perpendicular to the ways.

The drum gap size is an important consideration when aligning the drums. The OEM's recommended gap should be maintained during adjustments. When adjusting the drums, it is also necessary to consider the alignment of the drive components. Inspect and, if necessary, align each drive to its respective drum.

Rider roll. Differing aspects of rider roll design offer differing alignment challenges:

- Rider rolls are typically segmented rolls. As discussed earlier, adjustments to individual segments can affect the alignment of adjacent segments.
- The rider roll moves up on the ways as the set forms. Similar to the rider roll way parallelism mentioned earlier, worn or damaged mechanical components of the rider roll beam and mounting hardware can greatly influence rider roll alignment as the roll travels along the ways.
- Rider roll design/configurations dictate alignment procedures to be used. In traditional rider roll design/configurations, where the rider roll beam is raised and lowered by chains and sprockets, the following alignment procedure should be used. Inspections are normally performed at the bottom, mid-point and top of the rider roll's operating range to determine if its alignment changes with position. If the level condition changes, this often means that the chains, sprockets, or both, need replacement. In addition, the roll can be binding as it travels on the ways. If the horizontal alignment changes, this normally indicates way misalignment and/or worn hardware conditions.

Newer winders are equipped with articulating rider rolls, which dictate that special procedures be followed to properly align the rider roll segments. Typically the rider roll beam and roll segments will be found in a non-level condition, from tending side to drive side comparison. In this case, it may be beneficial to secure the rider roll beam in a level condition prior to aligning the segments. Rider roll segments will then be aligned to the OEM's recommended tolerances and profiles. If the beam is left in an out-of-level condition, alignment of the segments still needs to be done according to the OEM's recommendations, but additional care will need to be taken in adjusting the vertical attribute relative to the out-of-level "slope" of the beam.

When performing adjustments to the rider roll, it is important that its centerline and drum gap centerline remain coincident as shown in Figure 9.

Core chucks. Core chuck inspection typically occurs at selected points through their full range of operation. When aligning the chucks for both attributes, ensure that the core chuck centerlines are coincident with the drum gap centerline.

Tolerances. The OEM's recommended tolerances must be applied when aligning winder components. If the manufacturer's tolerances are not available or seem too large for the desired machine speed, follow the suggested tolerances in Table 1. NOTE: This table is only a guideline, since tolerances depend on equipment condition, operating speed, machine width and product type.

Periodic maintenance. An aligned winder requires periodic inspections and adjustment to maintain the optimum operating conditions. Tune-ups should occur after approximately six to twelve months of operation. The replacement or repair of major components should be augmented with precision alignment techniques to maintain the winder's alignment integrity. 360

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