PRECISION ALIGNMENT OF WINDERS

JAMES M. DUNN, DONALD J. ALLEN, MICHAEL A. CARTER,
STEPHEN M. PEPIN, AND WILLIAM E. LEONARD

ALIGNMENT OF WINDERS WITHIN STRINGENT TOLERANCES IS NECESSARY FOR ACHIEVING OPTIMUM OPERATING SPEEDS WHILE MINIMIZING ROLL DEFECTS AND WEB BREAKS. USING OPTICAL ALIGNMENT TECHNIQUES BEST ACHIEVES THESE TOLERANCES. THIS PAPER DISCUSSES THE EFFECTS OF MISALIGNMENT ON WINDER OPERATION AND PRODUCT QUALITY, THE BENEFITS OBTAINED FROM INSTITUTING AN ALIGNMENT PROGRAM, AND A TYPICAL WINDER ALIGNMENT PROCEDURE.

TO REMAIN COMPETITIVE, PAPER COMPANIES HAVE increased the operating speeds of their paper machines. This requires winder speeds to increase at a rapid rate to maintain the increased production. As winder speeds increase, any misalignment of components has a more detrimental effect on operation. Misalignment of winders therefore can limit total production rates.

Precision optical tooling typically provides the stringent tolerances required for efficient operation. Using this equipment and specialized optical inspection techniques can provide speed increases up to 1000 ft/min with significant reductions in waste and roll winding defects.

EFFECTS OF MISALIGNMENT

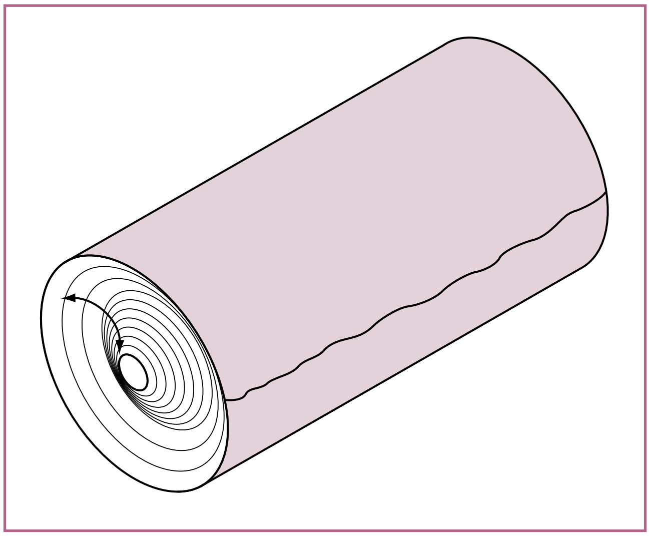
Product quality

Misaligned winder components often produce the baggy edges shown in Fig. 1, wrinkles, web tracking problems, and frequent web breaks. The following examples show how this misalignment can also contribute to roll defects:

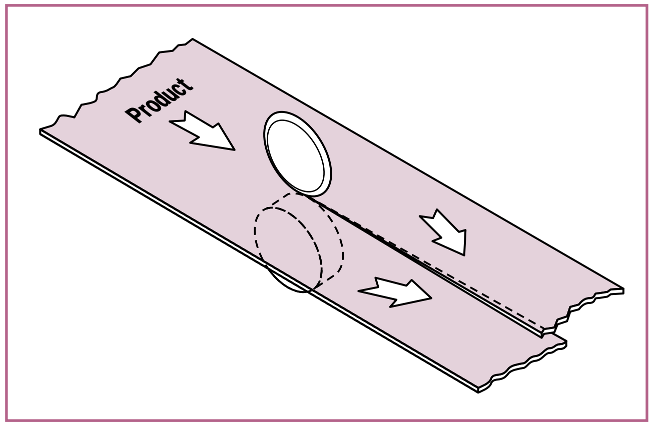
- Dishing shown in Fig. 2 can occur when rider roll, winder drum, or core chuck misalignment causes the product to move incrementally in the axial direction. This continuous movement creates dish-shaped ends on the roll.
- Interweaving shown in Fig. 3 is the result of misalignment in the rolls following the slitters. Here two adjacent strips of the slit web overlap during winding so that the adjacent rolls intertwine. It is often not possible to separate the rolls. Scrapping is necessary.
- Offsets shown in Fig. 4 are steps in the edge of the roll formed by rider roll misalignment that produces nonuniform nip loads. Tension variations in the web causing the web to shift due to the guiding action of misaligned rolls can also form off sets.
- Starring shown in Fig. 5 may be an indirect result caused by misalignment. Rider roll or way misalignment originally contributes to a soft start. The softer inner layers collapse under the pressure of the more tightly wound outer layers. This produces a star-shaped pattern on the end of the roll.
- Wrinkles shown in Fig. 6 can form if roll misalignment leads to unequal tension in the web. Drawing the wrinkle into the nip where it may fold over can cause a crease to form.

Components

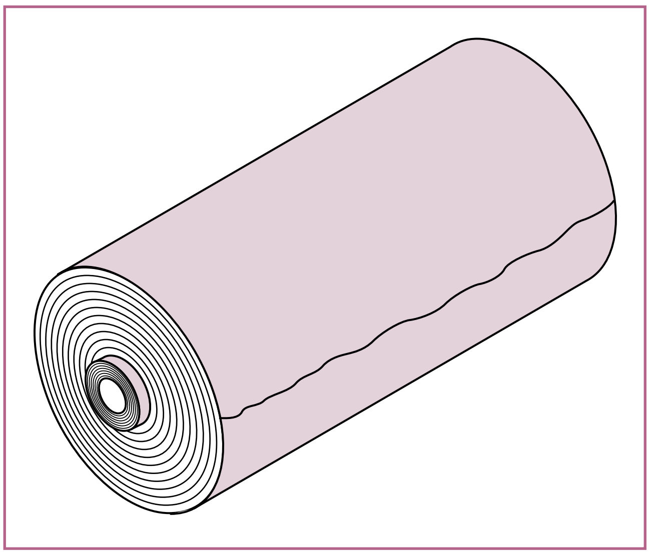
Several component problems can occur from misaligned rolls, drums, ways, and drives:



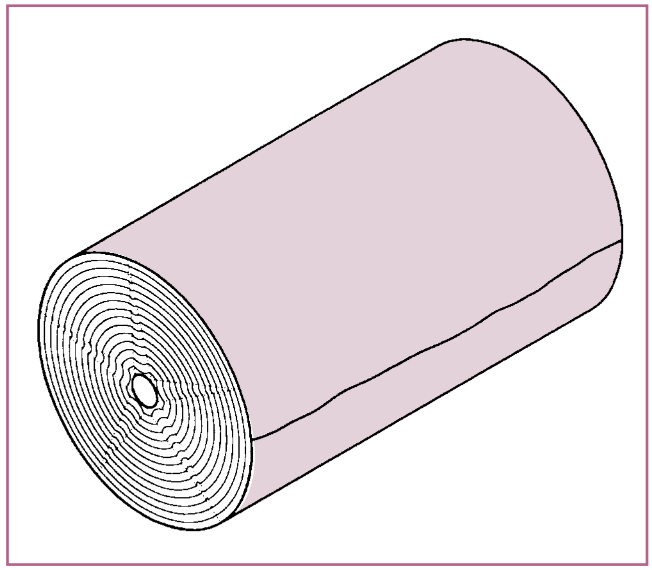
1. Dishing



2. Interweaving



3. Offset



4. Starring

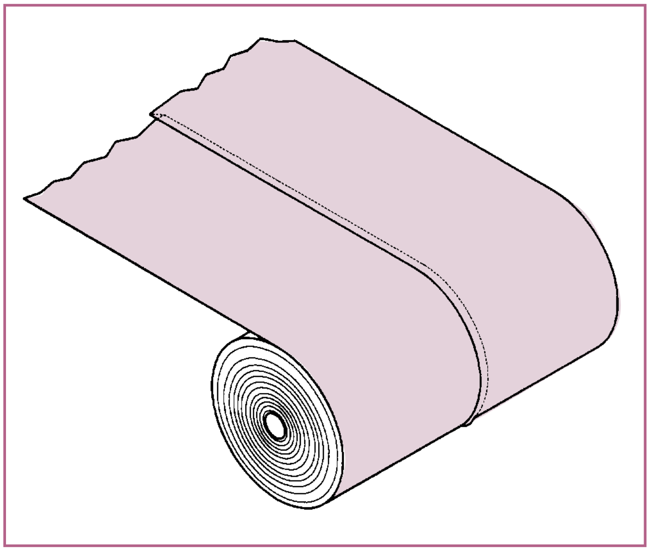
- Vibration can occur near the rider roll and winder drums. The winder drums and rider roll nip the product during windup. Parallel misalignment of the rider roll, drums, or core chucks can lead to uneven forces in the nip. These produce the vibration.
- Misalignment of the winder drives can also lead to excessive vibration. This often leads 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 component's level condition. To complete horizontal inspections, however, one must chose a reference line of sight or datum. It is general practice to create a line of sight parallel to the bottom of the rider roll fixed ways. This is the reference for all horizontal inspections as Fig. 7 shows.

Depending on the winder configuration, it is possible to use an alternate datum such as the rear drum. Figure 8 shows that the horizontal alignment then relates to the



5. Wrinkle

datum, and the vertical alignment or level relates to earth.

Survey inspection

The winder operates at high speeds. The web experiences short draws, and there is a large amount of roll wrap. It is important to obtain a good picture of total winder alignment before making any adjustments. A survey inspection usually obtains this information. Analysis of the data then reveals the best action for correcting the winder's misalignment problems.

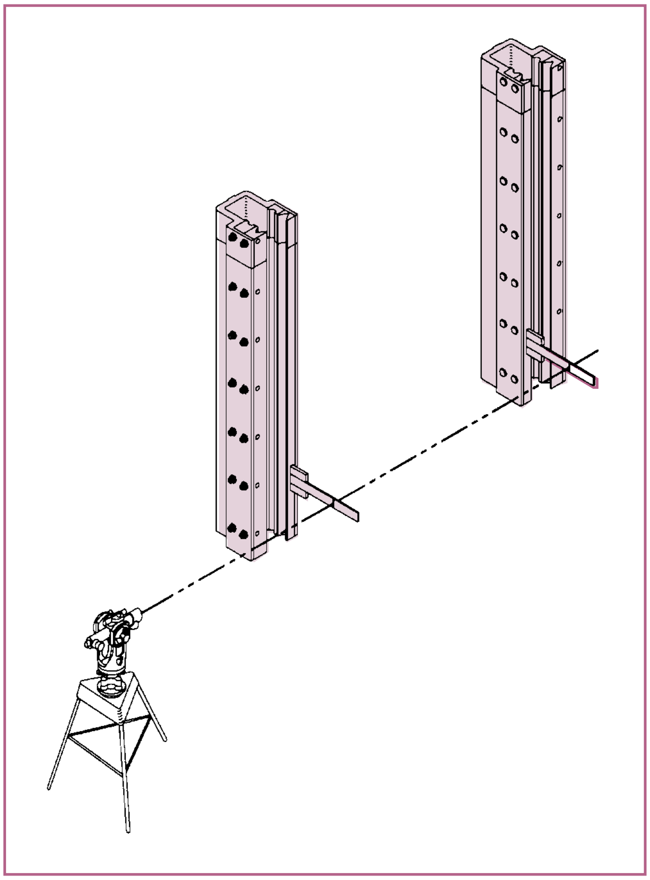
Unwind and lead-in rolls

Before completing the inspection of the unwind stand and its associated brake and clutch, one should load a new spool into the unwind stand. If a new spool is not available, the following precautions are necessary:

1. The spool should have no surface defects at the inspection points.
2. Consider the spool diameters at the inspection points.
3. Evaluate the bearing and unwind saddle condition.
4. Repeat inspections after rotating the spool to check for runout.

One next inspects the spool to determine the vertical and horizontal alignment of the unwind stands. Then one adjusts the stands as necessary and aligns the clutch and brake to the spool.

Lead-in rolls are usually adjustable for the vertical attribute to compensate for parent roll nonuniformities. Some operations improperly use this adjustment to compensate for gross misalignment between the unwind and slitter section. This produces uneven stresses on the sheet.



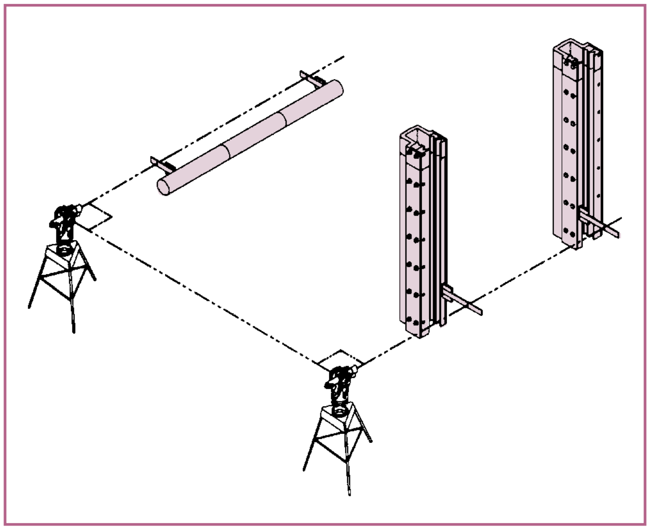
6. Establishing a horizontal reference

It is necessary to inspect and align these rolls as needed. A scribeline or other match mark on the adjustment mechanism will show when the roll is level. This reference mark may be a starting point to compensate for varying parent roll characteristics.

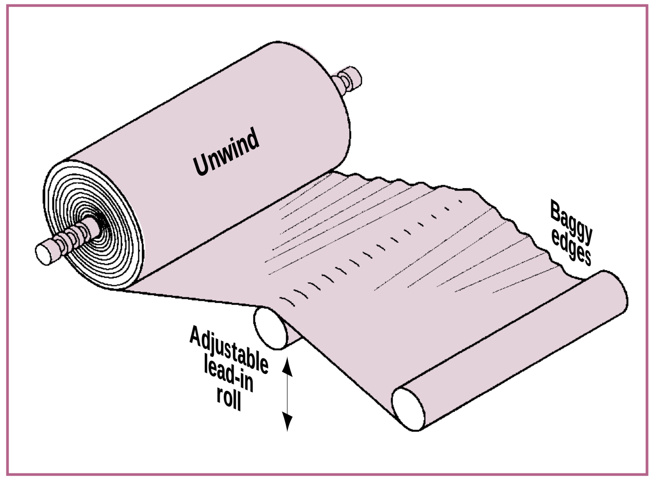
Slitter section

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. Adjustments allow aligning the components within tolerances and setting the slitter band penetration into the web.

Slitter roll alignment can be lengthy. One must inspect both ends of all segments to determine any offsets between the segments. Misalignment exceeding tolerances requires correction. Some realignment efforts may require repeating, since aligning one section of the roll can have an effect on the alignment of adjacent sections. Care is necessary during adjustments to prevent roll binding in the bearing. This can happen with improper alignment performance.



7. Typical horizontal inspection



8. Baggy edges caused by misalignment

Rider roll ways

Inspection of the ways will ensure that they are parallel to each other and plumb in both the machine and cross-machine directions. If the ways are not parallel, the gap between the ways will not be consistent from top to bottom or may be wracked in the machine direction. Both conditions can produce rider roll misalignment and concomitantly uneven nip pressures on the product. Any adjustable cam followers on the rider roll beam and core chucks should undergo adjustment for proper clearances.

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 rider roll and core chucks, the plane formed between the top surfaces of the drums should be perpendicular to the ways, as Fig. 9 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. One should maintain the manufacturer's recommended gap during adjustments.

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	0.005in. for plumb cross-machine 0.015in. plumb machine direction
Intermediate rolls	± 0.005 in.
Motors and gearboxes	Aligned to respective drum within ± 0.002 in.

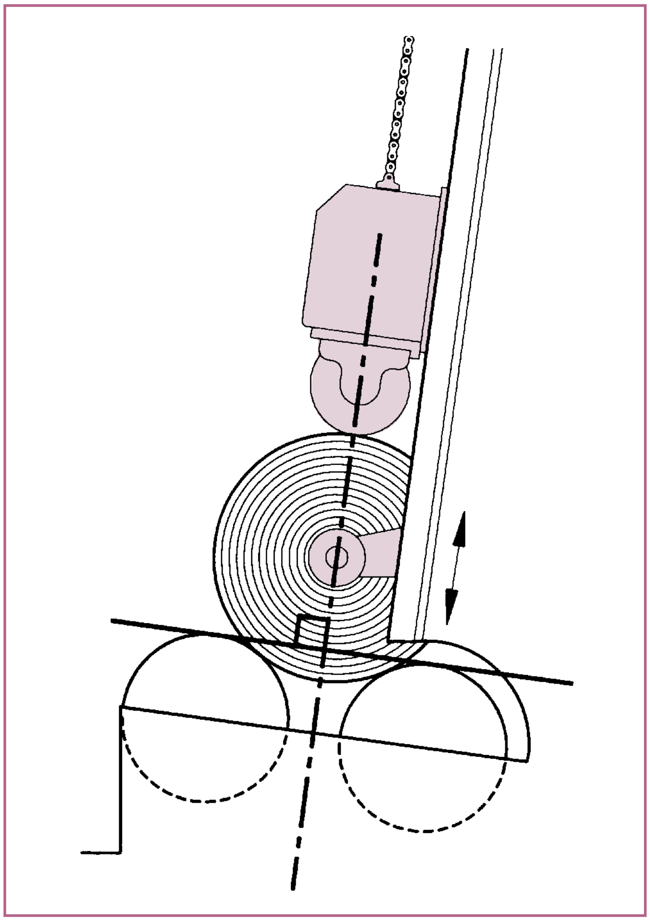
I. Suggested winder alignment tolerances

When adjusting the drums, it is also necessary to consider the alignment of the drive components. If necessary, align each drive to its respective drum.

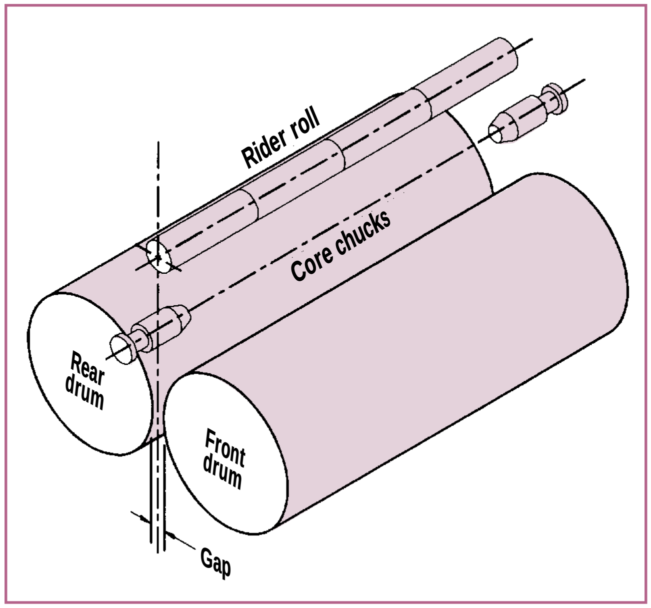
Rider roll

Two aspects of rider roll design offer additional alignment challenges:

- Rider rolls are typically sectional rolls. As discussed above, adjustments can affect the alignment of adjacent sections.
- The rider roll moves up on the ways as the set forms. Worn or damaged mechanical components can greatly influence rider roll alignment as the roll travels along the ways.



9. Plane perpendicular to angled ways



10. Centerline coincidence

Each section of the rider roll requires inspection as discussed earlier for sectional rolls. One examines the total alignment of the rider roll at the bottom, mid-point, and top of its operating range, however, to determine if 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, one should inspect the ways for plumb.

After making any necessary hardware changes, one should align the roll for both attributes. It is important when performing these adjustments that the rider roll centerline and drum gap centerline remain coincident as Fig. 10 shows.

Core chucks

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

Tolerances

One must apply the manufacturer's recommended tolerances when aligning winder components. If the manufacturer's tolerances are not available or seem too large for the desired machine speed, follow the tolerances in Table I. 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 adjustments to maintain the optimum operating conditions. "Tune-ups" should occur after approximately six months of operation. After replacement or repair of major components, one should verify the alignment. These inspections can occur during regularly scheduled outages.

SUMMARY

Optical alignment of winder components has resulted in large speed increases, significant waste reduction, and fewer roll defects. Employing the alignment methods discussed here and adopting an alignment maintenance program will help ensure that the winder operates to its fullest potential. TJ

Dunn is training coordinator, Allen is project estimator, Carter is technical writer, Pepin is optical engineer, and Leonard is technical writer at Oasis, Inc., P.O. Box 1805, Rochester, NH 03867.

Presented at the TAPPI 1995 Finishing and Converting Conference.