

WEB SPREADING
By
Jeff Damour
CONVERTER ACCESSORY CORPORATION
Wind Gap, PA USA

Introduction

This presentation is meant to be a basic tutorial into why spreader rolls are needed, their application and operating principals. Though there are many types of spreader rolls, this presentation will cover 5 basic types, including:

- | | |
|--|---------------|
| 1) Crowned and Concave idler rolls | pages 11 – 14 |
| 2) Grooved rolls | pages 14 – 19 |
| a. Rigid (metallic or hard rubber) grooved rolls | |
| b. Flexible (soft rubber surface) grooved rolls | |
| 3) Nip type (angled on each edge of the web) | pages 19 - 21 |
| 4) Curved axis (bowed) rolls and bars | pages 22 - 26 |
| 5) Expanding Surface rolls | pages 26 - 32 |
| a. Slat expanders | |
| b. Rolls with polymer bands | |
| c. Continuous expanding rubber surface | |

Definition of the term Spreader Roll

For the purpose of this presentation, spreader rolls are defined as web transport rolls (driven or idle) that cause cross machine direction web movement, as the web is traveling in the machine direction. There are three purposes of cross machine movement; 1) this action will remove wrinkles, 2) this action can separate slit widths, to prevent interleaving, 3) web width can be stretched a predetermined amount.

This presentation will cover each type of Spreader Roll and how they can be utilized in the applications listed above.

Why do webs wrinkle?

To understand why webs wrinkle and why spreader rolls work, it is necessary to understand the most important web handling principal when it comes to wrinkling. This principal states:

A web will seek to align itself perpendicular to a roll, in its entry span to that roll (see figure 11).

The web must be in traction with the roll for this web handling principal to be true and effect the web behavior. In other words, if the material slips over the roll face then it can wander or remain in its current alignment with a roll not perpendicular to it.

The reason webs wrinkle can be summed up in one expression – **lateral compressive forces**. This presentation will seek to explain why lateral compressive forces occur, how to avoid them and spreader rolls that will remove wrinkles when these lateral compressive forces cannot be avoided.

Causes of Web Wrinkles

In a perfect world, webs would be flat, without gauge band variations. Roll stock would always be wound with the perfect tension from the core through the full roll diameter. Processes would always be run at the perfect tension for each material and operation. All converting processes would be run in humidity-controlled environment, where temperatures never vary. All rollers would be parallel from unwind to rewind and balanced perfectly. There would be no machine vibration. There would be no long, unsupported web lengths. You get the idea.

Unfortunately we do not live and work in a perfect world. One or a combination of any or all of the circumstances listed above will cause wrinkles.

Web characteristics that will cause wrinkles:

- Gauge band variations (thickness variations) across web width, cross machine direction (figure 1) will cause wrinkles because tensions will vary across the web width. These tension variations will cause tensile stress in the thicker areas and compression in thinner areas. This compression causes wrinkles.
- Tight side/loose side (figure 2). This condition is caused by the web being longer (linearly), on one side than the other, in the machine direction. If you were to lay flat an extremely long length of material in this condition under no tension, it would actually arc instead of being straight. This condition again creates tensile stress on the tight (short) side and compression on the loose (long) side, causing wrinkles.
- Baggy center, tight edges (figure 3). The web being longer in the center than the two edges, in the machine direction, causes this condition. If you were to lay material with this characteristic, flat, then you would see ripples or bubbles develop in the center while the edges were straight and flat. In a converting process, webs with this material characteristic will wrinkle because most of the tension that is typically evenly distributed across the full width is mostly distributed on the shorter (machine direction) edges than longer (machine direction) center. Tensile stress on the edges will create lateral compression in the center of the web, causing wrinkles.
- Baggy edges, tight center (figure 4). The web being longer on the edges than the center, in the machine direction, causes this condition. If you were to lay material with this characteristic, flat, then you would see ripples or bubbles develop on the edges while the center was straight and flat. In a converting process, webs with this material characteristic will wrinkle because most of the tension that is

- typically evenly distributed across the full width is mostly distributed on the shorter (machine direction) center than longer (machine direction) edges. Tensile stress in the center will create lateral compression on the edges of the web, causing wrinkles.
- Poorly wound roll stock (parent roll) will cause wrinkles for the following reasons:
 - a) Tension too high (figure 5), especially at the outer layers of the roll can cause inner layers to buckle. This is evident by viewing the end of the roll and observing a starring effect. In extreme cases, the core may even be collapsed. This roll characteristic will cause the web to be wrinkled before it enters a converting process.
 - b) Tension too low (figure 6) will cause the roll stock to be wound loose. Layers will slip on each other, making tension control ineffective or intermittent. This will cause the material to neck down (under tension) and expand (when tension is low or nonexistent). These compression and decompression forces will create web wrinkles.

**CROSS SECTION OF WEB
GAUGE BAND VARIATIONS**

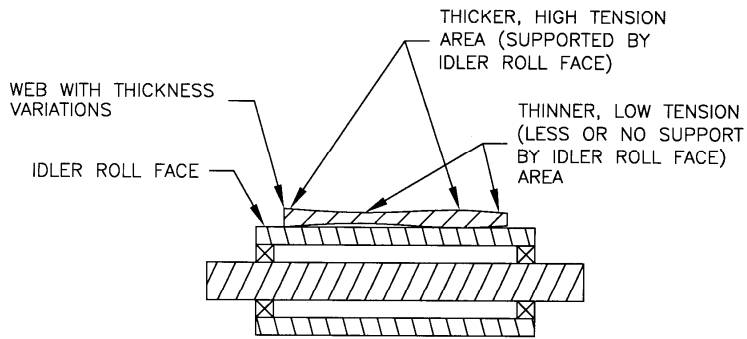


FIGURE 1

**TOP VIEW
TIGHT SIDE LOOSE SIDE WEB**
MACHINE DIRECTION

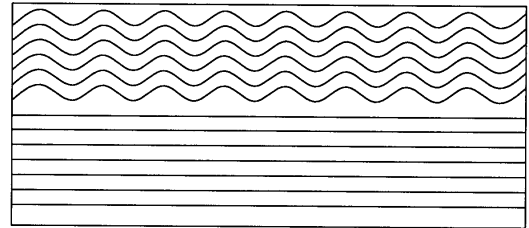
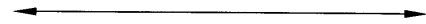


FIGURE 2

**TOP VIEW
BAGGY CENTER/TIGHT EDGES WEB**
MACHINE DIRECTION

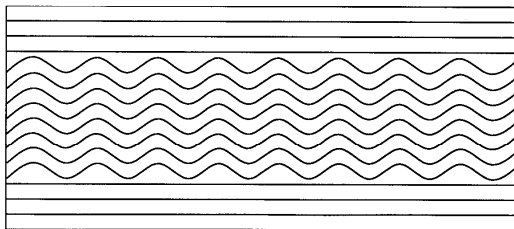


FIGURE 3

**TOP VIEW
BAGGY EDGES/TIGHT CENTER WEB**
MACHINE DIRECTION

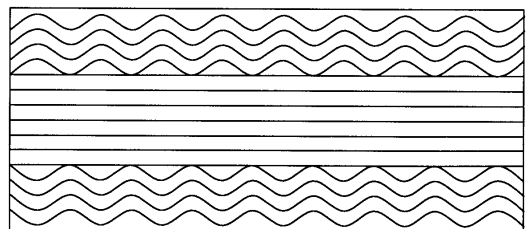
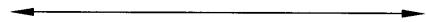


FIGURE 4

ROLL END VIEW
 "STARRING EFFECT" CAUSED
 BY TENSION TOO HIGH

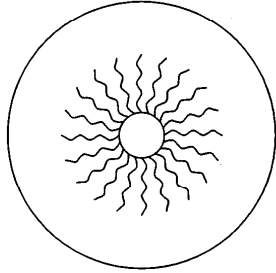


FIGURE 5

ROLL END VIEW
 LAYER SLIPPING CAUSED
 BY TENSION TOO LOW

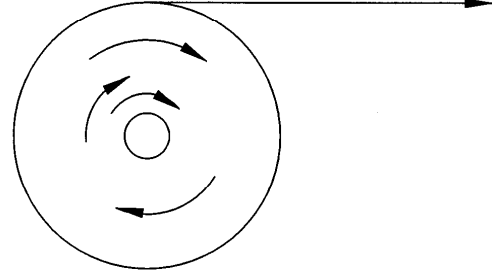


FIGURE 6

Machine characteristics that will cause wrinkles:

- Idler roll buckling or deflection (figure 7) will cause wrinkles because the web will actually deflect out of its normal running plane at different intervals across the web width. This out of plane condition will occur wherever the greatest amount of deflection (usually the center) is in the idler roll. When roll deflection occurs, webs will wrinkle because they will compress toward the deflection point.
- Air entrainment in webs (figure 8) as they flow over rolls will cause wrinkles. Air entrainment will create slippage between the web and the roll face. If this slippage occurs, then the web is not in traction with the roll. For the web handling principal, that a web will seek to be perpendicular to a roll in the entry span to that roll, to effect web behavior, it must be in traction with the roll. If the web is not in traction with a roll, it can wander or stay aligned with that roll to which it is not perpendicular. Webs that wander will wrinkle because the web will move to be perpendicular to the next roll with which it has traction. This movement to remain perpendicular will cause a strain on the web. Air entrainment problems can be detected by viewing idler rolls that stop rotating during the converting process. Also, if wear spots are seen across idler roll faces, air entrainment is probably the problem. Machinists' bluing dye can be applied to idler rolls where air entrainment is suspect to detect wear spots.
- Material roll buckling or deflection (figure 9). If the parent roll deflects on its support mechanism (air shaft, mechanical chucks or core cones mounted on a simple steel through shaft) then compressive forces will cause the material roll to buckle and wrinkle before the web enters the converting process.
- Varying tension through several different types of processes in one converting line (figure 10) will cause wrinkles. A good example of this is tension through a coating section, printing process, drying section and slitting section. Tension through the coating section may be high, then through the printing process may be lower, then through the drying process lower yet, then through the slitting section

may be high again. Wrinkles will occur under these conditions because the web will stretch and contract creating compressive and decompressive forces. Lateral (cross machine direction) compressive forces are created in the web because of a high tension. Decompressive forces are created from the web trying to return to its natural state after leaving a high-tension section. These lateral compressive and decompressive forces are very similar to stretching and relaxing a rubber band. When you stretch a rubber band, its length grows and its width narrows (lateral compressive forces make the rubber band narrow). When the same rubber band is relaxed, the length shortens and the width grows as it tries to return to its natural state (lateral decompressive forces). These individual tension sections (zones) can be affected by braked, defective or unbalanced idler or driven rolls that will create tension variations as the web is flowing through the process.

- A braked roller, defective roller or a defective bearing in an idler roll, will cause tension to vary on the downstream side of the idler roll. This will vary tension very similar to the situation described above. Again, as tensions vary, the web will stretch and contract creating wrinkles.
- Other web expansion and contraction effects on the web will create wrinkles. Examples of these effects are heat on plastics and moisture in paper.
- If idler rolls and/or driven rolls are not parallel to each other (figure 11), wrinkles will occur. These occurrences are again introduced because of the web handling principal, that a web will seek to align itself perpendicular to a roll in the entry span to that roll. As the web is seeking this right angle it will move or bend out of its normal running plane. This will create tension to variations across the web, tensile stress in high tension area and lateral compression in the low tension area.

WRINKLES CAUSED BY IDLER ROLL DEFLECTION OR BUCKLING AS VIEWED FROM THE FRONT AND SIDE. THIS EXAMPLE IS GREATLY EXAGGERATED.

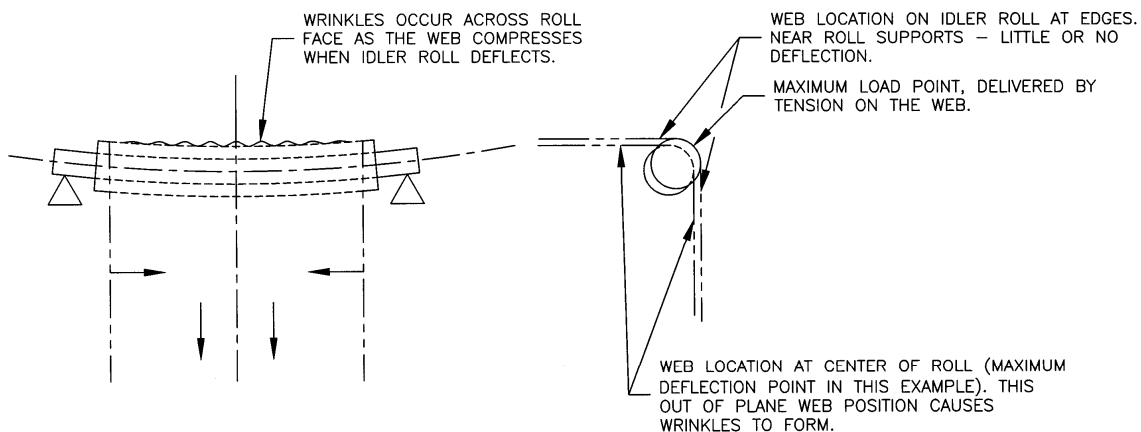


FIGURE 7

AIR ENTRAINMENT SIDE VIEW.

NOTE:
AIR ENTRAINMENT CAUSES WRINKLES BECAUSE THE WEB WILL WANDER ACROSS ROLLS THAT DO NOT HAVE TRACTION WITH THE WEB. THIS IS BECAUSE THE WEB HANDLING RULE (THAT THE WEB WILL SEEK TO ALIGN ITSELF PERPENDICULAR TO A ROLL IN THE ENTRY SPAN TO THAT ROLL) DOES NOT APPLY IF THERE IS NO TRACTION.

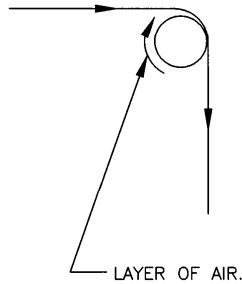


FIGURE 8

PARENT (UNWIND) ROLL DEFLECTION AS VIEWED FROM THE FRONT (OR BACK). THIS DEFLECTION CAN CAUSE WRINKLES BEFORE THE WEB STARTS OUT INTO A PROCESS.

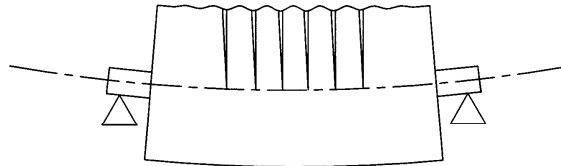
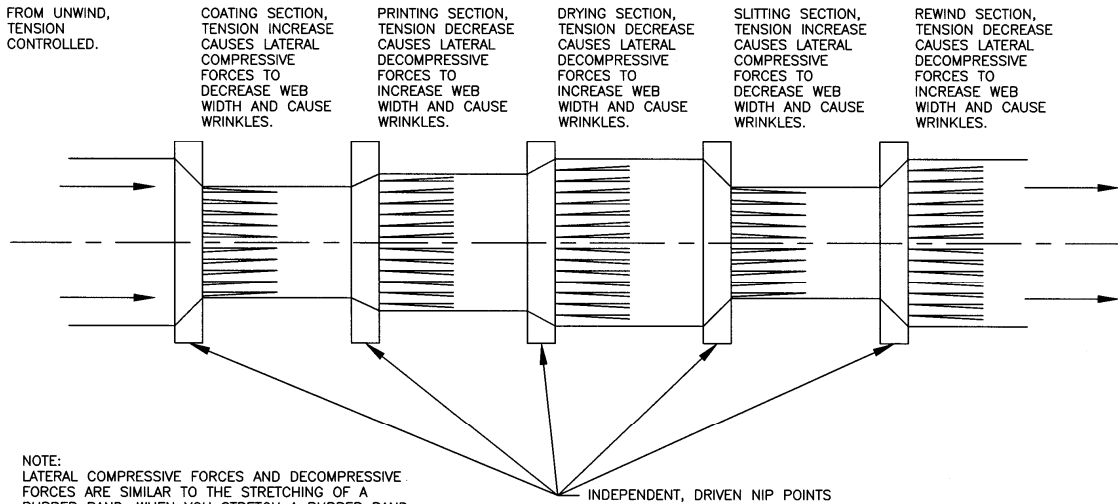


FIGURE 9

SIMPLE EXAMPLE OF A CONVERTING LINE WITH VARYING TENSION ZONES TO FACILITATE MANY DIFFERENT CONVERTING PROCESSES. THIS VIEW IS AS IF FROM THE TOP. THIS EXAMPLE IS GREATLY EXAGGERATED.



NOTE:
LATERAL COMPRESSIVE FORCES AND DECOMPRESSIVE FORCES ARE SIMILAR TO THE STRETCHING OF A RUBBER BAND. WHEN YOU STRETCH A RUBBER BAND, ITS LENGTH GROWS AND THE WIDTH NARROWS, THIS IS SIMILAR TO THE LATERAL COMPRESSIVE FORCES DESCRIBED ABOVE. WHEN THE SAME RUBBER BAND IS RELAXED THE LENGTH SHORTENS AND THE WIDTH GROWS (IT TRIES TO GO BACK TO ITS NATURAL STATE). THIS IS SIMILAR TO THE LATERAL DECOMPRESSIVE FORCES DESCRIBED ABOVE. THE INDIVIDUAL ZONES CAN BE AFFECTED BY BRAKED, DEFECTIVE OR UNBALANCED IDLER ROLLS AND OTHER FORCES THAT CAUSE WEB EXPANSION / CONTRACTION.

FIGURE 10

SKEWED (NOT PARALLEL) IDLER ROLLS AS VIEWED FROM THE TOP.

NOTE:
SKEWED (NOT PARALLEL) ROLLS WILL CAUSE WRINKLES BECAUSE OF THE WEB HANDLING RULE (THAT THE WEB WILL SEEK TO ALIGN ITSELF PERPENDICULAR TO A ROLL IN THE ENTRY SPAN TO THAT ROLL). THE WEB WILL CHANGE ITS PATH AND TENSIONS WILL THEN VARY ACROSS THE WEB CAUSING TENSILE STRESS ON THE HIGH TENSION SIDE AND COMPRESSION ON THE LOW TENSION SIDE. THIS COMPRESSION CAUSES WRINKLES. EVEN THE SMALLEST AMOUNT OF SKEW (LESS THAN .0005") CAN CAUSE WRINKLES IN SOFT, FLEXIBLE MATERIAL.

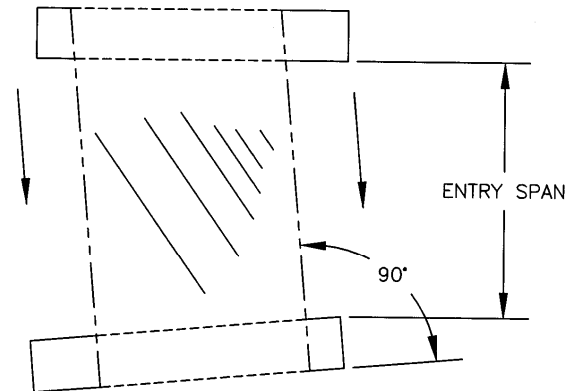


FIGURE 11

Why use spreader rolls?

- A) **To remove wrinkles.** As described in the previous section, webs will wrinkle for a lot of reasons. Some times, wrinkles can be avoided by correcting certain errors in converting processes. Many times, wrinkles will reoccur even though it seems all conditions are perfect in the converting process. These reoccurring wrinkles can only be removed with a spreader roll.

Spreader rolls used to remove wrinkles will do so prior to the wrinkle becoming a crease. If a wrinkle becomes a crease it becomes very difficult or usually impossible to remove. A wrinkle will become a crease when it enters a station where the web is being nipped or rewound.

Typically, spreader rolls are used as a “bandage” for wrinkling problems. Spreader rolls do not permanently change the characteristics of material. Multiple spreader rolls may be required for one converting process, each roll located just prior to each converting operation where wrinkles cause a problem or may become creases.

Applications where accumulated wrinkles require more cross machine movement than one spreader roll can provide will require multiple spreader rolls. Usually, multiple spreader roll applications will incorporate several of the same type of spreader rolls, each immediately following the other, again just prior to each operation where wrinkle removal is required. Different types of spreaders should

not be used in close proximity to each other, because each type utilizes different principals of web spreading. Many times, when different types of spreaders are used together, results can become unstable and unpredictable. Some times, different types of spreaders will counter act each other and cause wrinkles, this usually does more harm than good.

Imagine the print quality out of a printing station or edge quality out of a slitting station with an in-running wrinkle or crease. Spreader rolls are used to improve product quality and reduce waste by removing some, most or all of the wrinkles just prior to a converting operation. **Bottom line – spreader rolls used to remove wrinkles will increase profits by reducing or eliminating defective product.** With the use of spreader rolls, web speeds can often increase and webs that could not be run without wrinkling (example-very thin or soft webs) in the past can now be processed with little or no problems.

B) To separate slit widths, to prevent interleaving. When a web is slit into several separate widths, each width takes on the properties of a separate web. Each width will have its own tension and each width will have a tendency to wander, similar to how the parent web can wander (this is why the parent web is usually edge guided).

Normally, several slit widths are wound on a duplex (two station winder). This type of rewind has two separate rewind shafts, each with its own drive. Use of a duplex rewind will prevent interleaving by placing each slit width alternately, on the two separate rewind shafts. Example – The first slit width is placed and rewound on to shaft A, the second slit width is placed and rewound on shaft B, the third slit width is placed and rewound on shaft A, etc. Because each slit width is placed with the space of the next slit width between each rewind roll it is impossible for interleaving to occur.

However, in applications where several slit widths are wound on to a single rewind shaft, edge interleaving will occur with even the slightest wander by each slit width. When this interleaving occurs with several layers of web wraps on the rewind shaft, the edges of each slit roll will become overlapped. It is very difficult or impossible to separate each rewind roll if the edges are overlapped (figure 12).

SLITTING AND SINGLE STATION REWIND (NO SPREADER ROLL)
TOP VIEW

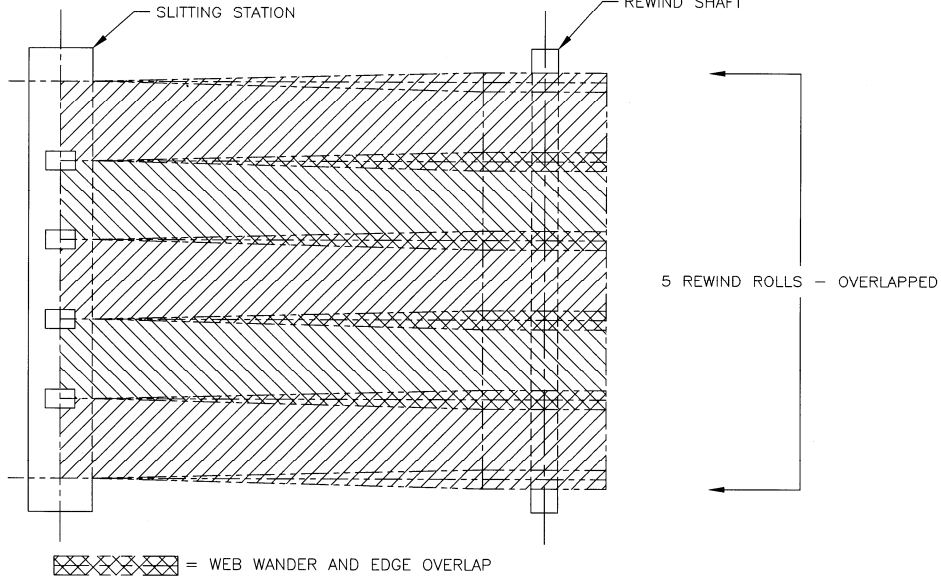


FIGURE 12

Bowed (curved axis) spreader rolls will prevent edge interleaving and roll overlap on a single rewind shaft by evenly separating each slit width. The separation must be greater than the maximum cumulative web wander for each slit width. This separation principal works, based on the web handling principal that the centerline of each slit width (now having the properties of a separate web) will seek to be perpendicular to the intersection point on the arc (curved axis) of the bowed roll (Figure 13).

SLITTING AND SINGLE STATION REWIND (WITH SPREADER ROLL)
TOP VIEW

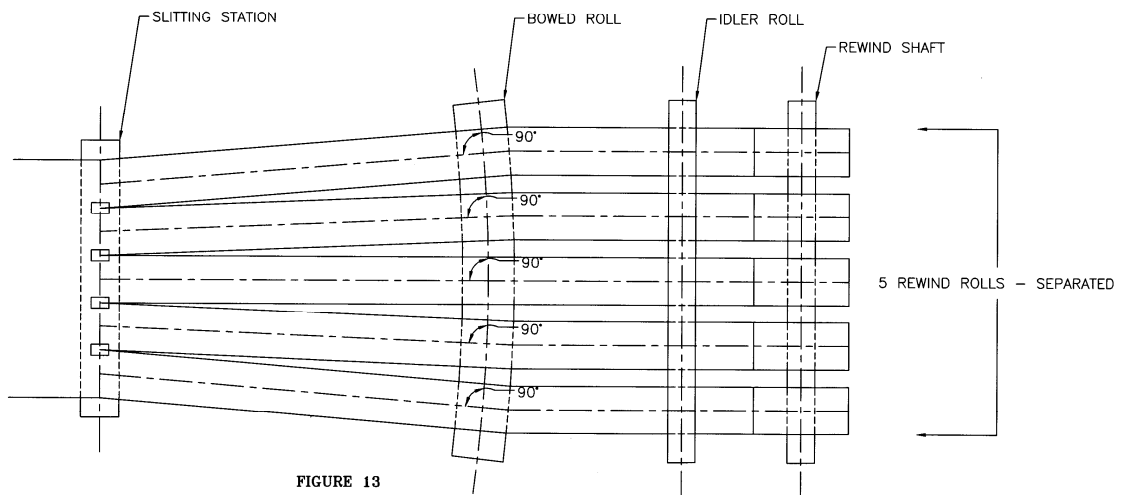


FIGURE 13

C) To stretch the web across the width. Some applications require that a web be stretched in the cross machine direction. A good example of this is a tenter frame application, often used for textiles. While a tenter frame is not a spreader roll by definition it does stretch material in the cross machine direction. Spreader rolls are used quite often immediately following a tenter frame to keep the web taught, so it doesn't return to its natural width state. Spreader rolls may be used in this application to increase stretch in the cross machine direction.

All spreader rolls have the ability (with varying aggressiveness) to stretch a web. Each uses its inherent spreading principal to do so which we describe further in the document (see Principals of Operation for each type of spreader).

TENTER FRAME EXAMPLE WHERE SPREADER ROLLS ARE USED TO STRETCH (OR KEEP STRETCHED) A WEB

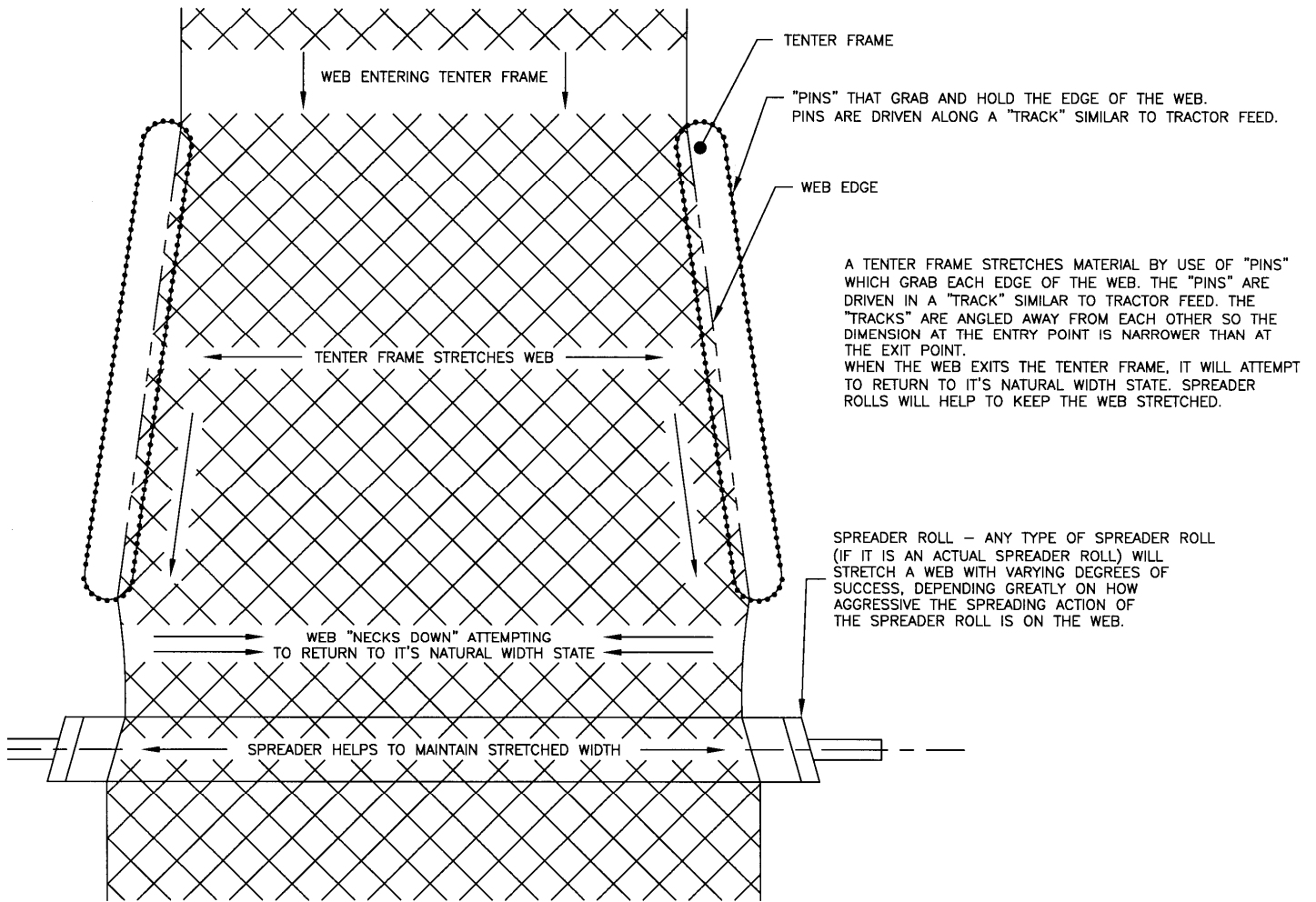


FIGURE 14

Principal of operation

Crowned Spreader roll

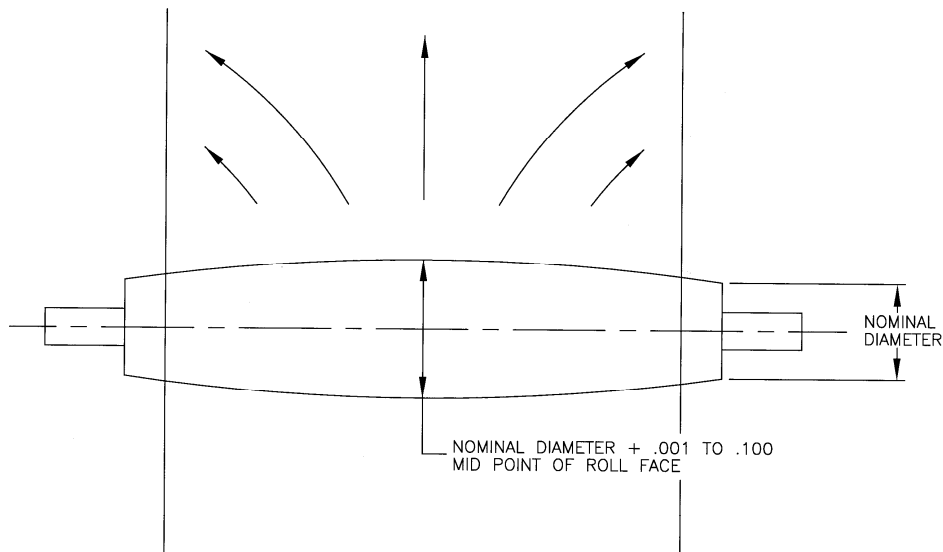
Description:

A crowned spreader roll can be manufactured from a variety of materials, such as steel, aluminum, stainless steel or plated aluminum or steel and can be rubber covered. Although crowned rolls with a rubber surface are the most common, it is not necessary for every application that the surface to be rubber. A crowned spreader roll has an arced surface across its face with the arc sweeping from the ends **out** toward the center of the roll face. The ends of the roll face are the smallest diameter while the roll diameter increases in equal increments across its' face to the center. The roll face diameter variance is strictly application dependent. However, it can be generally stated that the bigger the roll diameter, the less the variance. The longer the roll face the more the variance. Extreme variances may be .001" for a large diameter, short face roll and a .100" variance for a small diameter long face roll.

Theory of operation:

By varying the roll diameter across the face of the roll (roll is arced **outward** across its' face), tension will vary across the roll face. The increased tension toward the center of the roll will cause tensile stress in the center of the web forcing wrinkles to be pushed out from the center toward the roll face ends. See figure 15.

SIMPLE EXAMPLE OF THE THEORY OF OPERATION FOR A CROWNED ROLL



THEORY OF OPERATION:
BECAUSE THE CROWNED ROLL HAS A LARGER DIAMETER IN ITS' CENTER AND THE DIAMETER GRADUALLY DECREASES TOWARD THE ROLL FACE ENDS, THE TENSION ACROSS THE ROLL FACE IS NOT EVENLY DISTRIBUTED. THE "EXTRA" TENSION IN THE CENTER OF THE ROLL WILL CAUSE WRINKLES TO BE PUSHED TOWARDS THE ENDS OF THE ROLL FACE.

FIGURE 15

Recommended wrap angle varies greatly with this type of spreader roll. Typical wrap angles may range between 30° - 180° . Greater degrees of wrap angle will cause greater effect on the web. Spreading may increase with greater amounts of wrap, but the occurrence of web distortion will also increase.

Advantages:

- This type of spreader roll has a smooth surface, so it will not mark the surface of a web.
- Most any machine shop, rubber roll manufacturer or idler roll manufacturer can machine a crowned roll. This makes this type of spreader roll one of the least expensive, most readily available types of spreader roll.
- Simplicity of design, with no special parts makes this spreader roll extremely easy to maintain.
- Crowned spreader rolls can be used with all types of materials. The amount of crown depends greatly on the type of web. More extensible materials, like films, will require a minimal amount of crown, where more rigid materials, like paper, will require more amount of crown.

Disadvantages:

- The theory of operation for this type of spreader roll is not completely sound. While the tension variance through roll diameter variance is true, the idea of this

theory actually spreading the material is unfounded, especially for preventing or removing wrinkles under varying circumstances (see Causes of Web Wrinkles section). An example of this is that while this type of spreader roll may help with wrinkles caused by a baggy center by adding tension to the loose center area of the web, it may worsen the wrinkles caused by baggy edges because the center of the web is already tight. The tightness in the center of the web will only be increased with the use of this roll.

- Further reason why this type of spreader may do more harm than good is surface speed variance across its' face. As this roll rotates, the surface speed at the smaller diameter roll face off center is actually less than in the center (this is the case because the diameter is smaller at the ends than in the center). Slower surface speed toward each end of the roll face can actually drive the web at a slower speed than the center, which will cause the material edges to move in the cross machine direction toward the center of the web (exactly opposite what a spreader roll is supposed to do).
- Because this roll is not linear across its' face (while the web is or should be) it can stretch, distort and/or tear the center of the web.
- There is no set formula for the amount of crown for every application, so the amount of crown can only be determined through trial and error or past experience.

Concave Spreader Roll

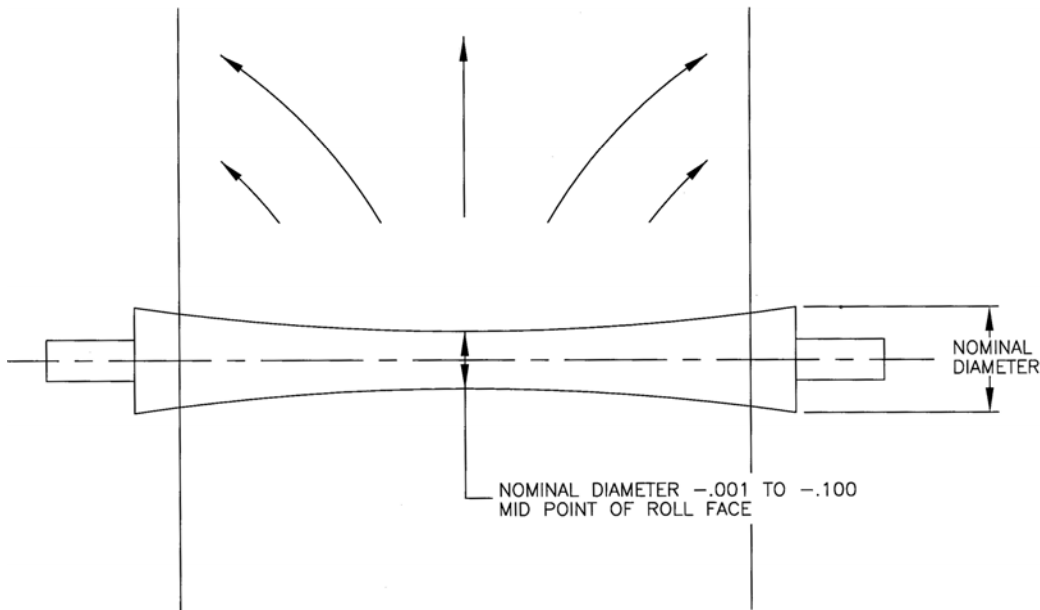
Description:

A concave spreader roll can be manufactured from a variety of materials, such as steel, aluminum, stainless steel or plated aluminum or steel and can be rubber covered. A concave spreader roll has an arced surface across its face with the arc sweeping from the ends **in** toward the center of the roll face. The ends of the roll face are the largest diameter while the roll diameter decreases in equal increments across its' face to the center. The roll face diameter variance is strictly application dependent. However, it can be generally stated that the bigger the roll diameter, the less the variance. The longer the roll face the more the variance. Extreme variances may be .001" for a large diameter, short face roll and a .100" variance for a small diameter long face roll.

Theory of operation:

By varying the roll diameter across the face of the roll (roll is arced **inward** across its face), surface speed will vary across the roll face. The increased surface speed toward the edges of the roll will cause wrinkles to "walk" out from the center toward the roll face ends. See figure 16.

SIMPLE EXAMPLE OF THE THEORY OF OPERATION FOR A CONCAVE ROLL



THEORY OF OPERATION:
THE CONCAVE ROLL HAS AN ARC'D SURFACE WITH THE ARC SWEEPING FROM THE ENDS IN TOWARD THE ROLL FACE CENTER. THE SURFACE SPEED OF THE ROLL IS FASTER ON THE ENDS THAN IN THE CENTER BECAUSE OF THE ROLL DIAMETER VARIANCE. THE WEB IS ACTUALLY DRIVEN FASTER IN THE MACHINE DIRECTION TOWARD THE EDGES SO WRINKLES ARE "WALKED" OUT TO EACH SIDE OF THE WEB.

FIGURE 16

Recommended wrap angle varies greatly with this type of spreader roll. Typical wrap angles may range between 30° - 180° . Greater degrees of wrap angle will cause greater effect on the web. Spreading may increase with greater amounts of wrap, but the occurrence of web distortion will also increase.

Advantages:

- This type of spreader roll has a smooth surface, so it will not mark the surface of a web.
- Most any machine shop, rubber roll manufacturer or idler roll manufacturer can machine a concave roll. This makes this type of spreader roll one of the least expensive, most readily available types of spreader roll.
- Simplicity of design, with no special parts makes this spreader roll extremely easy to maintain.
- Concave spreader rolls can be used with all types of materials. The amount of concave profile depends greatly on the type of web. More extensible materials, like films, will require a minimal amount of concave profile, where more rigid materials, like paper, will require more amount of concave profile.

Disadvantages:

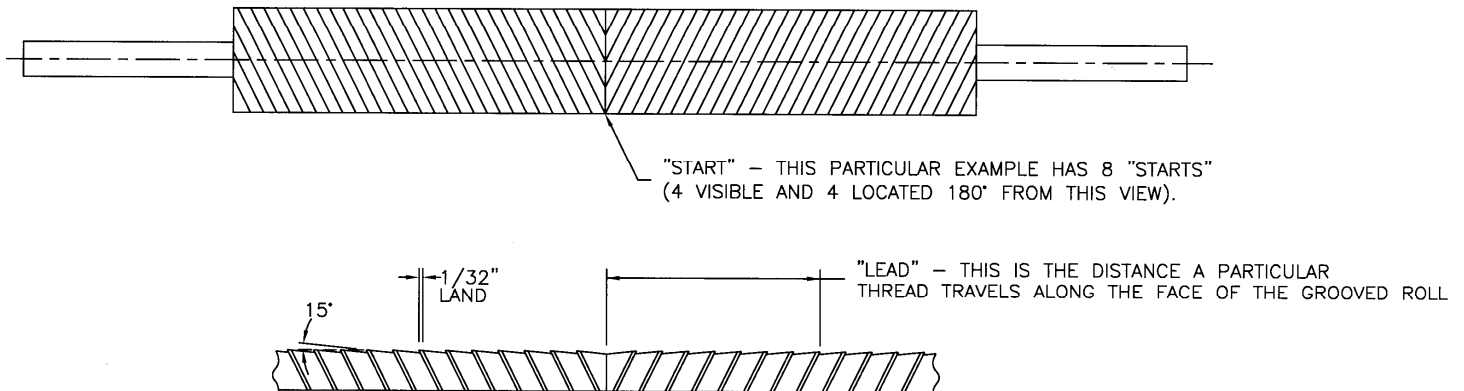
- While the theory of operation for this type of spreader roll is sound. It may not work or it may even compound certain wrinkling conditions. An example of this is that even though this spreader roll relies on surface speed differential across its' face (not tension variation, as in the case of the crowned roll) to spread the web, tension variations will occur across the web because the roll face is not linear. This roll will probably perform well for baggy edges type wrinkles – the roll diameter being larger toward the roll face ends adding tension to the loose edges. It could compound the problem for baggy center type wrinkles – the roll face profile worsening the looseness in tension, in the center of the web.
- Because this roll is not linear across its' face (while the web is or should be) it can stretch, distort and/or tear the edges of the web.
- There is no set formula for the amount of concave profile requirement for every application, so the amount of concave profile can only be determined through trial and error or past experience.

Grooved Roll – Rigid Metallic or Hard Rubber

Description:

A grooved spreader roll can be manufactured from a variety of materials, such as steel, aluminum, stainless steel, plated aluminum or steel and hard rubber. A rigid grooved spreader roll has grooves machined into the roll face surface. These grooves (resembling screw threads) are machined – starting from the center of the roll and leading out to each edge of the roll face. The grooves can be supplied in almost any fashion; from as simple as wrapping masking tape across the face of a standard idler roll to a machined groove that has very intricate machining details. See figure 17 for just one possible groove design. Groove design is completely application dependent, however it can be generally stated that the greater the number of groove starts there are (see figure 17) the greater the spreading will be realized.

EXAMPLE OF ONE TYPE OF GROOVED SPREADER ROLL



THERE ARE MANY DIFFERENT TYPES OF GROOVED TYPE SPREADER ROLLS. THEY CAN BE MADE OF ALUMINUM, STEEL, STAINLESS STEEL, PLATED ALUMINUM OR STEEL AND HARD RUBBER. GROOVES CAN BE SUPPLIED IN MANY DIFFERENT DESIGNS FROM MULTIPLE "STARTS" TO ONE "START" AND NARROW "LEAD" TO LONG "LEAD". TYPICALLY, GROOVED ROLLS WITH MULTIPLE STARTS WILL PROVIDE THE GREATEST AMOUNT OF SPREADING. THIS EXAMPLE IS JUST ONE TYPE OF GROOVE CONFIGURATION. THIS TYPE OF SPREADER ROLL IS DESIGNED PRIMARILY FOR USE ON TEXTILES AND NONWOVENS. IT HAS LIMITED APPLICATION IN FOILS, PAPER AND FILMS.

FIGURE 17

Theory of operation:

Quite simply the theory is that the grooves will push wrinkles out of the web, from the center out to each edge, which, unfortunately is not always the case (see advantages and disadvantages, below).

Recommended wrap angle for this type of spreader roll normally ranges between 90° - 180°.

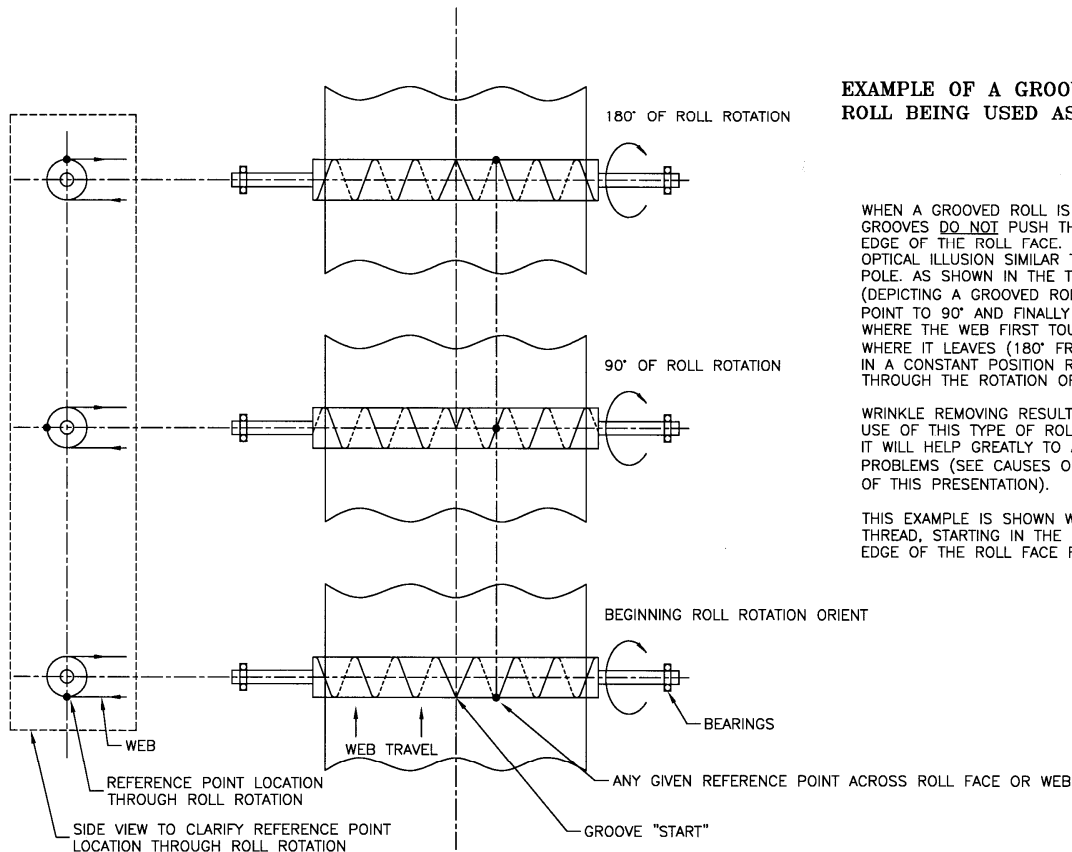
Advantages when applied as an idler roll:

- This type of spreader roll will remove air when air entrainment is a problem (this in itself will help to remove or prevent wrinkles).
- Depending on the groove design, these rolls can often be manufactured by most machine shops, rubber roll manufacturer or idler roll supplier. Making this type of spreader one of the least expensive, most readily available types of spreader roll.
- Simplicity of design, with no special parts, makes this spreader roll extremely easy to maintain.
- Because this roll is linear across its face, it will not stretch, distort or tear any portion of the web.
- This type of spreader roll is best suited for use with textiles and non-wovens. It has limited application with papers, foils and films.

Disadvantages when applied as an idler roll:

- When this spreader is applied as an idler roll (driven at the surface speed of the web), the grooves do not push wrinkles out from the center of the roll face (even though this is most often believed to be the case). As shown in figure 18, when the surface of the grooved roll is driven at the same speed as the surface of the web (such is the case when used as an idler roll) the tangent point, at any given point across the web or roll face, where the web first touches the roll remains in a constant position through the roll rotation. Because the tangent point of the web lying on top of the groove does not vary, the groove has no cross machine direction movement effect on the web. The belief that the grooves have some effect on the web is mostly an optical illusion (like the illusion caused by a rotating barber shop pole). An engineer once told me an excellent analogy of the non-effect of the grooves on the web in this application (I can't take credit for the analogy); if you place a plow in a field, does the field plow itself by the rotation of the earth? Of course not, and the reason is because the tangent point of the plow in the field remains constant with the earth in its rotation. See figure 18.

However, it should be stated that a grooved roll, applied as an idler roll (or driven at the same speed as the web), will remove the layer of air caused in an application where air entrainment is a problem. The groove profile can allow the layer of air a place to go and be exhausted from between the web and roll face.



EXAMPLE OF A GROOVED ROLL SPREADER ROLL BEING USED AS AN IDLER ROLL.

WHEN A GROOVED ROLL IS USED AS AN IDLER ROLL, THE GROOVES DO NOT PUSH THE WEB OUTWARD TOWARD EACH EDGE OF THE ROLL FACE. THIS EFFECT IS MOSTLY AN OPTICAL ILLUSION SIMILAR TO A ROTATING BARBER SHOP POLE. AS SHOWN IN THE THREE VIEWS TO THE LEFT (DEPICTING A GROOVED ROLL ROTATING FROM A START POINT TO 90° AND FINALLY 180°), THE TANGENT POINT WHERE THE WEB FIRST TOUCHES THE ROLL FACE TO WHERE IT LEAVES (180° FROM THE START POINT) REMAINS IN A CONSTANT POSITION RELATIVE TO ROLL FACE, THROUGH THE ROTATION OF THE ROLL.

WRINKLE REMOVING RESULTS CAN STILL BE REALIZED BY USE OF THIS TYPE OF ROLL, AS AN IDLER ROLL, BECAUSE IT WILL HELP GREATLY TO ALLEVIATE AIR ENTRAINMENT PROBLEMS (SEE CAUSES OF WRINKLES IN WEBS SECTION OF THIS PRESENTATION).

THIS EXAMPLE IS SHOWN WITH ONE - "LONG LEAD" THREAD, STARTING IN THE CENTER AND LEADING TO EACH EDGE OF THE ROLL FACE FOR CLARITY.

FIGURE 18

- This type of roll does not have a smooth surface so it has the potential to mark the web surface.
- Some materials may deform across the web face and the groove will actually form in the profile of the web causing wrinkles.

Advantages when used as a “dead bar” or driven slower or faster than the web:

- All the advantages as an idler roll plus one more.
- When the surface speed of this type of roll is not synchronized with the web speed (standing completely still is included here) then we get a different level of performance with this type of roll. When this is the case, the grooves will push the web outward toward each edge of the roll face. This effect occurs because the tangent point where the web touches the roll face is ever-changing as the web travels around the circumference of the roll. The changing position of this tangent point ensures that the web, at that point, will travel in the direction the groove is facing. See figure 19.

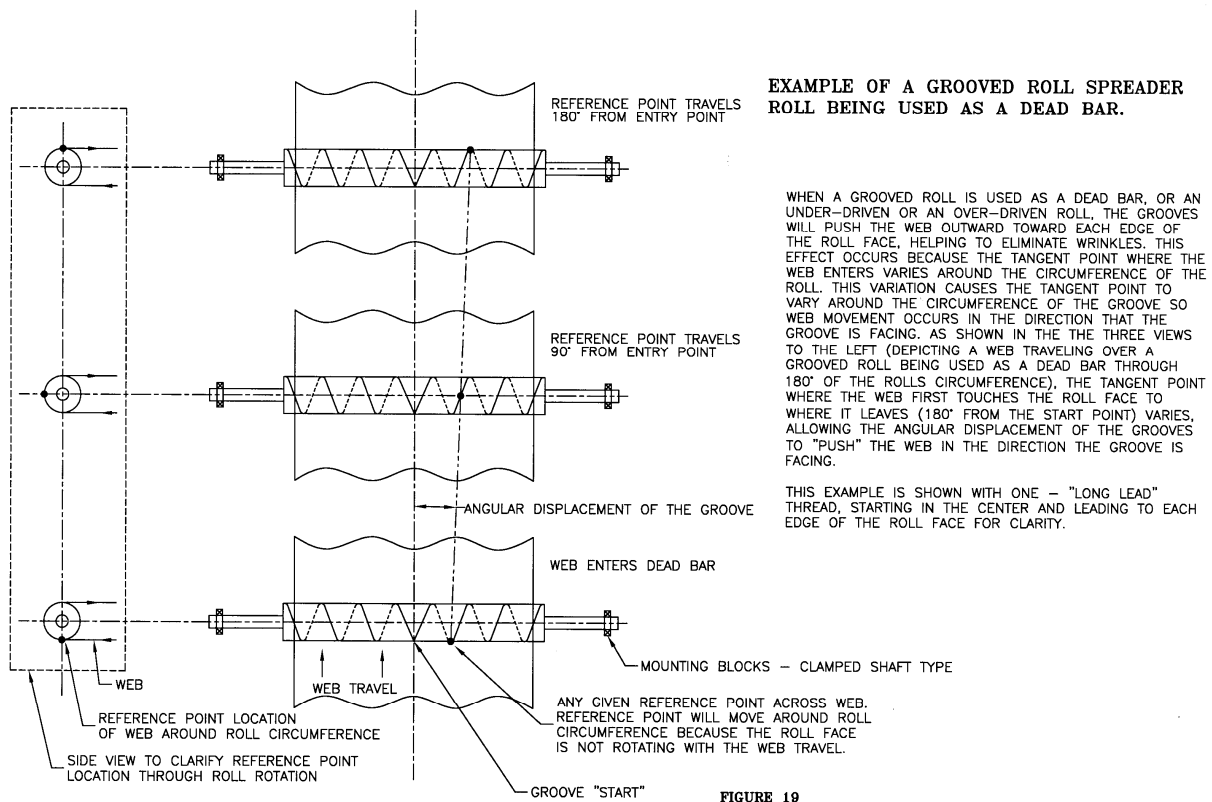


FIGURE 19

Disadvantages when used as a “dead bar” or driven slower or faster than the web:

- Web marking and scratching will occur much more frequently than with spreader rolls that rotate, at the same rate, with the web.
- When there is speed differential between the roll face and the web, the web is not in traction with the roll. For this reason the web position can vary across the roll

face causing edge guiding and possibly wrinkling problems down-line of this spreader roll.

Grooved Roll – Soft Flexible Rubber

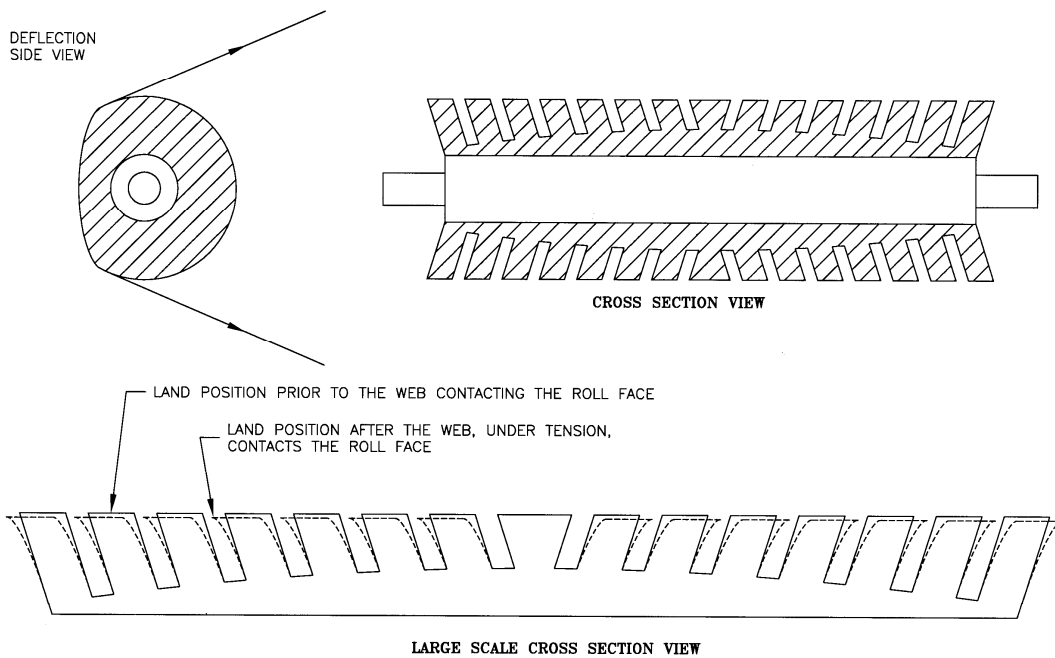
Description:

A soft flexible grooved roll can be manufactured from different types of rubber compounds, but what is most important is that the rubber is soft enough to flex under the pressure of the web tension. The flexible grooved roll has grooves machined under its' surface. The grooves must be precisely spaced. The groove depth is varied across the roll face, as the grooves move out from the center of the roll, they get deeper. This depth variance is even across the face of the roll and must be accurately controlled.

Theory of operation:

As this roll rotates with the same surface speed as the web, it has flexible lands (created by grooves machined into the surface of the soft rubber face), which deflect under the webs tension. The lands deflect in the direction they are angled, from the center out to each edge of the roll face. The depth of the grooves increases from the center out to each edge of the roll face. The reason for the depth adjustment out to each edge of the roll face is so each land will flex more than the land next to it, ever increasing from the center of the roll. The difference in flex amount between each land is important because it provides for web spreading between each land. In other words if all the lands flexed exactly the same amount, spreading would be achieved only in the center of the web, there would be no spreading from land to land. See figure 20.

FLEXIBLE – SOFT RUBBER GROOVED ROLL



AS THIS ROLL ROTATES, THE WEB, UNDER TENSION, DEFLECTS THE LANDS ALONG THE FACE OF THE ROLL, IN THE DIRECTION THAT THE GROOVE IS FACING. THIS ROLL REMOVES WRINKLES BECAUSE THE PRESSURE OF THE TENSION ON THE WEB ACROSS THE FACE CREATES THE FLEXING ACTION OF THE LANDS FROM THE CENTER OF THE ROLL OUT TO EACH EDGE OF THE ROLL FACE. THIS ROLL MUST ROTATE (IT CAN NOT BE USED AS A DEAD BAR), SO THE SURFACE SPEED OF THE ROLL MATCHES THE SURFACE SPEED OF THE WEB (NORMALLY AN IDLER ROLL).

FIGURE 20

Recommended wrap angle for this type of spreader roll is strictly application dependent and can vary between 30° to 180°

Advantages:

- This type of spreader will remove air when air entrainment is a problem. This will help keep the web in traction with this roll improving its' operation.
- Because this roll is linear across its face, it will not stretch distort or tear any portion of the web.
- Because of its soft surface, this roll will not mark or scratch the web.
- This type of spreader is used with all types of webs.

Disadvantages:

- While the lands do flex under the pressure of the tension on the web, they will return to their natural position as the pressure is being relieved. The pressure is relieved as the web exits the roll. As the lands flex back to their natural position, some of the wrinkles the roll removed may return.
- This roll does not have a smooth surface, so some webs may deform inside the groove, taking on the profile of the groove.

Nip Type (each edge of the web) Spreader Roll

Description:

Nip type spreader rolls are normally short face rolls (less than 12" face) and small diameter (less than 3" diameter). These rolls are supplied in a left and right hand set. Each set consists of 2 rolls pre-loaded so each roll face is pressed together; these roll faces must be parallel with each other. Each roll set is very similar in design to other nip rolls used in converting (such as drive nips). One of the rolls in each set must be rubber covered (for traction); sometimes both rolls in the set are rubber covered. See figure 21.

NIP TYPE SPREADER LEFT SIDE ONLY SHOWN

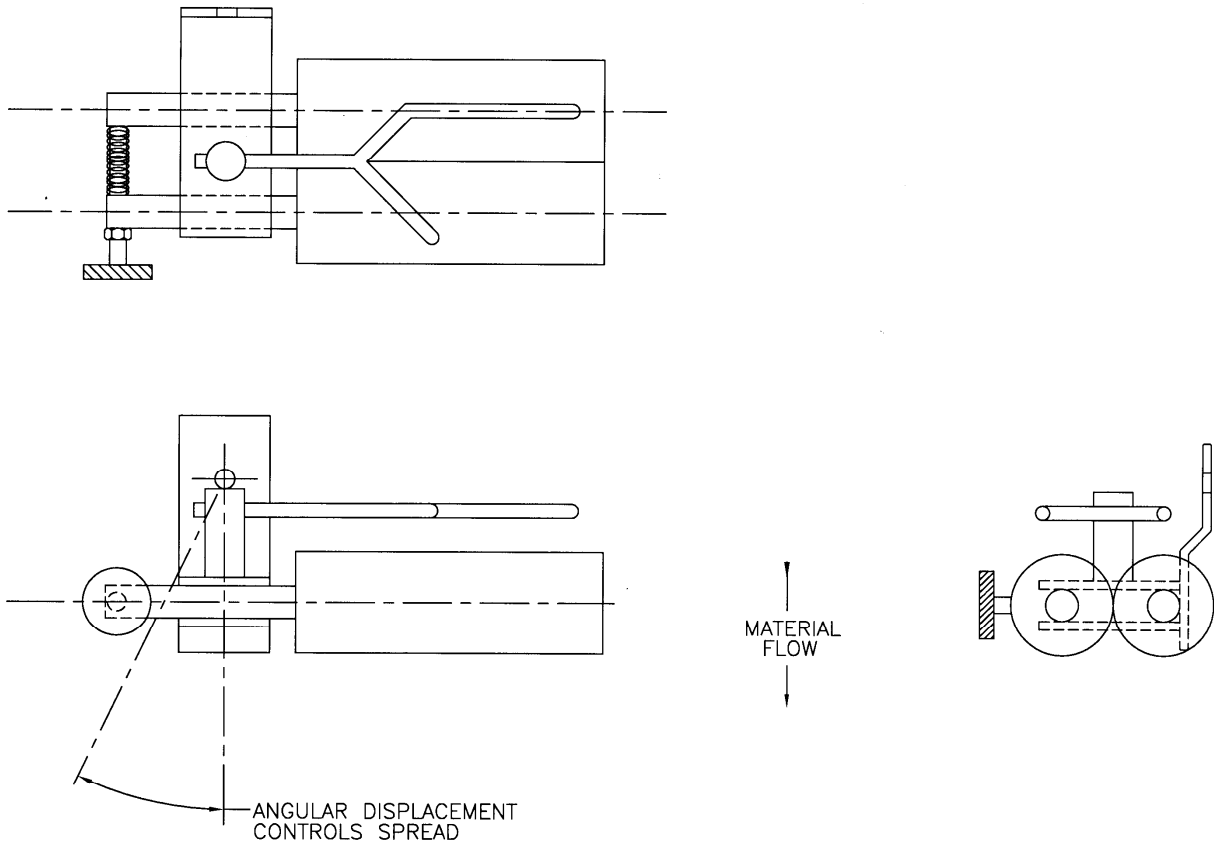


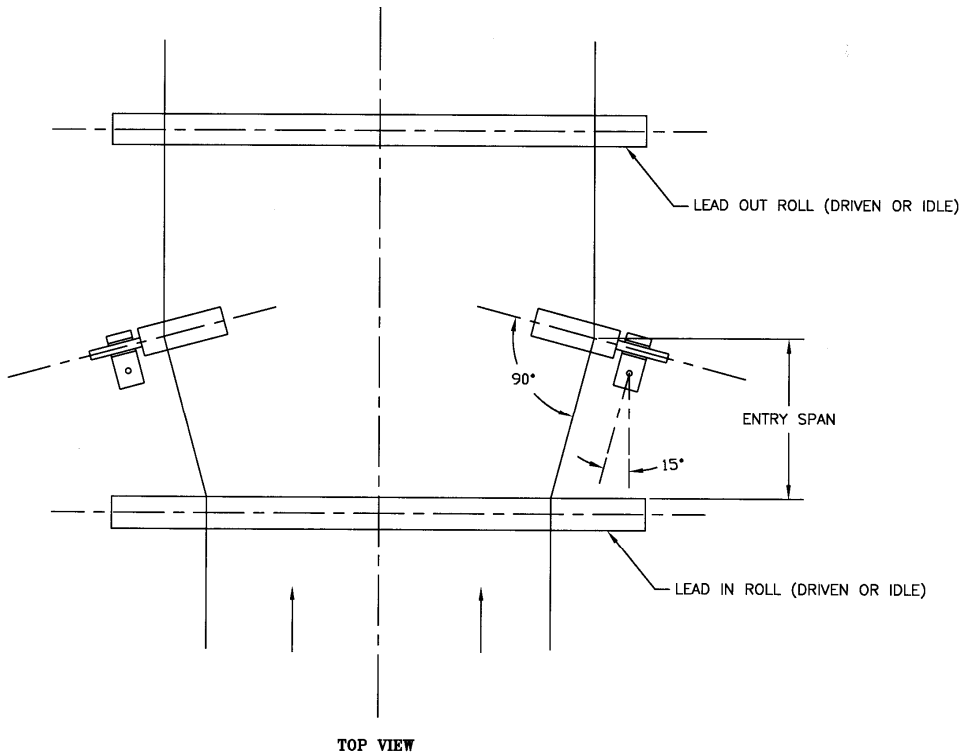
FIGURE 21

Theory of operation:

The left and right side nip sets are mounted to the machine frame and each edge of the web is fed through the nip rolls. The left and right side nip roll sets are then angled away from each other, facing in the down stream direction. Because of the web handling principal, that a web will seek to align itself perpendicular to a roll, in its entry span to that roll, each web edge will seek to be perpendicular to each nip roll set. This type of

spreader roll is extremely aggressive and will spread more aggressively than any other type of spreader roll presented here. See figure 22

NIP TYPE SPREADER ROLL – APPLICATION



THIS TYPE OF SPREADER ROLL REMOVES WRINKLES BASED ON THE WEB HANDLING PRINCIPAL THAT A WEB WILL SEEK TO ALIGN ITSELF PERPENDICULAR TO A ROLL, IN ITS ENTRY SPAN TO THAT ROLL. THE FACT THAT THE WEB MUST BE IN TRACTION WITH THE ROLL IS WHY THE ROLLS IN THIS APPLICATION MUST BE NIP ROLLS. USUALLY, TO IMPROVE TRACTION, AT LEAST ONE OF THE ROLLS IN THE NIP ROLL PAIR IS RUBBER COVERED (SOMETIMES BOTH ARE RUBBER COVERED).

THIS TYPE OF WRINKLE REMOVAL DEVICE IS EXTREMELY AGGRESSIVE AND PROBABLY WILL REMOVE MORE WRINKLES THAN ANY OTHER TYPE OF SPREADER ROLL DISCUSSED IN THIS PRESENTATION. IT'S USE IS VERY LIMITED HOWEVER, BECAUSE IT WILL MARK AND DISTORT MOST TYPES OF WEBS ON THEIR EDGES.

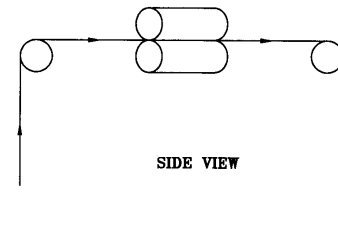


FIGURE 22

This type of spreader roll has no wrap angle. Because the web is not supported across its full width, the material must be fed straight in and out of this spreader roll assembly.

Advantages:

- This type of spreader roll is the most aggressive.
- Simplicity of design makes this type of spreader roll easy to maintain.
- The amount of spreading is easily adjustable, by changing the angle of each nip set independently of each other.
- Works well with woven and non-woven webs.

Disadvantages:

- Because this spreader roll will not support the web across its full width, it will mark, distort and possibly tear most foils and films.

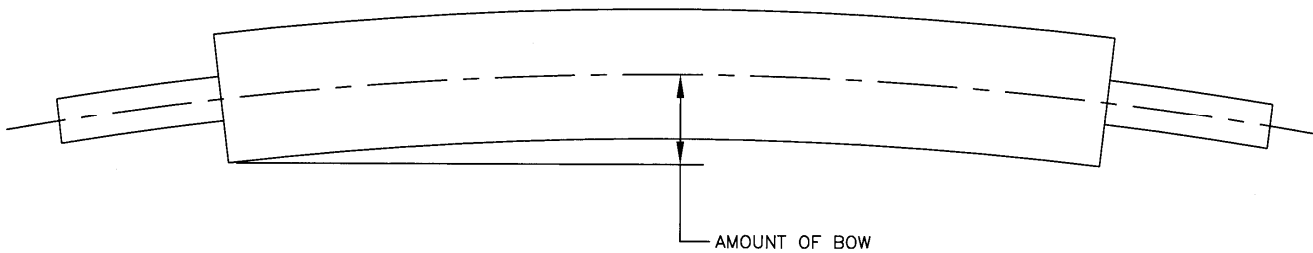
- This type of spreader roll is specifically designed for woven and non-woven materials. Any other type of materials may have difficulty with this type of spreader roll, because of web distortion.

Curved Axis (Bowed) Spreader Roll

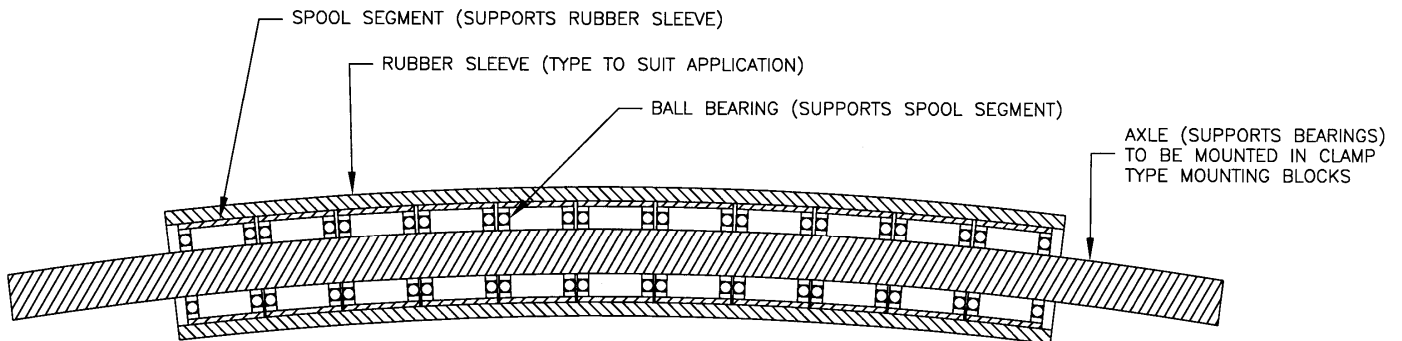
Description:

A Curved Axis (Bowed) Roll spreader roll is manufactured exactly as the name states – the center axle of the roll is bowed (not linear). A series of internal ball bearings, supported by the axle, in turn support a rubber sleeve which is continuous across the face. The amount of curve (bow) in the roll face is application dependent and is available in both an adjustable and non-adjustable version. See figure 23.

EXAMPLE OF A CURVED AXIS (BOWED) ROLL CONSTRUCTION



CURVED AXIS (BOWED) ROLLS ARE AVAILABLE WITH BOTH FIXED AND ADJUSTABLE AMOUNT OF BOW.



CROSS SECTION VIEW

FIGURE 23

Theory of operation:

This roll works based on two different spreading principals.

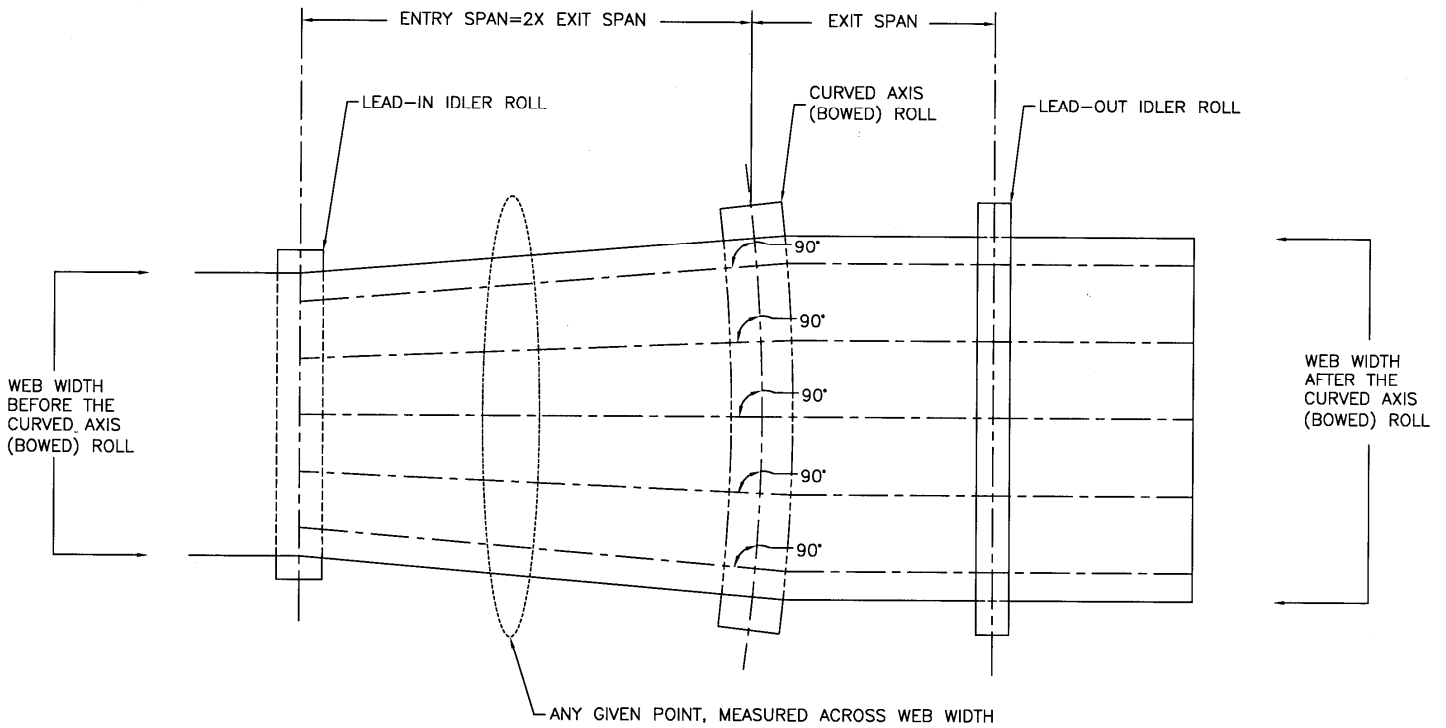
First, as we know, a web will seek to align itself perpendicular to this roll (as long as it is in traction with the roll). This causes the web to spread at any given interval across its width as it tries to maintain the 90° tangent points across the web width.

Second, the rubber sleeve, which spans the roll, is actually narrower on the entry side than the exit side, so as it rotates, the rubber sleeve stretches and the material, laying on top of the rubber surface, stretches with it.

Because this roll normally operates best with minimal wrap angle the first spreading principal does most of the work. Less surface contact between the web and the rubber sleeve means less stretching principal will effect overall spreading. However, the spreading based on web handling principal is hardly affected by wrap angle.

See figure 24.

**CURVED AXIS (BOWED) ROLL SPREADER ROLL APPLICATION
TOP VIEW**



THIS TYPE OF SPREADER ROLL WORKS, BASED ON THE WEB HANDLING PRINCIPAL THAT A WEB WILL SEEK TO BE PERPENDICULAR TO A ROLL IN THE ENTRY SPAN TO THAT ROLL. THIS TYPE OF SPREADER ROLL IS A VERY AGGRESSIVE SPREADER ROLL.

FIGURE 24

Recommended wrap angle is usually less than 30°. Many times, when it appears a curved axis (bowed) roll is not operating properly, this is due to wrap angles too great for the

application. More important than wrap angle, lead-in and lead-out distances are critical. Typical lead-in (entry span) to the curved axis (bowed) roll should be approximately double the lead-out distance (exit span). As you can see in figure 24, most of the spreading caused by this roll is done in the entry span to this roll, so the longer the entry span is, the more spreading will be realized. The exit span should be kept to a minimum so the web stays spread. The longer the exit span is, the more chance there is for the spreading affect to be lost (or the web may return to its wrinkled or natural state).

Advantages:

- This type of spreader roll is an aggressive spreading device.
- This spreader roll is used most often for all types of spreading applications. It is accepted for all facets of converting from narrow web to wide web (it is especially used in wide web applications) and slow speed to high speed.
- This type of spreader roll is used with all types of webs in all types of converting processes.
- It is available with a multitude of different sleeve compounds including abrasion resistance and reinforced (for extremely high speed applications).
- This roll is available in both adjustable and non-adjustable versions.
- It will spread multiple slit widths evenly, the only spreader roll used for this application.
- This roll has a smooth surface, so it will not mark or scratch the surface of the web.

Disadvantages:

- This roll is not linear, so it can permanently distort or tear the center of a web because tension is not evenly distributed across the face of this roll as the web travels over it.
- Maintenance is involved and normally this roll must be returned to the manufacturer to be maintained.
- Because the rubber sleeve is dynamic (it constantly stretches and contracts with each revolution) the rubber sleeve does wear over time.

Curved Axis (Bow) Bar (stationary, does not rotate)

Description:

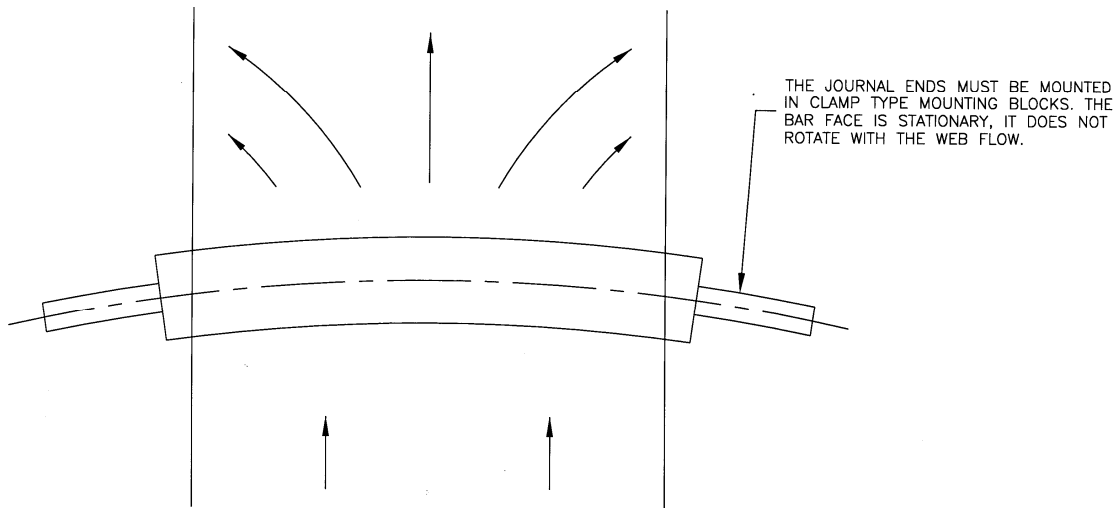
A Curved Axis (bow) bar spreader bar can be manufactured from steel or aluminum. Many times this spreading device is nothing more than a pipe, curved, using a pipe bender.

Theory of operation:

This spreading device works differently than a curved axis (bowed) roll. The web handling principals that effect web behavior for a curved axis (bowed) roll are not the same as the effects of a curved axis (bow) bar. The web must slip over the face of this bar because it is stationary, it does not rotate. Therefore, the web is not in traction with the bar so the web handling principal that affects the web where a bowed roll is used does not apply here. Instead, the curved axis (bow) bar works based on a tension differential

generated by the raised center of the bar. The center, being raised, has the highest tension. The tension decreases toward the bar ends. This tension differential causes wrinkles to be pushed out from the center of the web. The web is attempting to flow through the path of least resistance, which is closest toward the ends of the bar. See figure 25

SIMPLE EXAMPLE OF THE THEORY OF OPERATION FOR A CURVED AXIS (BOW) BAR



THEORY OF OPERATION:
 BECAUSE THE TENSION ACROSS THE BAR FACE IS NOT EVENLY DISTRIBUTED (HIGHER TENSION IN THE RAISED CENTER, LOWER TENSION TOWARD THE ENDS), THE DIFFERENTIAL IN TENSION WILL CAUSE WRINKLES IN THE CENTER OF THE WEB TO MOVE TOWARD THE LOWER TENSION ENDS (THE WEB IS ATTEMPTING TO FLOW THROUGH THE PATH OF LEAST RESISTANCE). THIS ROLL DOES NOT ROTATE, SO THE WEB IS NOT IN TRACTION WITH IT. THE WEB HANDLING PRINCIPAL DOES NOT AFFECT SPREADING ON THE WEB AS IN THE CASE WITH THE CURVED AXIS (BOWED) ROLL.

FIGURE 25

Recommended wrap angle for this spreading device can be from 15° to 90°. Most applications require minimal wrap. More wrap angle usually means more potential web distortion.

Advantages:

- This spreading device is extremely easy to manufacture. A pipe bender is all that is required.
- This spreading device has a smooth surface.
- Low maintenance (no moving parts).
- This type of spreader will separate slit widths. However, the amount of spreading is completely tension driven. If tension is not accurate and even across the web, slit spacing may not be kept consistent and even.
- This type of spreading device is used with woven, non-woven and paper webs.

Disadvantages:

- This type of spreader is not linear, so it can permanently distort or tear the web center.
- The amount of bow required is application dependent and there is no set formula for generating the amount of bow. Bow amounts are normally determined through trial and error or past experience.
- This type of spreader can scratch and mark the web because the face does not rotate with the web flow.
- This bar will create drag on the web; tension problems may result down stream of this spreading device.

Expanding Surface Spreader Roll – Slat Type

Description:

A Slat Expander spreader roll is manufactured with slats that move along the roll face as it rotates. The slats are manufactured from aluminum, steel or wood. The slats appear from the outside of the roll to be separate from each other.

Theory of operation:

This roll has many slats that slide along the face from the center out to each roll end. The spreading occurs on the roll face as opposed to the entry span to the roll (as with other types of spreader rolls). The slats are engaged, mechanically, under the roll face and as this roll is driven (usually by the web, as an idler), the slats are mechanically pushed from the center to each roll end for 180° of rotation. For the next 180° of rotation, the slats move back toward the center of the roll. The web enters the roll face where the slats are closest to the center and exits where the slats are farthest from the center (closest to the roll ends). As the slats move toward the roll ends, under the surface of the web, wrinkles are removed. See figure 26.

SLAT EXPANDER THEORY OF OPERATION

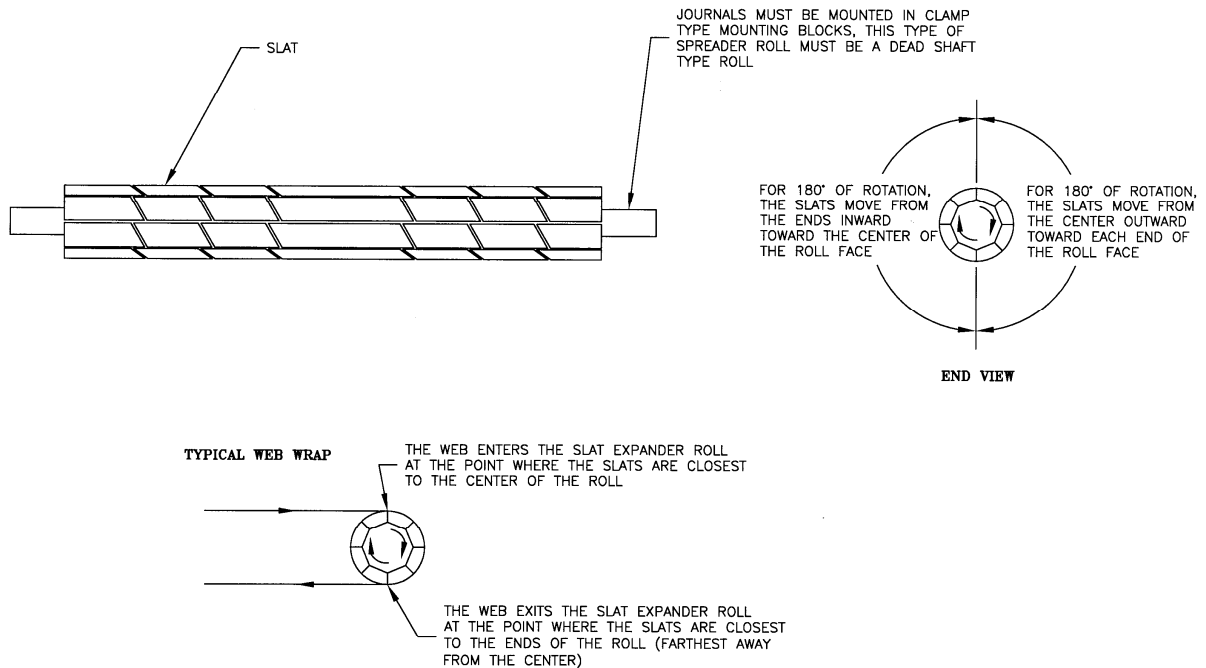


FIGURE 26

Recommended wrap angle for this roll is from 90° to 180°. More wrap (up to 180° maximum) means more spreading. The amount of spreading is directly proportional to the amount of wrap angle. In other words 180° of wrap will provide for 100% of possible spreading, 90° of wrap will provide 50% of possible spreading, 45° of wrap will provide 25% of possible spreading, etc. Lead-in and lead-out distances are not critical in the application of this type of spreading device.

Advantages:

- This type of spreader roll is an aggressive wrinkle removal device.
- This roll is linear across its face, so tension remains evenly distributed across its face.
- This roll will not permanently distort or tear the center or edges of a web.
- This roll is manufactured for use with mainly woven and non-woven webs.

Disadvantages:

- This roll does not have a smooth surface so many webs can be marked, scratched or deformed from the use of this roll.
- This roll can be a high maintenance device. It has many moving parts.
- The amount of spreading is not adjustable.

Expanding Surface Spreader Roll – Polymer Band Type

Description:

A Polymer Band Expander spreader roll is normally manufactured with an aluminum roll face. The roll face has longitudinal grooves cut below the surface in a shape corresponding to the shape of the polymer bands. Polymer bands are laid down into the grooves with their surface raised above the surface of the roll face. The ends of the polymer bands are clamped on each end with clamping end collars. The end collars are mounted on bearings, as is the roll face so they rotate together. The only thing connecting the roll face and the end collars are the polymer bands.

Theory of operation:

This roll must be mounted as a dead shaft idler or driven roll in order to operate properly. The clamping end collars, on each end of the roll face, clamp the ends of the polymer bands. The collars are mounted on bearing and axle assemblies, which allows the collars to be canted, relative to the axis of the roll face. The canting action is designed so the collars face in, toward each other, on one side of the roll face, and out, away from each other, on the opposite (180°) side of the roll face. As this roll rotates, the polymer bands expand for 180° of rotation, from the point where the end collars face toward each other to where they face away from each other. The polymer bands then contract for 180° of rotation, from the point where the end collars face away from each other to where the end collars face toward each other. The web must enter the roll in the 180° portion where the polymer bands are expanding and exit prior to the 180° portion where the polymer bands are contracting.

POLYMER BAND TYPE EXPANDING SURFACE SPREADER ROLL

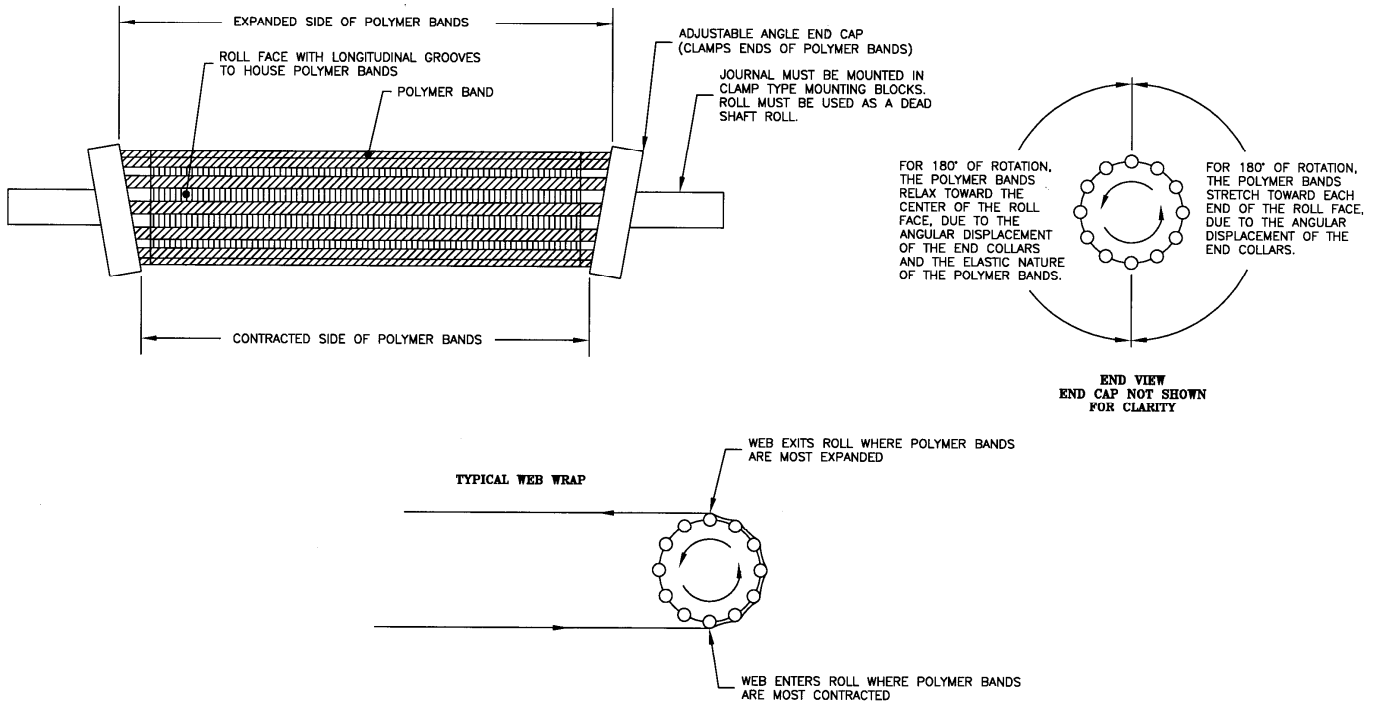


FIGURE 27

Recommended wrap angle for this roll is from 90° to 180°. More wrap (up to 180° maximum) means more spreading. The amount of spreading is directly proportional to the amount of wrap angle. In other words 180° of wrap will provide for 100% of possible spreading, 90° of wrap will provide 50% of possible spreading, 45° of wrap will provide 25% of possible spreading, etc. Lead-in and lead-out distances are not critical in the application of this type of spreading device.

Advantages:

- This type of spreader is an aggressive wrinkle removal device.
- This roll is linear across its face, so tension remains constant in the cross machine direction as the web travel over the roll face.
- This roll will not distort or tear the center or edges of a web.
- The amount of spreading is adjustable.
- This roll is used with all types of webs.

Disadvantages:

- This roll does not have a smooth surface so many webs can be marked, scratched or deformed from use of this roll.
- The raised surface of the polymer bands can cause wrinkles in the cross machine direction.

- The polymer bands are dynamic in their use, so they will wear over time.

Expanding surface Spreader Roll – Continuous Rubber Sleeve Type

Description:

This type of spreader is manufactured with a rubber sleeve stretched across its face. On each end of the rubber sleeve there are end collars that clamp and hold the sleeve in place. The end collars are mounted on bearings and an adjustable axle. The sleeve is mounted across a series of flexible rubber disks. The rubber sleeve and end caps rotate together.

Theory of operation:

This roll must be incorporated as a dead shaft idler roll, in order to operate properly. The continuous rubber sleeve is pre-loaded across the face of the roll. The end collars are clamped on to each end of the rubber sleeve. The end collars are then canted with an adjustment screw and flange-axle assembly. The canting adjustment is designed so that the collars are facing each other on one side of the roll face and they are away from each other on the opposite (180°) side of the roll. The continuous rubber sleeve stretches from the point where the collars are facing each other, to where the collars are away from each other. The sleeve then contracts for the next 180° of rotation, from where the end collars are facing away from each other to where they are facing toward each other. Bottom line, the rubber sleeve physically stretches from the short side of the rubber sleeve to the long side of the rubber sleeve, then contracts again. The web enters the contracted side of the rubber sleeve and exits on the expanded side. As this roll rotates, the stretching action of the rubber sleeve spreads the web. See figure 28-31.

EXPANDING SURFACE TYPE SPREADER ROLL, UTILIZING A CONTINUOUS RUBBER SLEEVE

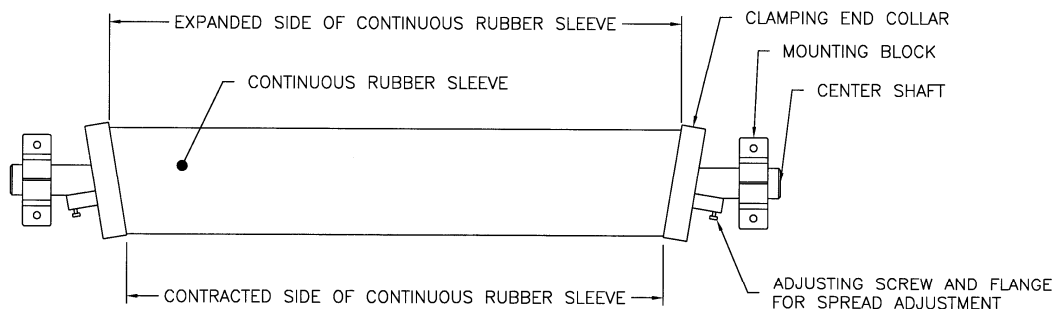
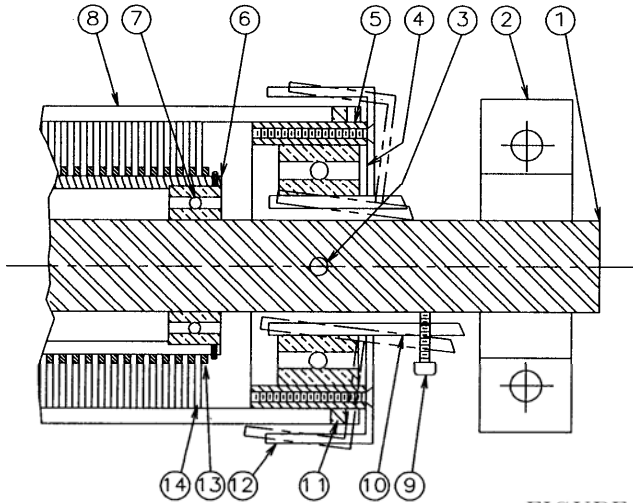


FIGURE 28

CROSS SECTION VIEW
EXPANDING SURFACE SPREADER ROLL
CONTINUOUS RUBBER SLEEVE TYPE



Adjusting Screw (9) lifts Ring (10), and Cap (12) which expands Sleeve (8), thus Spreading any Material in contact with the roll at this point.

- 1 - CENTER SHAFT
- 2 - MOUNTING BRACKET
- 3 - PIVOT PIN
- 4 - OUTER BEARING
- 5 - OUTER BEARING RING
- 6 - DISC TUBE
- 7 - DISC TUBE BEARING
- 8 - RUBBER SLEEVE
- 9 - ADJUSTING SCREW
- 10 - ADJUSTABLE OUTER BEARING RING
- 11 - RUBBER SLEEVE CLAMP
- 12 - END CAP
- 13 - DISC SPACER
- 14 - FLEXIBLE DISC

FIGURE 30

END VIEW SHOWING WRAP ANGLE
EXPANDING SURFACE SPREADER ROLL
CONTINUOUS RUBBER SLEEVE TYPE

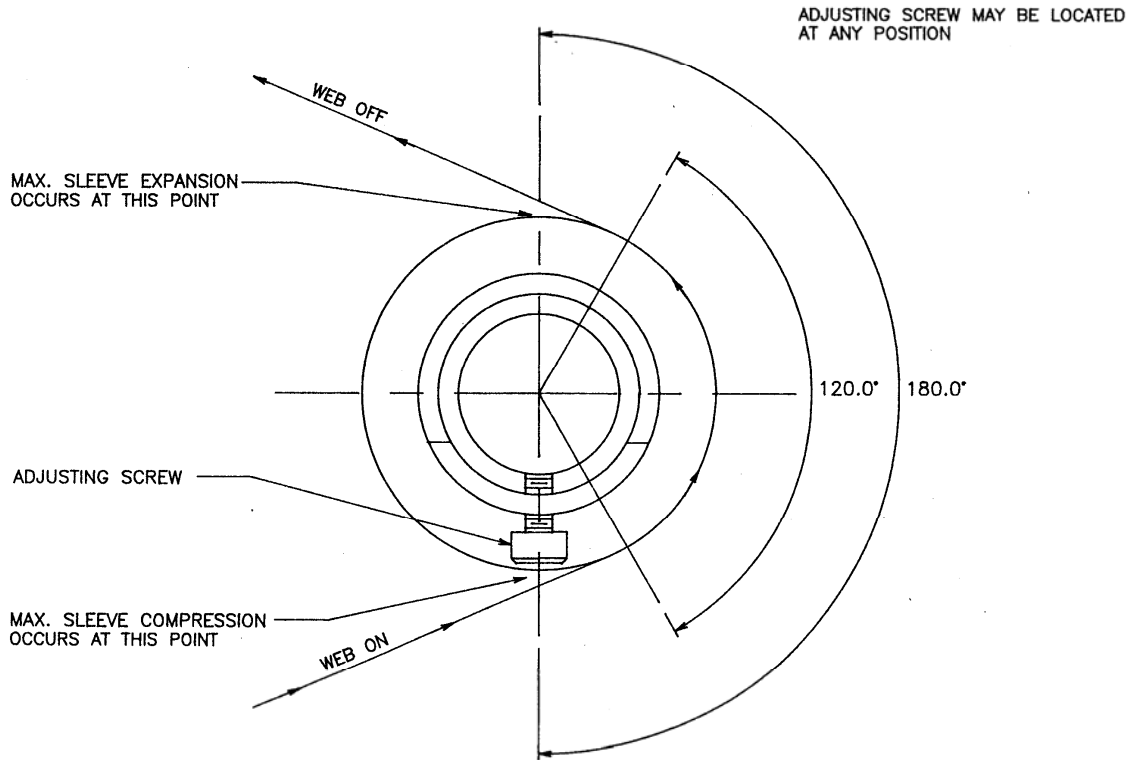


FIGURE 29

THEORY OF OPERATION
EXPANDING SURFACE SPREADER ROLL
CONTINUOUS RUBBER SLEEVE TYPE

A = LEAD IN
B = WRAP ANGLE
C = END CAP ANGULAR DISPLACEMENT
D = SLEEVE @ ZERO STRETCH
E = SLEEVE @ MAX. STRETCH

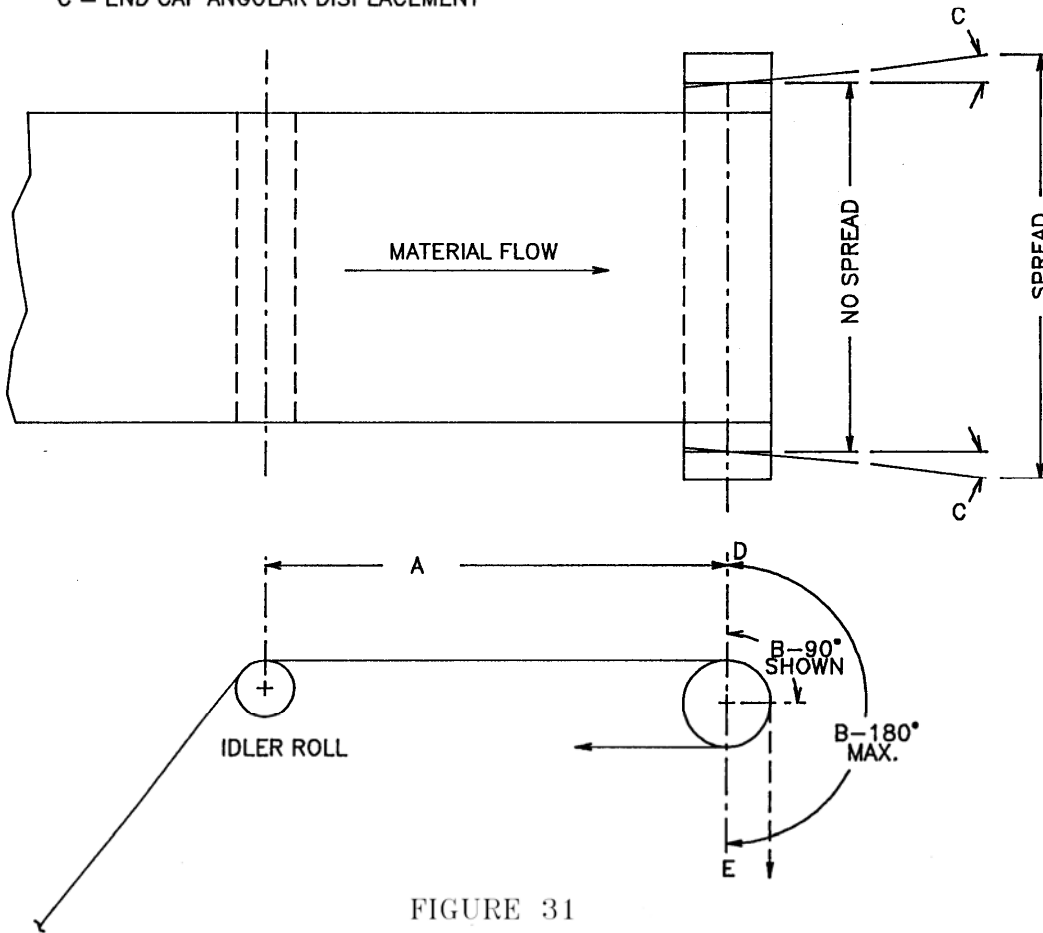


FIGURE 31

Recommended wrap angle for this roll is from 90° to 180°. More wrap (up to 180° maximum) means more spreading. The amount of spreading is directly proportional to the amount of wrap angle. In other words 180° of wrap will provide for 100% of possible spreading, 90° of wrap will provide 50% of possible spreading, 45° of wrap will provide 25% of possible spreading, etc. Lead-in and lead-out distances are not critical in the application of this type of spreading device, because all or most of the web spreading is taking place on the roll face, not in the entry span to the roll.

Advantages:

- This type of spreader is an aggressive wrinkle removal device.
- Spreading amount is adjustable from 0% (no spreading) - 100%.

- Spread adjustment can be made from each end of the roll, independent of each other, while the machine is running and with standard tools.
- This roll is linear across its face, so tension remains evenly distributed across the roll face.
- This roll will not distort or tear the center or edges of a web.
- It is available with a multitude of different sleeve compounds including abrasion, chemical and heat resistance and release for adhesive applications.
- Roll surface is smooth and linear so it will not mark, scratch or deform a web.
- This roll is used with all types of webs.

Disadvantages:

- Web speeds are a consideration when utilizing this roll. If the web speed causes the sleeve to balloon, as a result of centrifugal force, then the effect on web may be reduced.
- The sleeve is stretching and contracting with every revolution, so the continuous rubber sleeve will degrade over time.
- Although spreading does occur across the full width of the roll face, most of the spreading occurs toward the ends of the roll face, so the amounts of spreading are not even in measured increments across the face of this roll.

The future of spreader roll technology:

As converting processes run thinning webs faster and wider, more answers to solve wrinkling problems are required. Today's converter wants to run more types of webs with the highest level of productivity. Converters will be looking for spreader rolls to remove wrinkles, at high speeds, with no web distortion. Continuing advances in spreader roll technology must strive to supply converters with products and service to gain the highest level of productivity.