

Thinner/Wider/Faster Challenges in Web Handling

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Abstract

Today's productivity demands for the web manufacturing and converting industries is to consistently produce and convert thinner and wider web materials at ever increasing production speeds. The challenge of conveying these thinner webs at lighter tensions and higher speeds requires special attention to the web handling components on the process line. This presentation outlines these web handling components including the requirements of proper idler roll design, good web spreading and proper web guiding to insure consistent production of defect free web materials.

Introduction - Web Conveyance

Thinner webs produced at higher speeds pose special challenges in order to delicately handle a wide variety of web substrates through a process without distortion or defects such as scratches and wrinkles. Thinner (lighter gauge) and more delicate web materials need to be processed at lighter tensions. The ability to control these light tensions requires that the web handling idlers rolls do not significantly produce additional web tension from bearing friction and inertia. Thin webs are more prone to wrinkling and the alignment of the web conveyance rolls is much more critical. As a web is conveyed through a process, a layer of air follows the web. When handling non-porous webs such as films at light web tensions, this air film layer can cause the loss of traction between the web and idler rolls. Positive traction between the web and the web support rollers is very important to ensure that the idler rolls turn at the web speed so the web does not weave through the process and also to insure that the slower turning roll does not scratch the web's surface. Web spreading after long web leads and before nips and before other critical components such as coaters and laminators is an important component for proper web handling. Positive traction between the web and the spreader roll is critical to insure a positive spreading action of the web. Positive web traction is also very important to assure proper web guiding off the unwinding operation and through critical web position processes.

Web Support Rolls

Proper web handling requires supporting and conveying the web through the process without distortion or wrinkles. This requires that the web support idler rolls be the correct roller material, the right diameter, have proper bearings and the proper surface for the application. Then the optimized roller spacing and alignment need to be obtained to assure successful conveyance of the web. (4)

Roll Material - The most common shell material for rolls used to transport film, aluminum foil, light weight paper and extensible non-woven substrates is aluminum. This aluminum shell is normally anodized to give it a harder surface. Paper and paperboard usually require steel shell material that is normally has a chrome plated surface. The higher modulus of elasticity of steel produces less roller deflection for running higher web tensions and higher nip loadings. Steel being much harder than aluminum is more durable and less prone to be damaged in normal use and cleaning. However, a steel roll is considerably heavier than the aluminum roll with a greater inertia (WK^2) resulting in more tension required to accelerate and keep the roll turning.

The preferred idler roll material for conveying wide, thin webs at high speeds is carbon fiber composite shells. The carbon fiber material weighs less than aluminum and can be wound with the same stiffness as steel. Carbon fiber rolls have less inertia and greater critical speed for wider and higher speed applications. The drawbacks for carbon fiber material is that they are more expensive and is less durable than steel and aluminum shell materials. However, costs of carbon fiber roll shell materials has lowered considerably over the past few years. Also high abrasion resistant coating can now be applied which give these rolls excellent durability and traction characteristics.

Roll Diameter - The proper diameter of the web conveyance idler rolls is important to insure stable web conveyance. Idler rolls that are too large in diameter have high inertia and rolls that are too small in diameter will have deflection and critical speed problems. Stiffer web materials need to consider the bending radius on highly wrapped idler rolls.

Roll Bearings – Idler rolls may be either Live Shafted or Dead Shafted design. See Figure #1. Generally, the dead shafted design are less expensive and have lower inertia however the roll deflection and bearing size & lubrication restrictions make the live shafted idler roll design preferable for handling wider, lighter gauge webs at higher speeds. The important design considerations is that the bearings be very free turning with oil lubrication and low friction seals and to keep the bearing diameter small to minimize to bearing friction's effect on web tension.

Idler Roll Designs

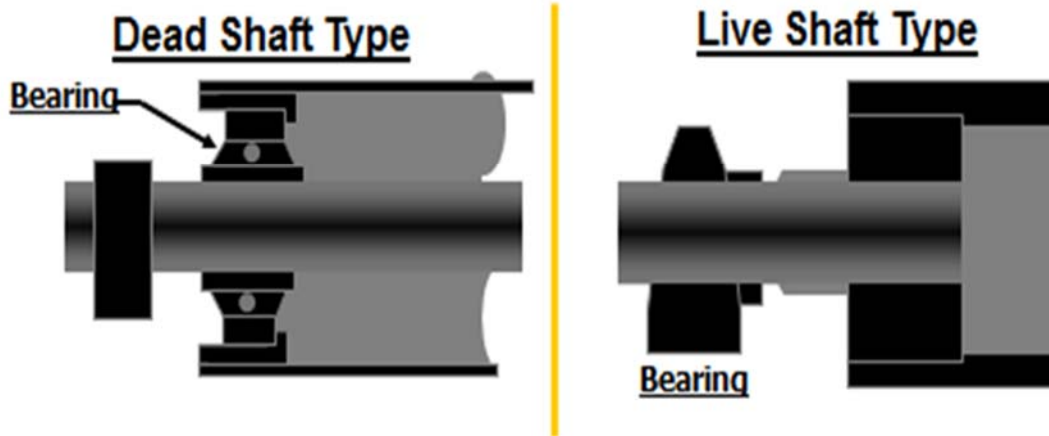


Figure #1

Roll's Surface - As stated earlier, positive traction between the web and the web support rollers is very important to ensure that the idler rolls turn at the web speed so the web does not weave through the process and/or cause scratches. As a web is conveyed through a process, a layer of air follows the web. See Figure #2. When handling non-porous webs such as films at high speeds and light web tensions, this air film layer can cause the loss of traction between the web and idler rolls. To prevent this, the idler roll's surface must be rough enough or have VentAir grooving to ensure that traction is maintained. The common belief that rough rolls will cause web scratching is not true. Smooth surface rolls lose traction with the web before rough surface rolls. The slower turning roll can cause web scratches. A rougher surface where traction is maintained does not scratch the web's surface.

AIR GREASING

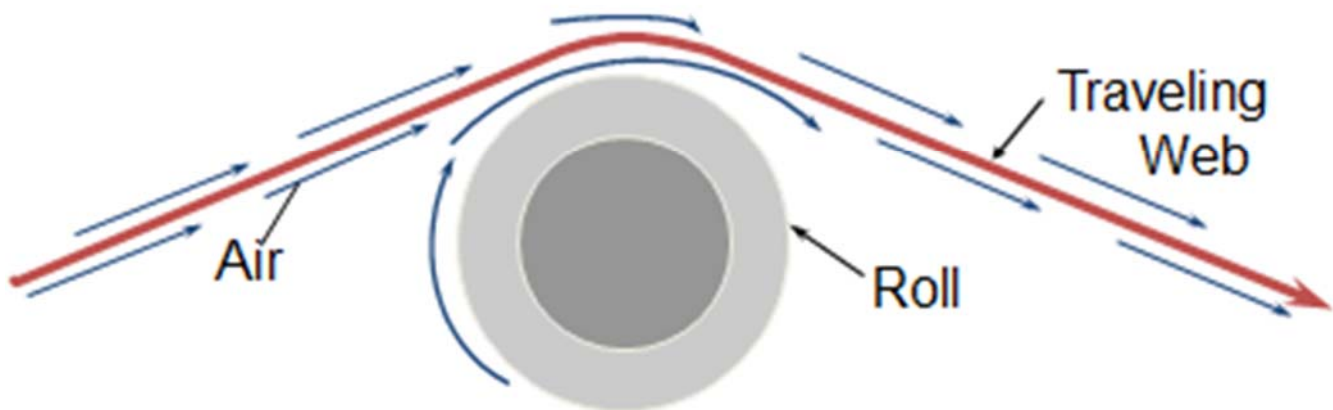


Figure #2

Roll Spacing – Too many web support idler rolls adds greater uncontrolled web tension. However, too few support rolls can also be a web handling problem. Long web spans when conveying thinner (lighter gauge) webs are prone to web flutter and wrinkling problems. To minimize web flutter and the bagginess, the spacing of idler rolls needs to be optimized. Optimized roll spacing is an Art more than a Science and is based on substrates, web width, thickness, speed and experience. A good *rule of thumb* for a converting line handling paper and films is the roll spacing should be two-thirds of the maximum web width. If the line handles light gauge non-extensible films and foils, then the spacing may need to be closer to half the maximum web width. For heavier paper and paperboard, roll spacing greater than two-thirds could be permissible. Generally, vertical web leads can tolerate a longer span than horizontal leads. For web widths over 100" (2.5 m), this *rule of thumb* is generally no longer valid and empirical experience needs to be used to optimize the number of idler rolls.

Proper web handling requires that prior to a component such as a pull roll, coater, laminator, treater, slit, etc., the support roll should be located as close as possible to insure a good flat web into the section.

In some processes it may be desirable to have a longer span between rolls. Longer web spans can be tolerated if a spreader roll is used after the long lead.

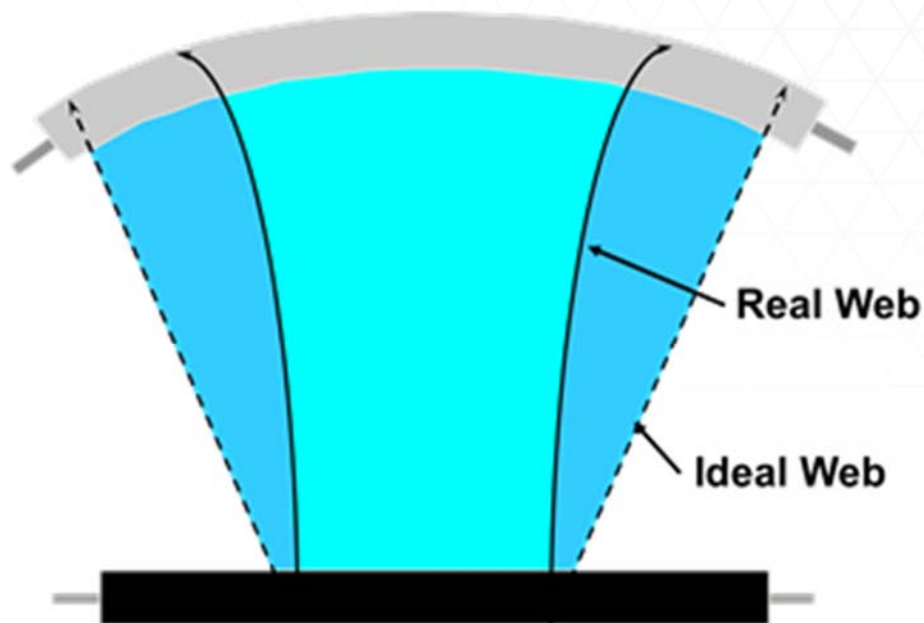
Roll Alignment - Proper Alignment of idler rolls is the key for successful web handling. Misaligned web support rolls will try to steer the web and is a major cause of the costliest defect in the web industry – Wrinkles! The amount of misalignment allowable depends on the web width, web wrap on the roll, web tension and the thickness and elasticity of the material. The thinner (lower gauge) and stiffer (higher modulus) a material is, the more critical the alignment of web support rolls needs to be.

A *rule of thumb* for the permissible misalignment of web handling rolls is that they should be level and tram within 0.001" per each 10" (0.1mm / meter) of roll face length. In general, greater misalignment can be tolerated for slightly wrapped rolls and for rolls on lines handling extensible materials. However, for lines that handle thin, non-extensible materials such as light gauge polyester, BOPP and light gauge foils, then web support roll needs to be aligned well within this tolerance to prevent possible wrinkling of these materials. Please refer to the Tech Tip on *Wrinkles* available through Davis-Standard for problem solving techniques for lines which tend to have wrinkling problem.

Web Spreading

Proper web spreading in critical areas on a machine line is where the best "bang for bucks" can be obtained. As stated above – wrinkles are the #1 costliest defect in web production and converting. By using the proper type and properly adjusted web spreader in area prone to generating wrinkles, many web handling problems are eliminated. Spreading devices should be used before all nips, before critical processes such as coating and laminating and just before winding. As stated above, web spreading needs to be used just after long web leads. Listed below are the common types of web spreaders used on web forming and converting lines from the most passive to most powerful spreader rolls.(5)

- Reverse Crown Spreader Roll
- FlexSpreader Roll
- Herringbone Grooved Roll (aluminum foil)
- Bowed Spreader Roll
- Expanding Surface Spreader Roll



Bowed Spreader Roll Spreading Action

Figure #3

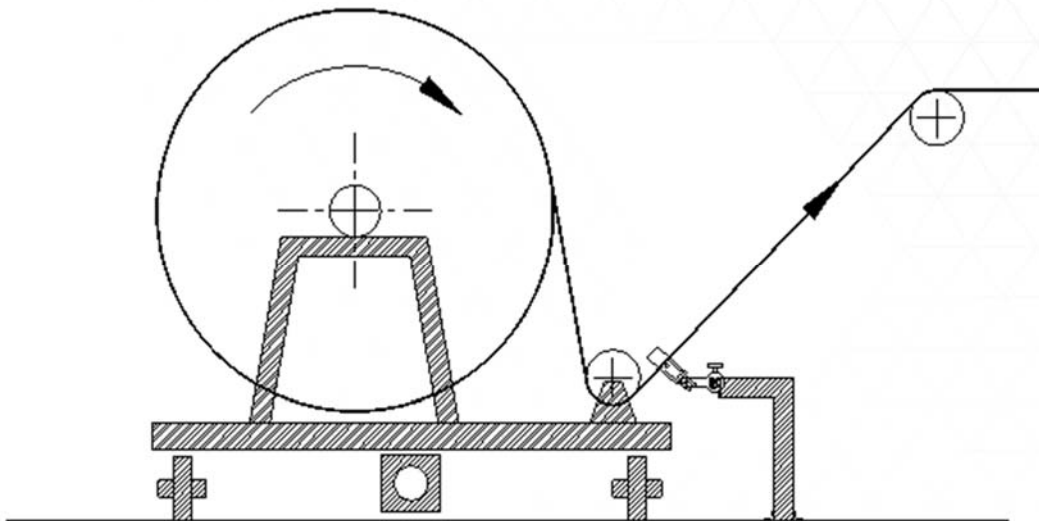
As stated in the web conveyance section, for the spreading action to be effective, there must be positive traction between the spreader roll and the web as “you can’t spread what you can’t grip”! See figure #3. For a complete description of each of these types of spreaders and their proper application and adjustment, please refer to the Tech Tip on *How to Get the Most from Your Web Spreader* available through Davis-Standard.

Edge Guiding

Proper edge guiding is needed on almost every web processing line. Edge guiding systems are necessary to compensate for dished and/or telescoping rolls of material being unwound into the process. Intermediate edge guiding is needed to guide a web into edge critical processes such as coating, printing and laminating. Edge guides can help correct for web handling problems such as uneven cross machine web tension, roll misalignment or loss of traction on idler rolls that tend to steer a web off the machine centerline. Edge guides are also needed to guide webs out of sections with long web leads such as out of floatation dryers. Web guides are often used to insure winding of straight sided rolls when not slitting

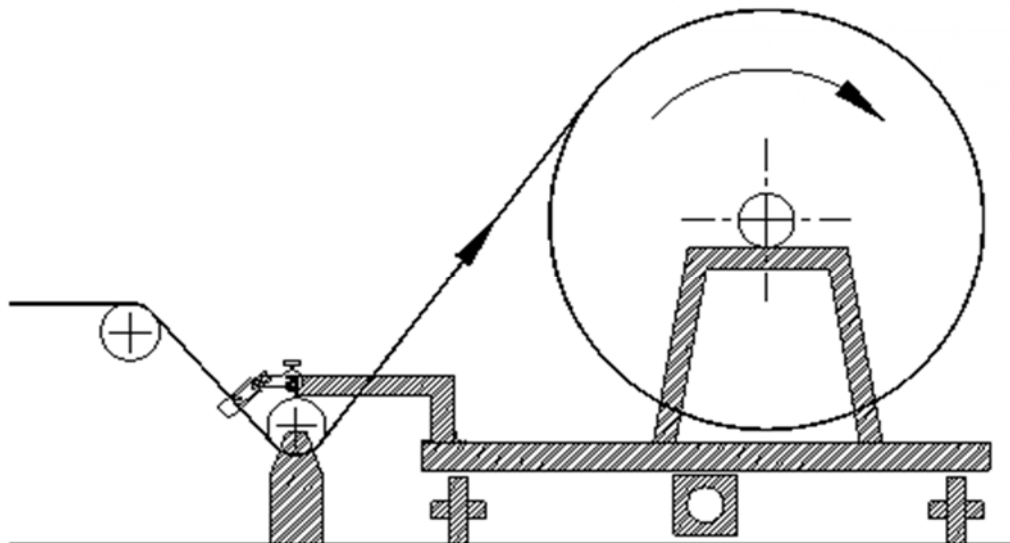
and/or to provide web oscillation to help randomize web profile defects on slitting and winding operations. (5)

Unwinds and winders can be mounted on sidelay bases. For unwinding roll edge guiding, the edge guide moves the unwind to a fixed sensor location on the floor. See Figure #4. For winding the edge guide moves the winder to guide it to the location of the incoming web with the sensor mounted to the winder. See figure #5.



Unwind Edge Guide Sensor Location

Figure #4



Winder Edge Guide Sensor Location

Figure #5

Intermediate edge guiding can be accomplished by a two roll displacement guide commonly known as an Offset Pivot Guide, or OPG. See figure #6.



Figure #6 - Offset Pivot Guide (OPG)

After long web leads such as out of a floatation dryer, a 90 degree steering guide is normally used. See figure #7. This type of guide requires a long entering span, which a floatation dryer application provides. A 90 degree steering guide fits well for processes where only one side of the web can be contacted.



Figure #7 - 90 Degree Steering Guide

The keys to success of web guiding are:

- Be sure that the guiding system is located as close as possible to the point in the process that proceeds where accurate web positioning is required.
- The guiding system needs to be designed to accommodate the maximum lateral web displacement required.
- On OPG and 90-degree steering guides, the lead-in web length needs to be as long as possible because the steering action takes place upstream to the first shifting roller.
- On all web guides the sensor needs to be the proper type for the web that is being guided and located as close to the shifting roll as possible.
- The shifting idler just before the sensor needs to have a tractionized surface for steering without slippage!

In Conclusion

Today's productivity challenges require web producers and converters handle webs that are increasing thinner in gauge and wider in width at ever increasing production speeds. The conveying these more delicate webs at higher speeds without distortion and/or defects such as wrinkles and scratches requires special attention to the web handling components on web processing lines. Web Handling defects such as wrinkles, web distortion and scratches have become so prevalent that two chapters in the TAPPI Press bestselling book, *The Ultimate Roll and Web Defect Troubleshooting Guide* have been dedicated to these subjects. (6) This paper outlined the web handling requirements for proper web tension and control, proper web support rolls, good web spreading and proper web guiding. I hope that the information presented will be helpful in the consistent production of defect free web materials off your web processing operation..

References

1. Roisum, D.R., *The Mechanics of Web Handling*, TAPPI PRESS, Atlanta, 1994, page 50.
2. Smith, R. Duane, *Guidelines for Web Conveyance and Winding Tensions for Polymer Films, Papers and Paperboard Webs*, AIMCAL Converting Quarterly, 2011 Quarter 3, pages 58-62.
3. Smith, R. Duane, "*The Challenges of Winding Flexible Packaging Film*", Society of Plastic Engineer's ANTEC Conference, Moscone Convention Center, San Francisco, CA, May 2002
4. Smith, R. Duane, *Guidelines for Selecting Proper Idler Rolls for Web Handling*, AIMCAL Converting Quarterly, 2012 Quarter 2, pages 44-48.
5. Smith, R. Duane, *Guidelines for Rolls for Web Handling*, AIMCAL Converting Quarterly, 2012 Quarter 3, pages 59-63.
6. Smith, R. Duane (Editor), *The Ultimate Roll and Web Defect Troubleshooting Guide*, TAPPI PRESS, Atlanta, 2013.



Today's Thinner/Wider/Faster Challenges in Web Handling

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Thinner/Wider/Faster Web Handling Challenges

All web processes require conveying a web straight through a process without distortion, scratching or wrinkle defects.

Today's productivity demands for the web manufacturing and converting industries is to consistently produce and convert thinner and wider web materials at ever increasing production speeds.

Thinner/Wider/Faster Web Handling Challenges

The challenge of conveying these thinner webs at higher speeds requires special attention to the web handling components on the process line.

This presentation outlines these web handling components including the requirements of proper web tension and control, proper web support rolls, good web spreading and proper web guiding to ensure consistent production of defect free web materials.

Web Conveyance

As a web is conveyed through a process, a layer of air follows the web.

When handling non-porous webs such as films at light web tensions, this air film layer can cause the loss of traction between the web and idler rolls.

Positive traction between the web and the web support rollers is very important to ensure that:

- The web does not weave through the process**
- Idler rolls turn at the web's speed to prevent slower turning rolls from scratching the web's surface.**

Web Conveyance- Spreading and Guiding

Web spreading after long web leads and before nips and other critical components such as coaters and laminators is an important component for proper web handling.

Positive traction between the web and the spreader roll is critical to ensure a positive spreading action of the web.

Positive web traction is also very important to ensure proper web guiding off the unwinding operation and through critical web position processes.

Web Conveyance

Thinner (lighter gauge) and more delicate web materials need to be processed at lighter tensions. The ability to control these light tensions requires that the web handling components do not significantly produce uncontrollable web tension due to the component's bearing friction and inertia.

Proper Web Handling Tension

The “**Cardinal Rule**” for proper web handling-

- The unwind's web tension needs to be isolated from
- The process's web tension(s) which needs to be isolated from
- The winding web tension.

As a general rule, web conveyance tension should be as low as possible. Only use sufficient tension to convey a web straight through a process without wrinkles and to ensure that there is no web slippage on the idler rolls.

Web Tension- How Much ???

Since no web is perfectly flat, we need to use sufficient tension to convey imperfect webs straight through a process without wrinkles.

“Rule of Thumb”

10 - 25% of Machine Direction Elastic Limit of Web Material

Sufficient tension must also be used to overcome the inertia and bearing friction of idler rolls to insure proper web tracking and that the idlers turn at the web's speed to prevent scratching defects.

Definition of Web Tension

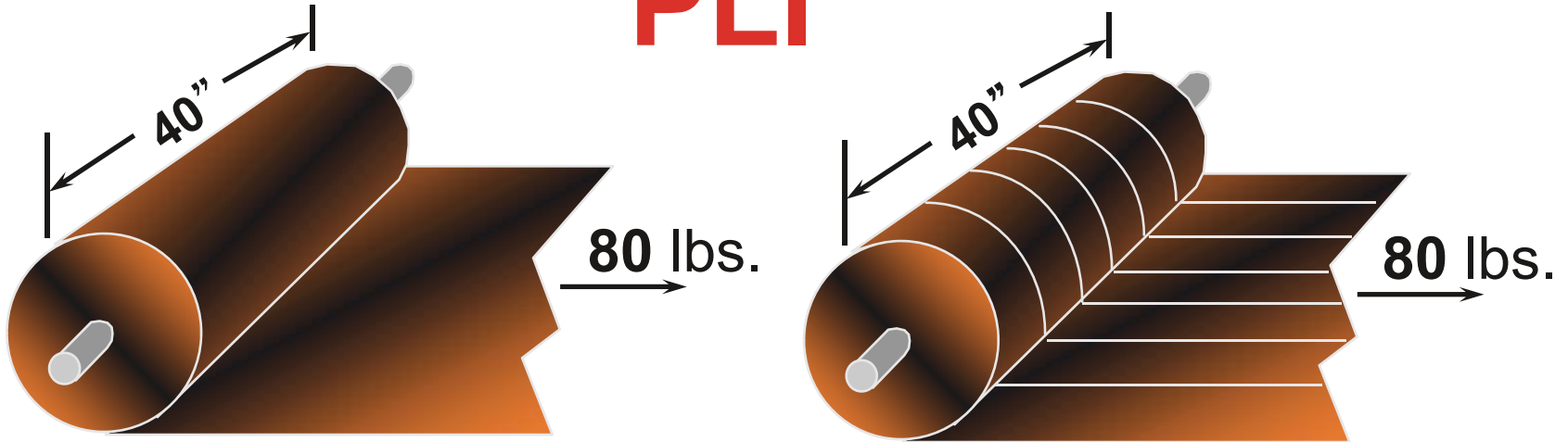
**Web Tension = Strain (stretch) put into the web
Function of Width, Thickness & Material's Modulus**

**Strain = Stress (psi) /Modulus of Elasticity (E)
= Web Tension/Area/Modulus
= Web Tension/(Width x Thickness)/Modulus**

English Web Tension Terms

Unit tension: pounds / linear inch

PLI



Per 1 inch width $\frac{80\#}{40"} = 2$ pounds per linear inch (PLI)

Metric tension conversion: 1 PLI = 0.571 newtons/cm

TYPICAL TENSION VALUES- Paper, Films & Foil

Material

TENSION LEVELS

- **Paper** 0.35 TO 0.55 lbs./inch/mil (25 to 38 N/cm/mm)
- **Polyester** 0.5 TO 1.5 lbs./inch/mil (35 to 105 N/cm/mm)
- **Polypropylene** 0.2 TO 0.5 lbs./inch/mil (14 to 35 N/cm/mm)
- **BOPP** 0.3 TO 1.0 lbs./inch/mil (21 to 70 N/cm/mm)
- **Polyethylene** 0.1 TO 0.25 lbs./inch/mil (7 to 18 N/cm/mm)
- **Polystyrene** 0.5 TO 1.0 lbs./inch/mil (35 to 70 N/cm/mm)
- **Vinyl (*uncalendered*)** 0.05 TO 0.2 lbs./inch/mil (3.5 to 14 N/cm/mm)
- **Cellophane** 0.5 TO 1.0 lbs./inch/mil (35 to 70 N/cm/mm)
- **Nylon** 0.1 TO .3 lbs./inch/mil (7 to 21 N/cm/mm)
- **Aluminum Foils** 0.5 TO 1.5 lbs./inch/mil (35 to 105 N/cm/mm)

*** 1 lbs./inch/mil = 7.03 kg./cm/mm- N/cm/mm x 0.102 = kg/cm/mm

Example to calculate Maximum Suggested Tension

<u>Films</u>	<u>Tension Levels</u>
• Polyester	0.5 to 1.5 lbs./inch/mil
• Polypropylene	0.2 to 0.5 lbs./inch/mil
• BOPP	0.3 to 1.0 lbs./inch/mil
• Polyethylene	0.1 to <u>0.3 lbs./inch/mil</u>

Example

Suggested maximum web tension for a 60" wide and 2 mil (0.002") thick Polyethylene (PE) material would be:

$$\begin{aligned} &\underline{0.3 \text{ lbs./inch/mil}} \times 60'' \text{ width} \times .002'' \text{ thickness} \\ &= 36 \text{ pounds total web tension} \end{aligned}$$

Metric & English Values in Tech Tip



Guidelines for Web Conveyance and Winding Tensions for Polymer Films, Papers and Paperboard Webs

Web handling can be a real challenge! We need to convey a web flat and straight through the process without generating defects such as wrinkles. To do this, we need to convey this web under a certain amount of web tension. The question then becomes, "How much web tension do I need to ensure success in producing a defect-free web product that will run problem-free on our customer's process and meet the expectations of their Customer for the web material?" The answer to the web conveyance question, "How much web tension should I use?" : AS LITTLE AS POSSIBLE!

In a perfect world, we would not need to use web tension. We would simply float the sheet straight through the process without wrinkling or bagginess defects. Unfortunately, webs are not perfect and rollers are not perfect. Therefore, we do need to use web tension to successfully convey webs through a production line. This Tech Tip will address the suggested maximum web tension. Just remember, in almost all cases, when it comes to web tension – MORE is usually NOT BETTER!

Since no web is perfectly flat, we need to convey imperfect webs. The suggested amount of web tension is typically between 10 and 25 percent of the web material's tensile strength or elastic limit when dealing with stretchy materials. For example, if it takes 100 newtons (23 lbs.) of tension to stretch a 2.5 cm (1 inch) web to the point it will break or permanently deform, then the suggested amount of web tension to convey this web would be 10 percent of this number or $10N/2.5cm = 4 \text{ newtons/cm}$ (2.3 pli) of tension with a maximum tension of 10 newtons/cm (5.7 pli) = 25 percent of the elastic limit.

Plastic and paper technical organizations such as SPE and TAPPI have done studies and gathered a great deal of empirical data on the suggested amount of tension. They suggest that the MAXIMUM web tension for plastic films is below the level that the film is stressed to 1.5 percent of the modulus of elasticity of the film material.

Typical Tension Values –Films and Foil

Product	Tension Range (Metric)	Tension Range (English)
Polyester	35 to 105 N/cm/mm	0.5 to 1.5 lbs/inch/mil
Polypropylene	14 to 35 N/cm/mm	0.2 to 0.5 lbs/inch/mil
BOPP	21 to 70 N/cm/mm	0.3 to 1.0 lbs/inch/mil
Polyethylene	7 to 21 N/cm/mm	0.1 to 0.3 lbs/inch/mil
Polystyrene	35 to 70 N/cm/mm	0.5 to 1.0 lbs/inch/mil
Vinyl (uncalendared)	3.5 to 14 N/cm/mm	0.05 to 0.2 lbs/inch/mil
Nylon	7 to 21 N/cm/mm	0.1 to 0.3 lbs/inch/mil
Cellophane	35 to 70 N/cm/mm	0.5 to 1.0 lbs/inch/mil
Aluminum Foils	35 to 105 N/cm/mm	0.5 to 1.5 lbs/inch/mil
Conversion: $\text{kg/cm/mm} = \text{Newton/cm/mm} \times 0.1$		

Suggested Maximum Tensions for Papers

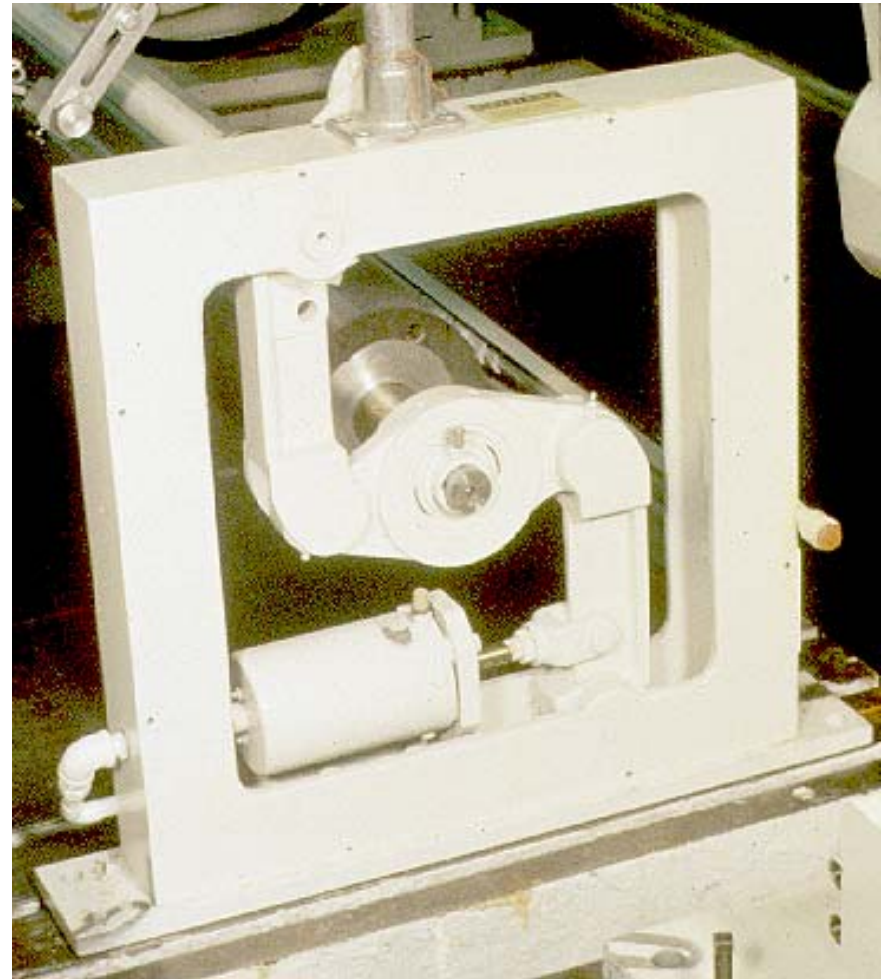
25 gsm (15#/3000 ft ²)	.88 N/cm (0.5 pli)
33 gsm (20#/3000 ft ²)	1.31 N/cm (0.75 pli)
50 gsm (30#/3000 ft ²)	1.75 N/cm (1.0 pli)
65 gsm (40#/3000 ft ²)	2.6 N/cm (1.5 pli)
100 gsm (60#/3000 ft ²)	3.5 N/cm (2.0 pli)
135 gsm (80#/3000 ft ²)	4.4 N/cm (2.5 pli)
Conversions: $\text{kg/cm} = \text{Newton/cm} \times 0.1$	

Tension Control

- Highly-extensible webs draw control with transducer operator feedback
- Normal webs
 - Unwinds - dancer control
 - Processes - transducer control
 - Winders - transducer control unless roll changer has significant web length changes, then must use dancer
- Dancer system must be properly designed

Z-Bar Dancer

- Center position control system
- Low friction, pneumatic actuated/loading
- Roll's weight taken through pivots
- Hysteresis free
- Inertia compensated
- Best for unwinds for soft tension control



Transducer Load Cells

Best for winder tension control

- + Most responsive for drive trimming
- + Direct readout of tension
- + Good for high-speed operation
- + Precision roll balance for best accuracy

Calibration needs to be checked on a regular basis!



***What are the challenges of
web handling roller design?***

Web Handling Rolls: Design Considerations

- Having the right roller **Material**
- Having the right roller **Diameter**
- Having the right roller **Bearings**
- Having the right roller **Spacing**
- The challenges of air **Greasing**
- Web handling roller **Alignment**



Roll Materials –

Chrome Plated Steel-
*Normally Used with
Paper & Paperboard*

Anodized Aluminum-
*Used for Films, Light
Paper & Aluminum
Foil*

**The cost of Steel and
Aluminum are about
equal**

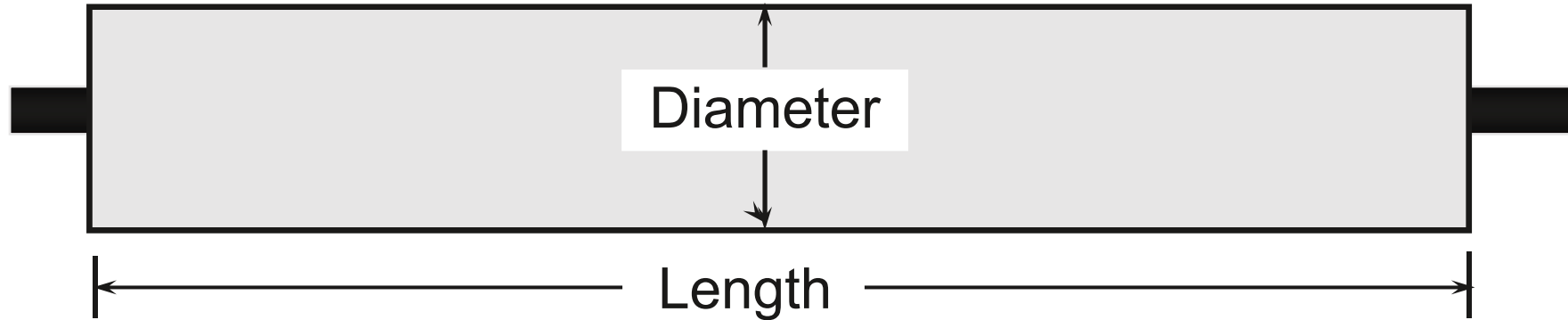
**Trends for thinner
materials and higher
speeds require –**

**Carbon Fiber Composite
Rolls which are-**

- + *Less weight & inertia***
- + *Higher Critical Speeds***
- *Less Durable than Metal***
- *Carbon Fiber Rolls are
More Expensive***

**However Costs are
Coming Down**

Idler Roll Diameter-



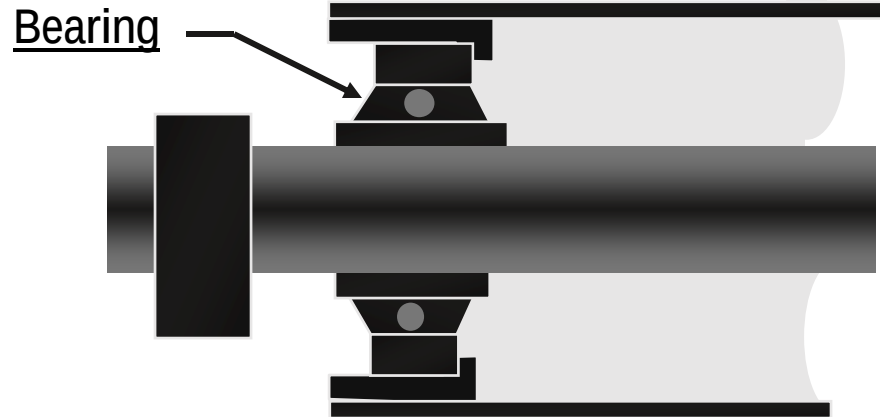
Roll Diameter

- Generally $\frac{\text{LENGTH}}{\text{DIAMETER}} = 16$ or Less, i.e. 64" = 4" dia or 1.6m = 100mm
- Paperboard or Stiff Material, Consider Bend Radius
- Unloaded Roll Deflection, ***Rule of Thumb:***
Generally, 0.015" per each 100" of face
0.15mm per each 1 Meter of Roll Face

Idler Roll Bearings-

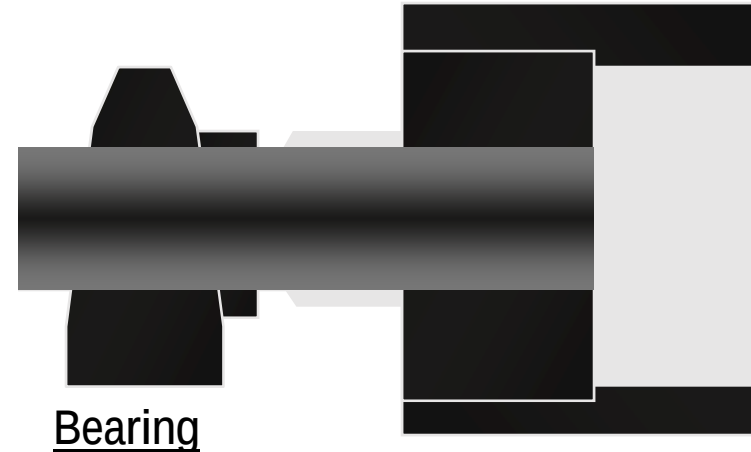
Low friction seals & Keep bearing size to minimum.

Dead Shaft Type



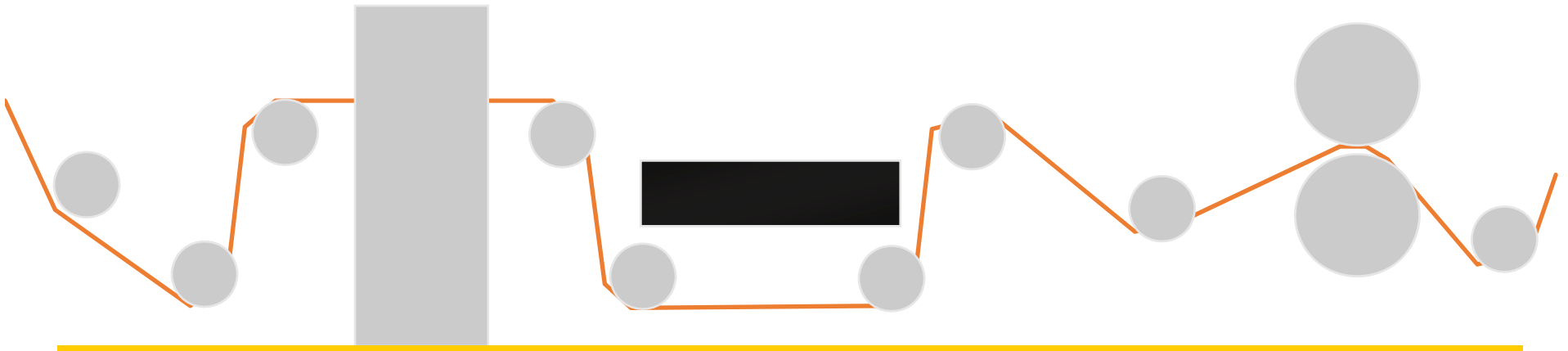
- + Usually Less Expensive
- + Lower Inertia
- Greater Deflection (Not for Wide, High Tension Applications)
- No Bearing Re-Lubrication
- Difficult Bearing Replacement
- Requires Larger Diameter bearings (journal sag w/ small dia. bearings)

Live Shaft Type



- + Less Deflection due to Head Stiffness and Larger Journals
- + Bearings Out in the Open
- + Bearing Size Not Limited
- + Bearings Easily Lubricated
- More Expensive
- Greater Inertia

Idler Roll Spacing-



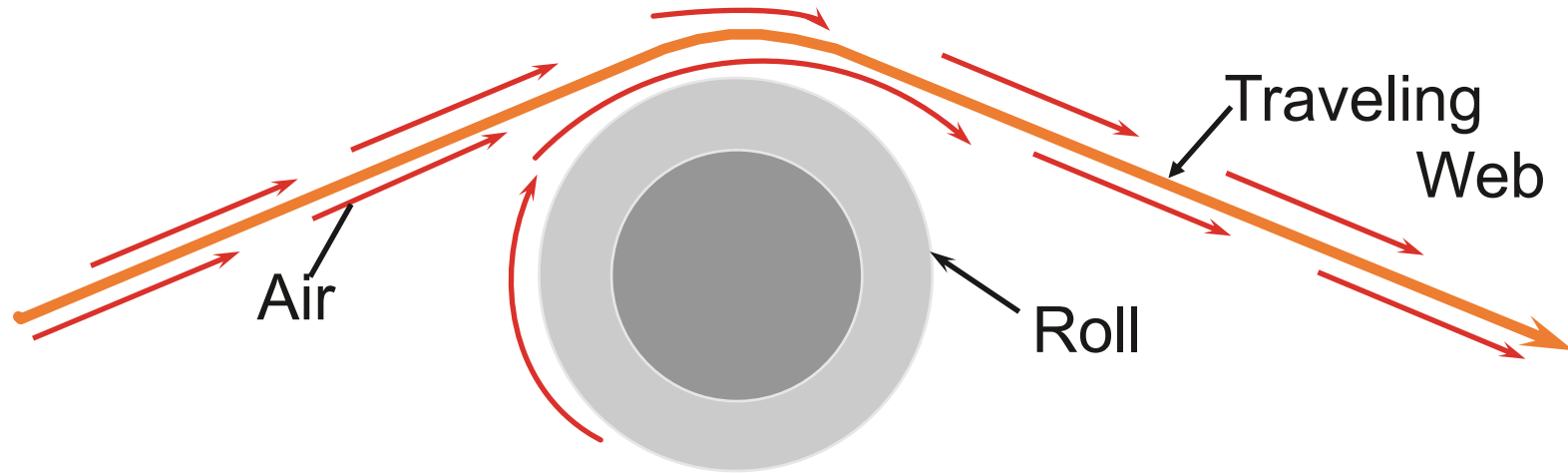
“Rule of Thumb”-

- ***2/3 Max. Web Width***
- ***Thin Aluminum Foils, use 24” (.6 meter) max.***
 - **Longer spans if a spreader roll is used after the longer span.**
- **Roll Spacing is Speed / Tension Influenced**
- **Web Flutter - Shorten distance between rolls**

The challenges of **Air Greasing**

Air Greasing = loss of traction

Tracking and Web Scratching Problems



- Air entrainment principles
 - Surfaces of roll and web do not affect air layer
 - Larger roll diameters entrap more air
 - Smoother rolls will lose traction easier and scratch web
- Possible solutions
 - Rougher roll surface
 - VentAir groove roll surface

Web Handling Roller Alignment

Rule of Thumb:

- Rollers should be level and tram within
0.010 inch/100 inches (0.001 inch/foot)
- Greater allowable misalignment for extensible materials (stretchy films)
- Less allowable misalignment for non-extensible materials (aluminum foil)

Other Web Handling Roller Considerations

- **Roundness (TIR)**
- **Roller straightness**
- **Dynamic balance**

Reference Book: ***The Mechanics Of Rollers***
by Dr. David Roisum, TAPPI Press

The Most Costly Defect in Web Handling is Wrinkling


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Wrinkles

Wrinkling is the number one cause of defect waste in the web industry. This subject is so important that a complete chapter has been written on wrinkles by Dr. David Roisum in the new TAPPI book - *Roll and Web Defect Terminology*. [Please go to this link for more information on this book.](#)

Wrinkles can be soft (non-creased) or hard where they actually fold over and form creases. They are man, material and/or machine induced. Most wrinkles are a combination of these elements.

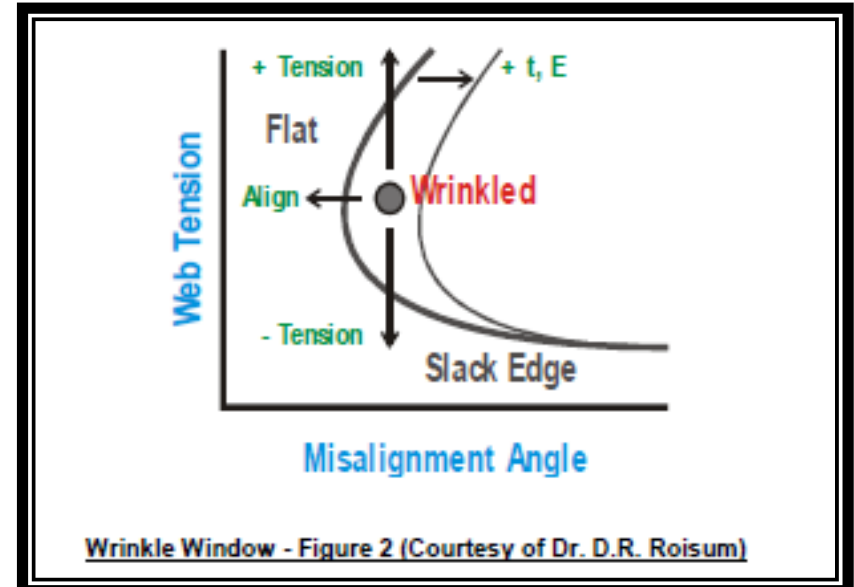
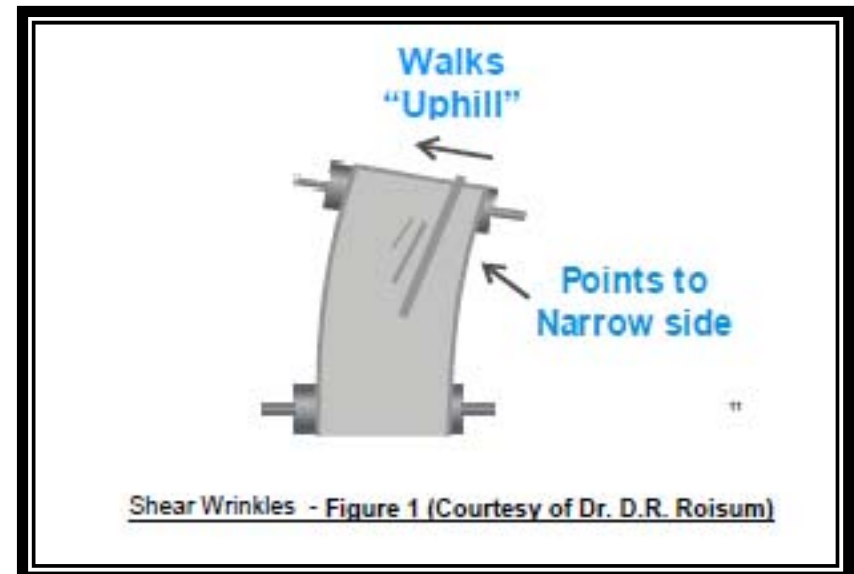
Wrinkles caused by man (improper settings) can usually be attributed to improper web tension and/or winding settings. Wrinkles can form in the web in the process line by running tension settings (man) that are too low or too high in combination with material and machine deficiencies. Roll wrinkle defects, such as baggy lanes, buckles, corrugation wrinkles and crepe wrinkles, are caused by improper roll structure settings (improper use of the Tension, Nip, and/or Torque roll structure tools) or the winding of non-uniform webs too tightly into a roll form.

Wrinkles caused by material are due to non-uniform formation, conditioning, coating, drying and/or laminating in the web's process history. The root cause of many wrinkles is the non-uniformity in the cross machine direction surface of the web. Since no web is perfectly flat or uniform across its surface, our challenge as web processors is to handle webs with acceptable variations in consistency and to produce wrinkle-free products to our customers that will run on their processes without problems.

Wrinkles caused by machine deficiencies are the focus of this Tech Tip. Many times material deficiencies, which produce soft wrinkles, can be turned into hard or creased wrinkles when the web goes over a highly wrapped idler roll or through a nipped section.

If these wrinkles are straight in the machine direction (M.D. wrinkles), then either the web material is trying to expand and the machine won't let it, or M.D. wrinkles are caused by excessive roller deflection or grooving. When these M.D. wrinkles show up in the wound roll, this defect is often referred to as "Tin Canning." Adding proper web spreading in the proper location, or ensuring that the spreaders already provided are in

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Thinner webs are dramatically more prone to Wrinkling

Proven at the Web Handling Research Center at OSU:

“The resistance for a web to buckle (wrinkle) is a function of the cube of its thickness.”

Therefore,

- a... 1 mil (25 micron) thick web is 8 times more prone to wrinkling than a 2 mil (50 micron) thick web with the same physical properties.
- an... 80 gauge film (20 micron) thick web is 2 times (twice as) prone to wrinkling than a 1 mil (25 micron) thick web with the same physical properties.

Spreader Rollers to minimize wrinkling

General web handling *Rule of Thumb*-

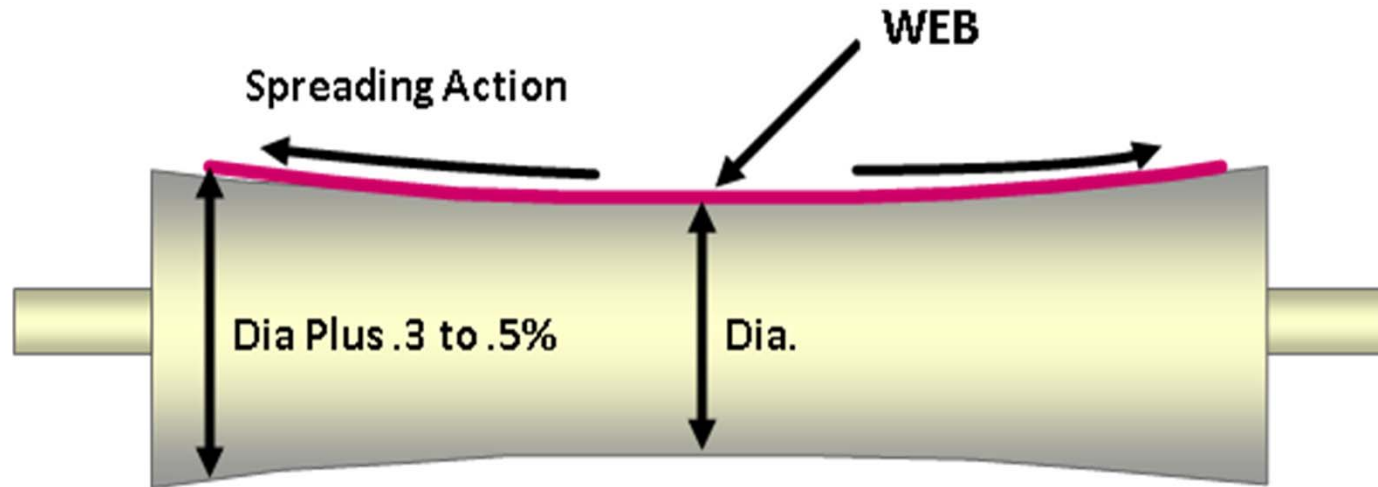
Web Spreading Rollers needs to be provided after long web leads, before nips and critical processes such as coaters.

Common Types of Spreader Rollers

Listed from least to most powerful spreading action

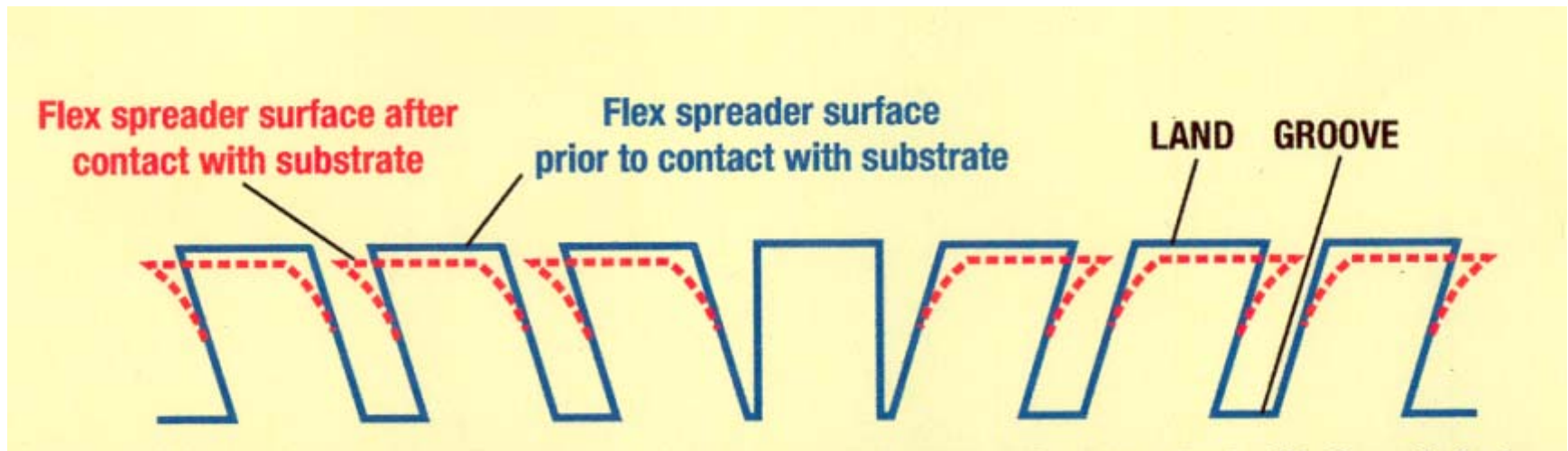
- Reverse crown rollers
- Flex Spreader rollers
- Herringbone grooving (aluminum foil)
- Single bowed spreader roll
- Expanding surface spreader roll

Reverse Crown Spreaders



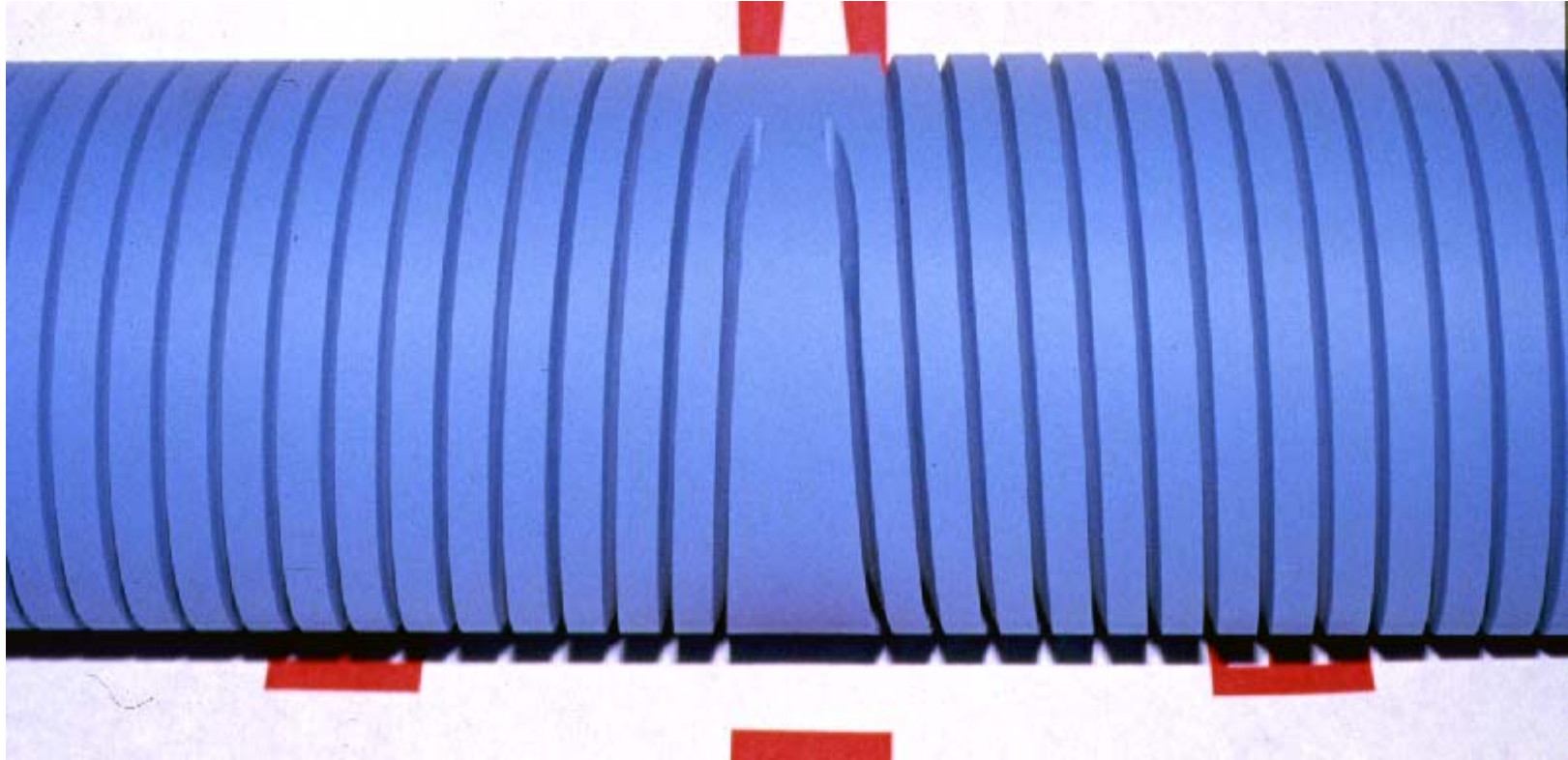
- Roll that has a diameter at ends slightly larger than in center
- Surface speed is greater at ends than center
- Surface speed difference causes an upstream web tension distribution that is shaped similar to the speed profile
- Roll's spreading action is a function of its crown and roll deflection
- Most effective on extensible materials

Flex Spreader Roll



- Roller that has a spiral grooving cut into a soft rubber covering
- Grooving starts at center and is cut at an angle so that web tension deflects the lands outwards, carrying the web with them to provide spreading action
- Amount of spreading is function of rubber cover hardness and web tension

Flex Spreader Design



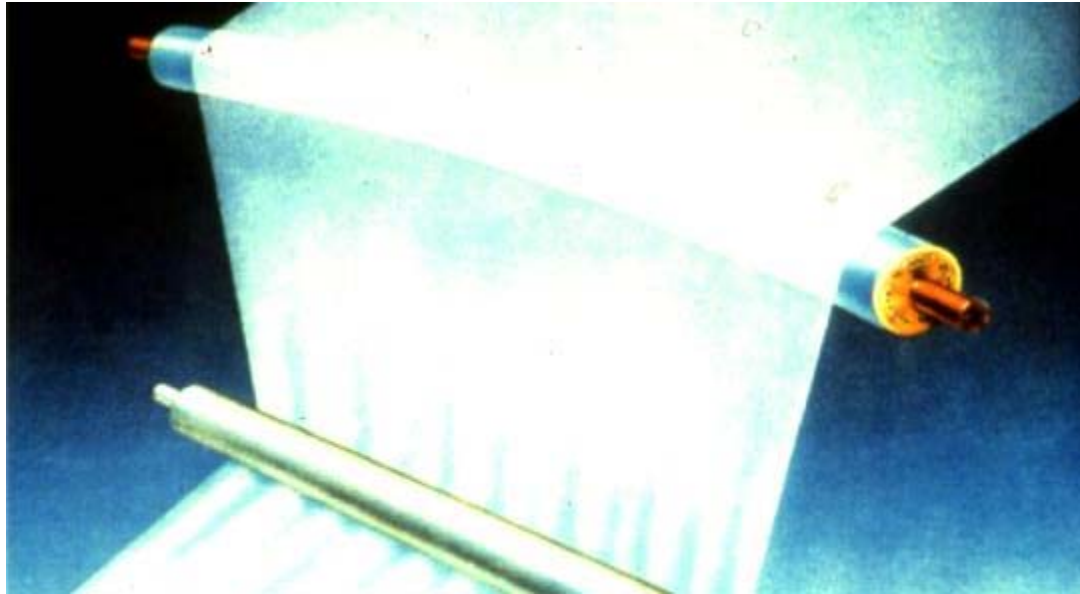
- Spiral points in web direction
- Most effective on non-extensible materials

Aluminum Foil Spreading Herringbone Rolls

- Outward groove machined into shell
- Roll is directional
- Works well on foil web paths
- Keep to less than 90 degrees wrap for foil

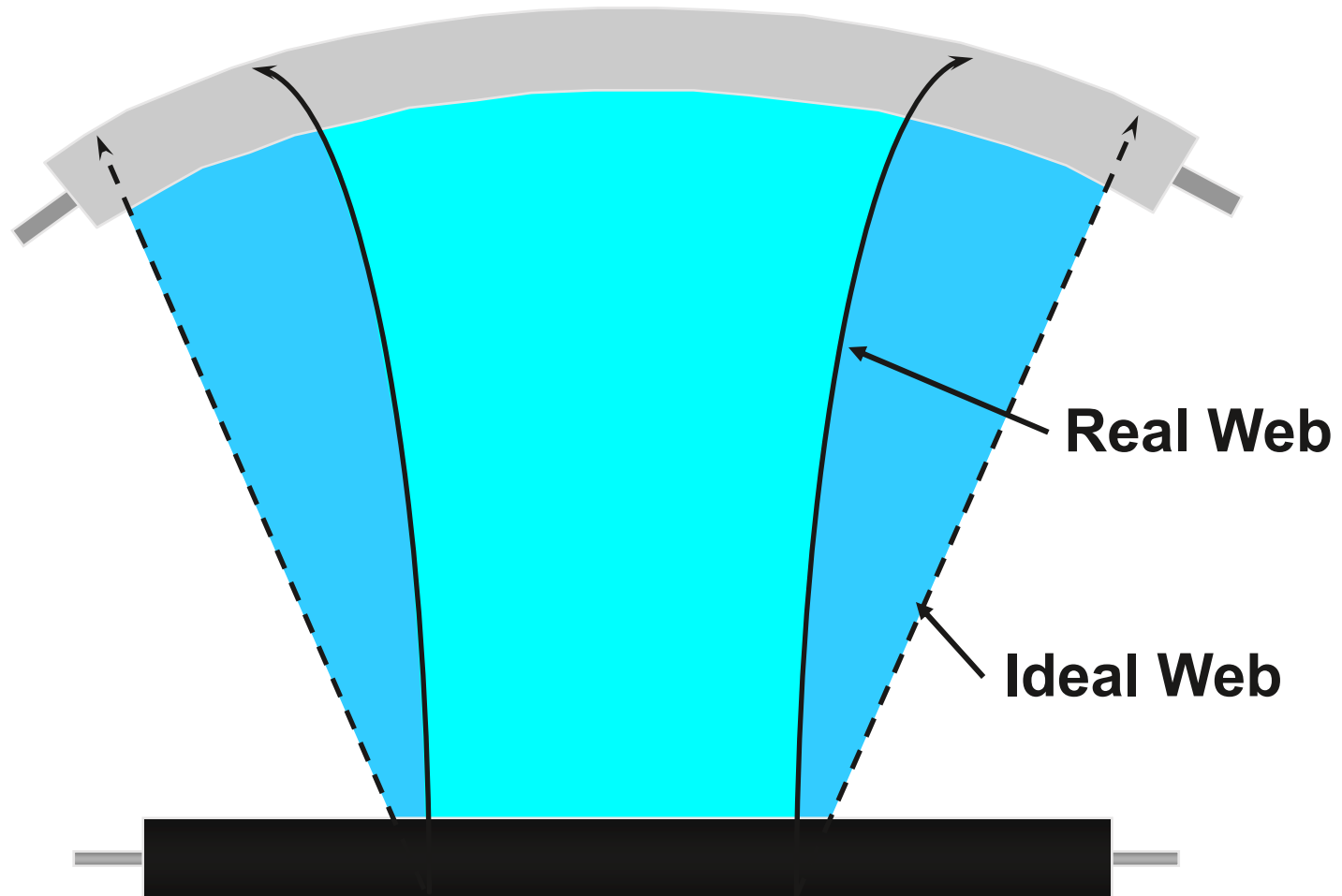


Bowed Spreader Roll

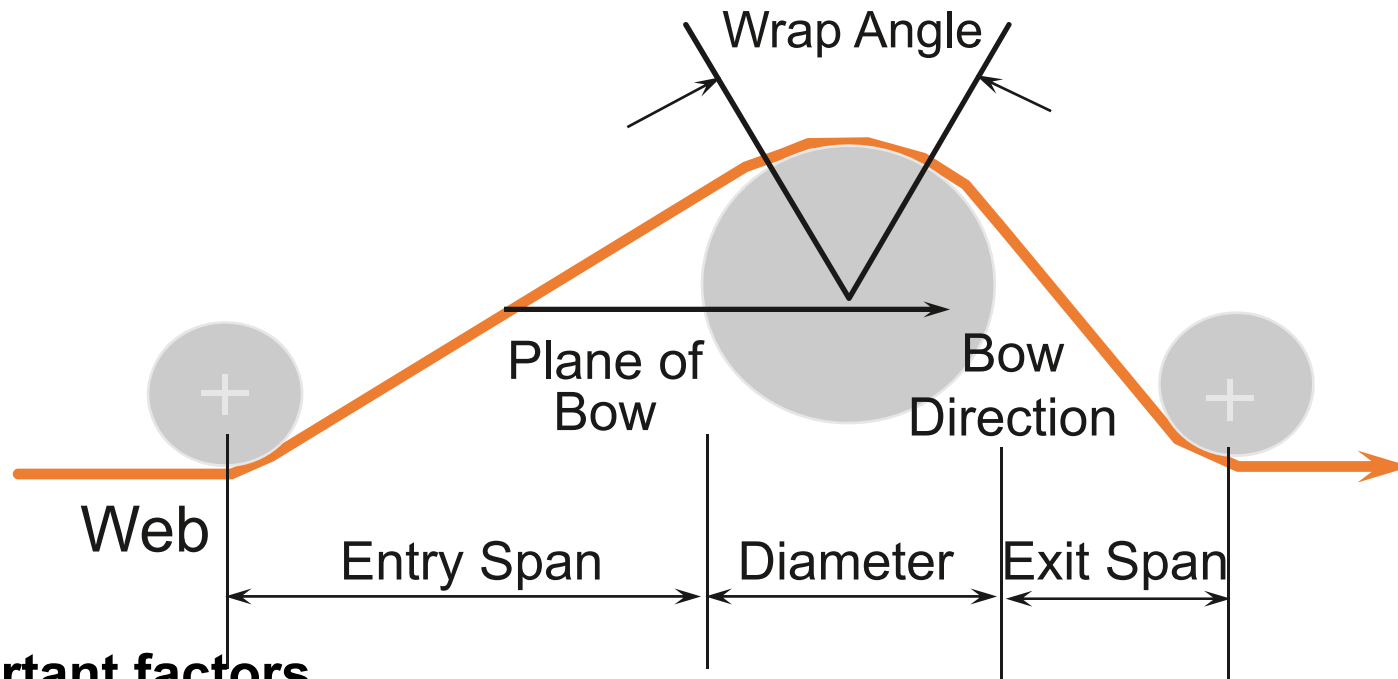


- Roll with fixed or variable curved axle supporting segmented, bearing-mounted metal sleeves
- Sleeves are typically covered with a flexible soft rubber covering
- High-wear applications - eliminate the cover and the metal sleeves are traction coated

Bowed Spreader Roll - Web Behavior



Bowed Spreader - Web Path



Important factors

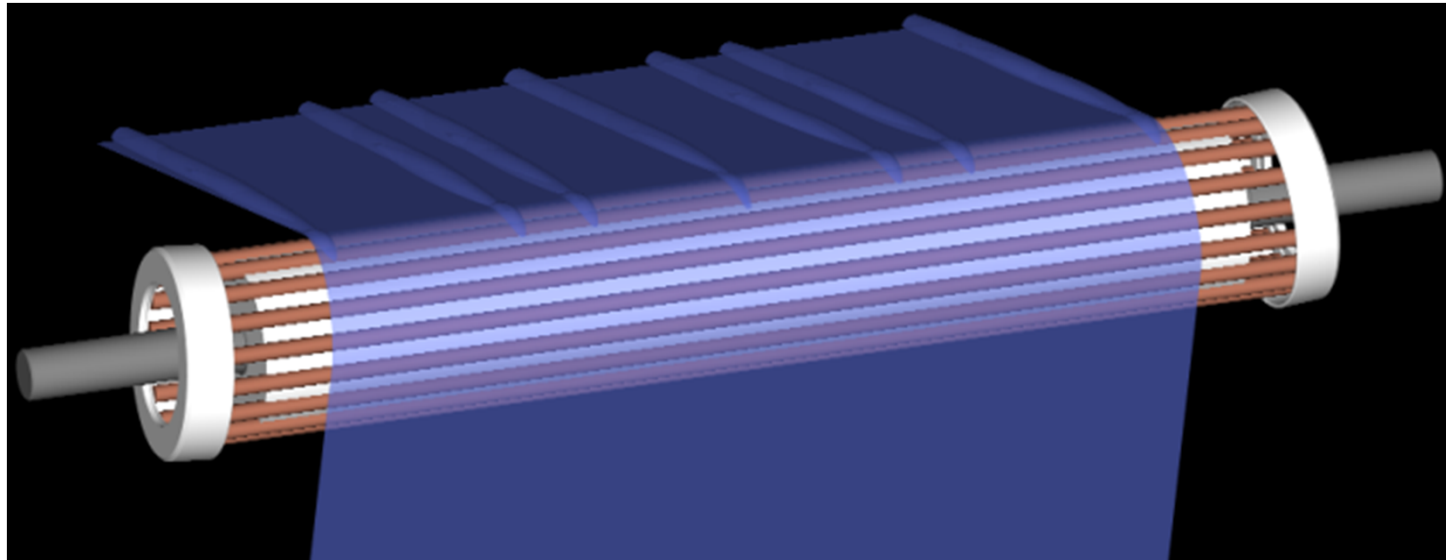
- Web length of entry span as long as possible to minimize required bow and the stresses put into the web
- Web length of exit span short as possible
- Wrap angle to be 45 -90 degrees to maximize traction and minimize bow (Old thinking was 15 - 30 degrees -- not true today!)
- Bow direction to be set at 90 degrees to bisector of wrap angle in the direction of the web travel

Bowed Spreader Roll

Amount of spreading a function of

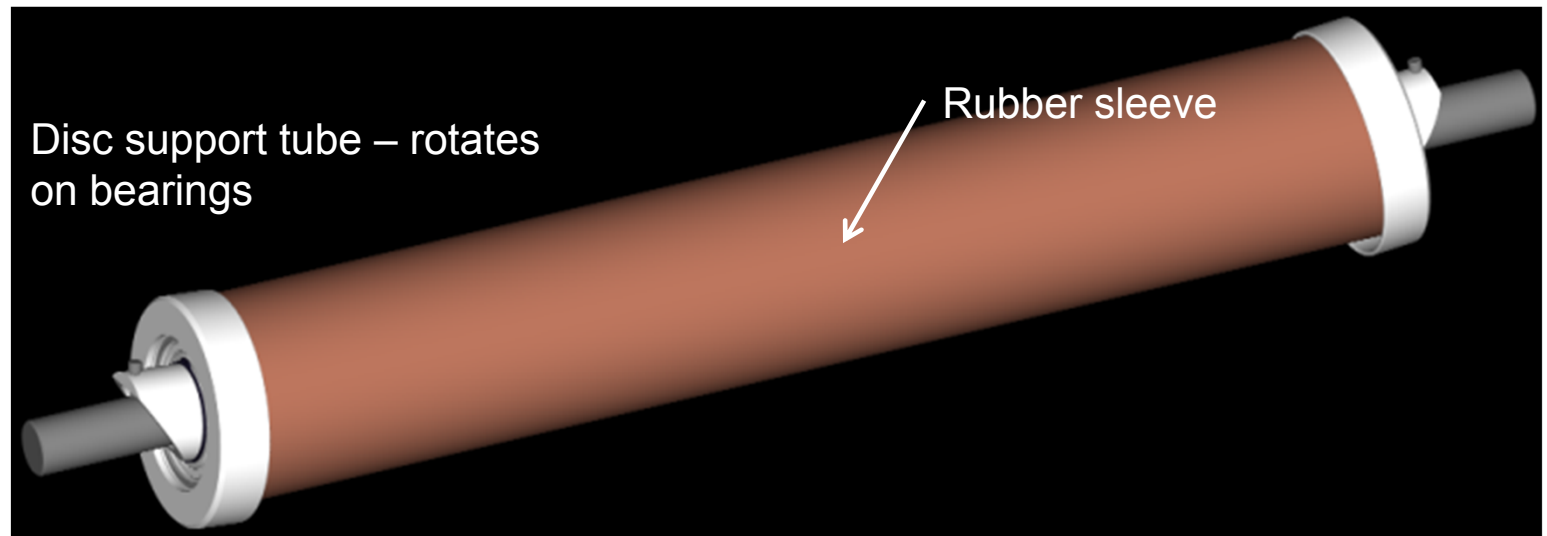
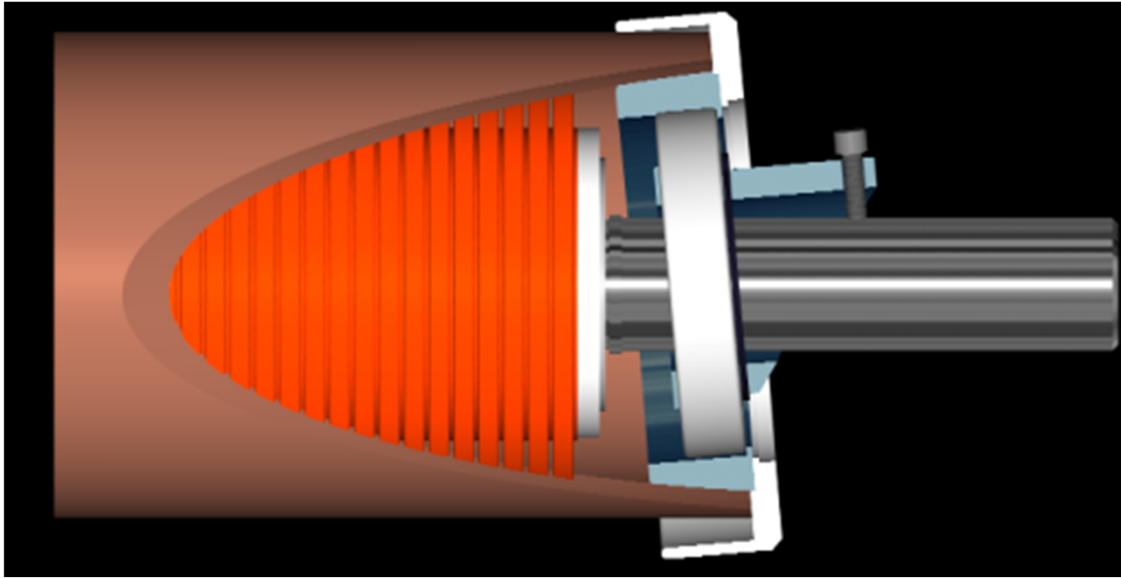
- Amount of bow
- Amount of wrap
- Amount of web tension

Expanding Surface Spreader



- Powerful spreading device that uses series of rubber cords that stretch as roll rotates
- Amount of spreading determined by angle of expansion plates
- Continuous rubber sleeve helps prevent marking
- For slower speeds because of the constant expansion/contraction

Expanding Surface Rolls – Continuous Rubber Sleeve Type



Illustrations courtesy of Converter Accessory Corp.

Spreading Applications Tech Tip

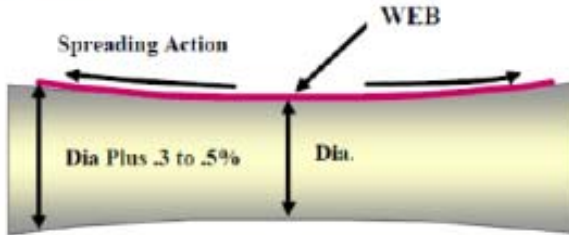
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How to Get the Most From Your Web Spreader

Almost all web processing systems require web spreading before critical components to remove wrinkles or for slit web separations. Unfortunately, many of the spreading devices are misapplied or not properly adjusted. This results in not getting the web spreading action desired and, in some cases, the spreaders become wrinkle generators.

This Tech Tip will discuss the various types of spreaders commonly used in the web converting industries, gives a description of the spreading mechanism, application information and lists the Pros and Cons for using this type of spreading device. We hope that you will find this information helpful in overcoming your web spreading challenges.

Reverse Crown Spreader



Description

A conventional roll, normally an idler but may be driven, that has a diameter at the ends slightly larger than the diameter in the center of the roll. Since the roll has a constant rpm, the surface speed is greater at the ends than the center. The surface speed difference causes an ingoing web tension distribution that is shaped similar to the speed profile. The roll's spreading action is a function of this web tension profile difference. It is important that this roll has a good traction surface to achieve the spreading action.

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Web Edge Guiding Systems

Needed on almost every web processing line to:

- **Compensate for dished or telescoping rolls on unwind**
- **Guide webs into critical processes such as printing, laminating or corrugation operations**
- **Guide webs after long web leading such as out of a dryer on a coating operation.**
- **Guide Webs into a winding operation**
- **Edge Guide can provide web oscillation to help randomize web profile defects before winding.**

Keys to Success for Edge Guiding & Oscillation Systems

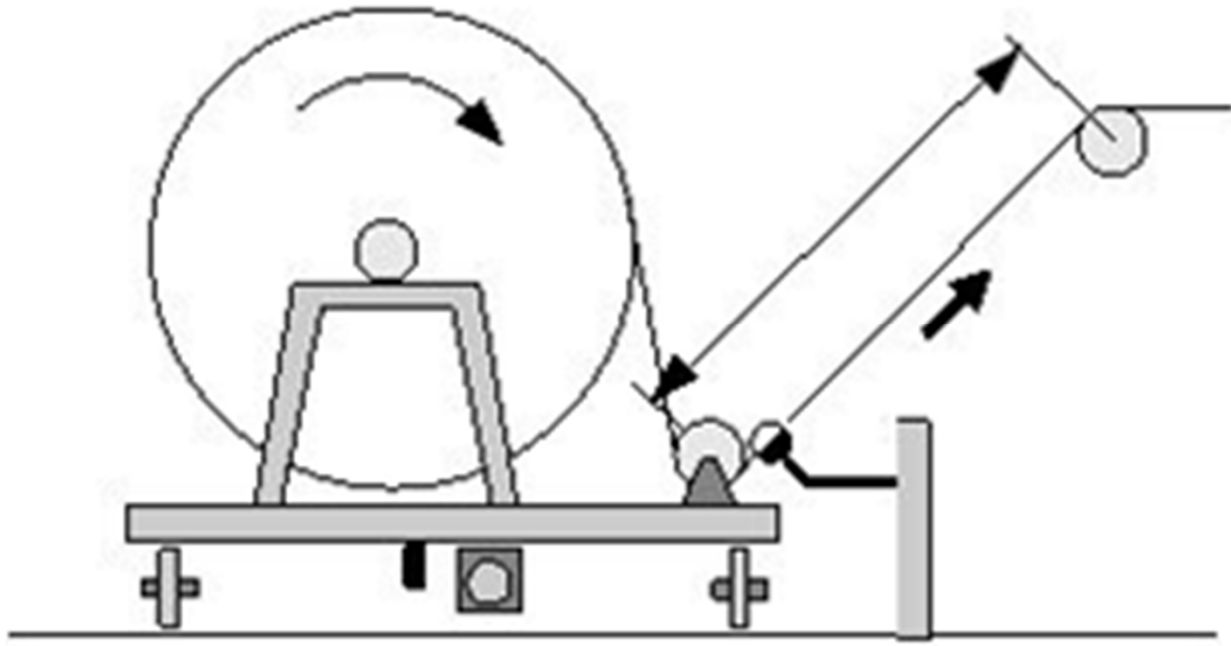
- **Guiding System located close to where accurate web position is required.**
- **Designed to accommodate max. displacement required.**
- **Steering Guides require long lead-in web span.**
- **Proper edge sensor type.**
- **Sensor located close to shifting roll.**
- **Shifting roll requires traction surface.**

Unwind Edge Guiding Systems

Choice of:

- **Unwind mounted on sidelay base and whole unwind is shifted to guide web into process.**
- **Offset Pivot Guide (two roll displacement guide) positions web after it is unwound into the process.**

Unwind Lead-out Roller Design



- Lead-out Roller must shift with Unwind
- Lead-out Roller needs to have traction surface for positive guiding

Offset Pivot Guide (OPG)-

Positions web after it is unwound



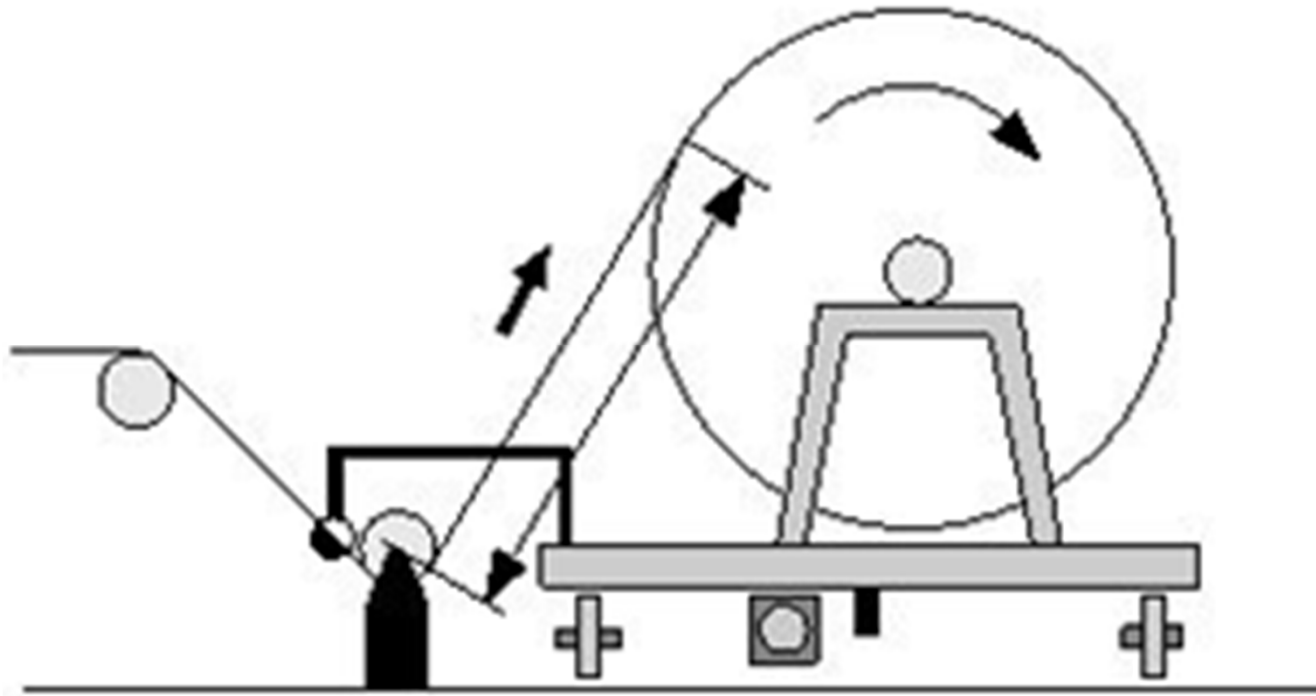
- Idler Rolls shift to steer web
- Needs parallel web lead into and out of guide
- Lead-out Roller needs to have traction surface for positive guiding

Unwind Guiding Comparison

- **OPG**
 - + Less Expensive
 - + Easier Unwind loading (fixed base)
 - + More Responsive (less mass)
- **Unwind Sidelay Base- More Costly but**
 - + Preferred as can handle greater offsets without high web stresses
 - + Uses less machine direction space
 - + Easier web threading

Winder Guiding Systems

(Guides the Winder to the web)



- Lead-in Roller fixed to the floor
- Roller needs to have sufficient wrap or traction surface for positive guiding

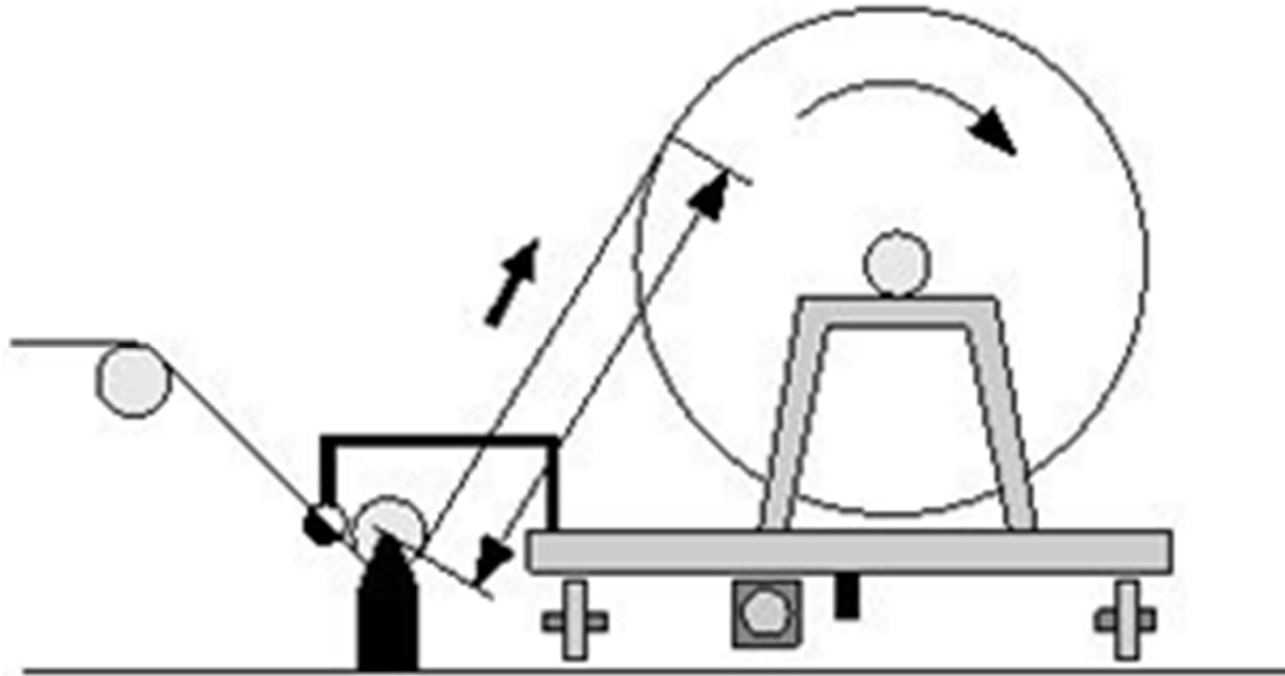
Winder Guiding Systems

Used for winding straight sided rolls without edge trimming.

Used for winder oscillation to randomize gauge bands when edge slitting is incorporated into winder frame.

Winder Guiding Systems

Requirements for Success



- **Rigid mounting of sensor**
- **Sensor close to roll fixed to floor**
- **Ensure that roll unloading system can accommodate guiding**

In Conclusion

Today's productivity challenges require web producers and converters handle webs that are increasing thinner in gauge and wider in width at ever increasing production speeds.

The conveying of these more delicate webs at higher speeds without distortion and/or defects such as wrinkles and scratches requires special attention to the web handling components on web processing lines.

In Conclusion

This presentation “*Thinner/Wider/Faster Challenges of Web Handling*” outlined the web handling requirements for proper web tension and control, proper web support rolls, good web spreading and proper web guiding.

I hope that the information presented will be helpful in the consistent production of defect free web materials off your web processing operation.

Reminder

If interested in Tech Tips for:

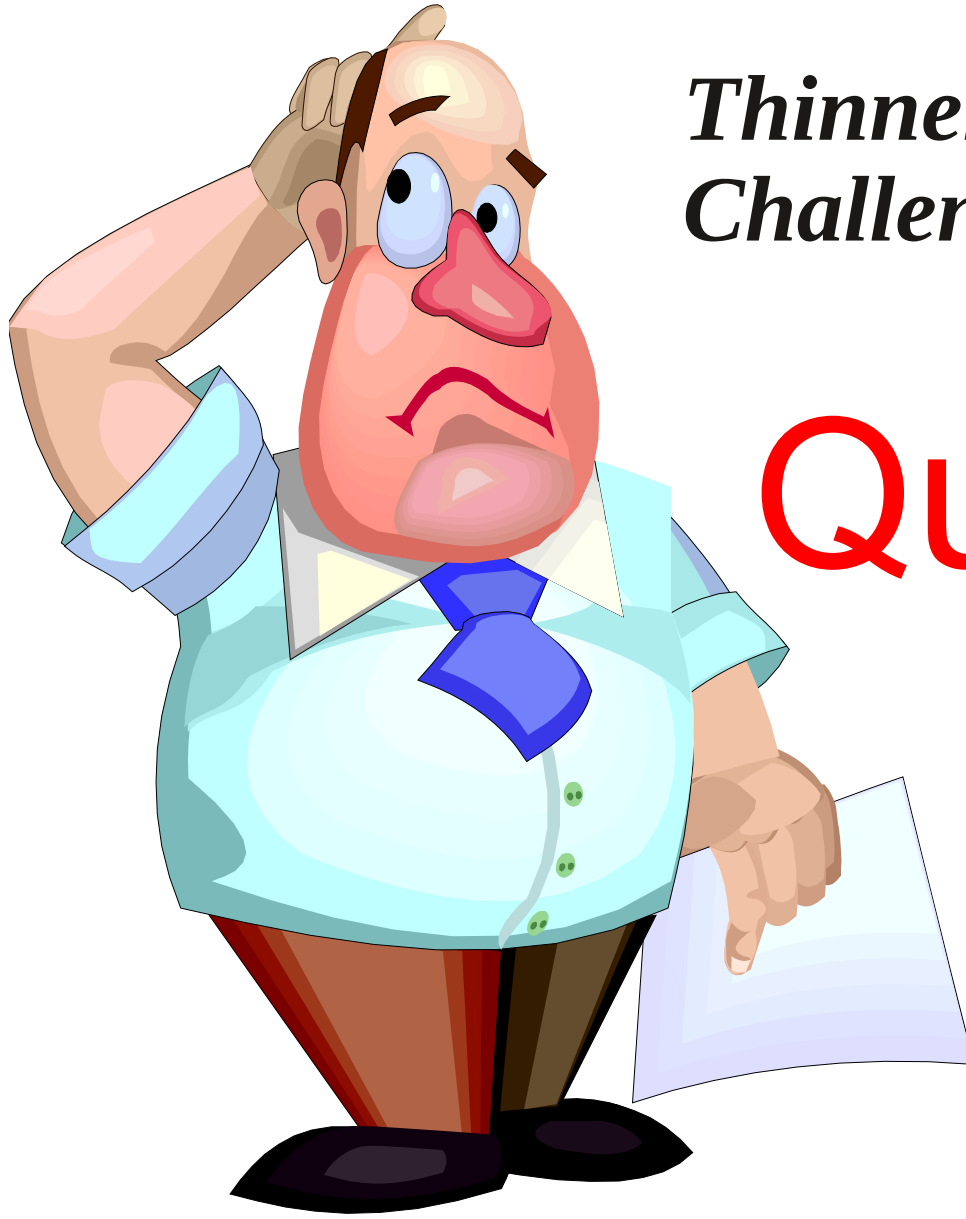
*** Web Tension**

*** Wrinkles**

*** Spreading**

Then email me or contact your Davis-Standard rep for a link where you can request any or all of Davis-Standard's Articles & Technical Tips.

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***Thinner/Wider/Faster
Challenges in Web Handling***

Questions?

**Slide Courtesy of
Dr. David Roisum**



Thank you for your attention-

Today's Thinner/Wider/Faster Challenges in Web Handling

By R. Duane Smith

Process Manager of Web Handling and Specialty Winding

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