What type of **web guide** do you need?

For a winning hand at web guiding, follow these three easy steps.

By Ken Hopcus, Web Handling Applications Engineering Manager, Fife Corp.

If converting was like a good night of poker, every input roll would be flush, every web would be straight, and every two rollers would be a parallel pair. But in the real world, whether Texas Hold 'Em or converting, you will be dealt many bad hands for every nice one. Rolls are telescoped or offset, webs are cambered or baggy, and rollers are out of alignment or deflecting. These imperfections will all contribute to off-tracking of the web.

A little off-tracking is okay, but too much lateral shifting can create big problems. Automatic web guides are the Ace up your sleeve that you need to turn a bad hand into a winner.

To find a winning hand in web guiding, there are three easy steps. One—determine where you need lateral position accuracy. Two—choose which web guide will best meet your needs at each guiding location. Three—install the web guides in each location following the application guidelines. Once you decided which type of guides you will use in your process, the next step is to ensure each is installed properly.

Four "edge position controllers"

There are four types of web lateral-position control systems (sometimes called web guides or edge position control/EPC): unwind sidelay guide, displacement guide, steering guide and winder sidelay guide. Three of these are truly web-guiding systems (unwind sidelay, displacement, and steering), redirecting the web to the correct lateral position. The last option, winder sidelay, doesn't actually guide the web, but instead moves the equipment to meet or chase the web.

The correct web guide, set up properly, at the right location will give you a winning hand every run for every product. Keep reading to understand how to determine the right type of guide by process location and some rules to set up each type of guide. But don't worry. You don't have to play all these cards by yourself. You can trust that the professionals who have been working on web guides for years will ensure that any guide you install will give you a winning hand.

Let's break down Steps 1 and 2 into three possible web guide locations: At the input or unwind of your process, at any intermediate location between unwinding and winding, and at the winding process (See Table 1). Next are application guidelines for the four types of web guides along with five basic questions you should answer about each.

Unwind Sidelay

The unwind sidelay guide positions the web so the web enters the machine at the desired lateral position. The unwind guide corrects for incorrect placement of the roll of web on the unwind shaft, and roll defects such as telescoped wraps in the roll.

Where should the web sensor be? The sensor is a fixed reference to where you want the web to be. It should be placed immediately downstream of the unwind sidelay guide between the last shifting roller and the first non-shifting roller. As the web unwinds, at least the first roller it contacts should be sidelay shifted with the unwinding roll. This establishes a fixed web path to detect the web that doesn't change as the roll diameter decreases. Also, this roller should have sufficient traction to prevent the shifting span to send any lateral forces back to the unwinding roll.

What are recommended web span lengths? The shifting span is usually 0.5 to 1.0 web widths in length, but since there is no intentional twisting or bending, these spans can be as short as 25 percent of the web's width.

What are the recommended wrap angles? Since sidelay guiding has no significant twisting or bending, there are no critical wrap angles.

How important is good web-to-roller traction? To prevent upsetting the unwinding roll, there should be enough traction on a roller or rollers to isolate the unwinding roll from any tension variations in the correction span.

What other factors are important to this type of web guide? The sidelay guide needs to have sufficient actuator size and good structural rigidity between the actuator and the winding roll to prevent undamped oscillations.

Table 1: Determining Web Guide Locations & Types		
Guiding Location	**Where do you need to laterally align your web?**	**What type of web guide is best for your application?**
Input Guiding	For processes that start with an unwinding roll, the incoming material should be centered on the transport roller's face width.	Either an unwind sidelay or a displacement guide are compact, effective options to correct for offset or shifted layers in the input roll. An unwind sidelay guide has the simplest web path, but does require lateral shifting of the unwinding roll. A displacement guide immediately downstream of the unwind stand adds to the web path complexity, but will guide the web with a smaller actuator without shifting the winding roll.
Intermediate Guiding	As the web moves through a process it may have many web-to-equipment or web-to-process alignment requirements such as avoiding contact with sidewalls or slots and entering centered to coating, laminating or slitting processes.	Either displacement or steering type guides are used for intermediate web-to-process needs. Displacement guiding with its easy setup and compact design should be the first choice for intermediate guiding. Steering guides are best used to control the position of a long span.
Winder Guiding	At winding, the web needs to be centered or aligned to the winding core. Successive layers should align to previous wound layers. Either displacement or winder sidelay are compact, effective options for aligning the web to the core and previously wound layers.	A winder sidelay guide is the simplest option, shifting the winder to "catch" the wandering web. Like using a displacement guide at unwinding, a displacement guide immediately upstream of the winder adds to the web-path complexity but will guide the web with a smaller actuator without shifting the winding roll.

Displacement Guides

An intermediate displacement guide is used in areas where span lengths are shorter and a long, free span does not exist. Most displacement guides have two rollers, but the location of two additional rollers that determine the entry and exit span are critical to their proper setup.

Where should the web sensor be? The sensor is a fixed reference to where you want the web to be. It should be placed immediately downstream of the displacement guide between the last shifting roller and the first non-shifting roller. Depending on the displacement angle and the sensor jaw gap, the sensor may need to be one-third or more down the exit span to avoid web contact with extreme displacement twisting.

What are recommended web span lengths? The most common layout is to have entry, displacement, and exit spans all greater than one web width. Longer displacement spans reduce the angle required for a given correction. Entry and exit span minimum should avoid excessive high-edge stress and not create slack in the center of the web.

What are the recommended wrap angles? Displacement guides have two general layouts, either a U-shaped web path where the web exits parallel but in the reverse direction to how it enters, or a Z-shaped path where the web exits parallel and continuing in the same direction it entered. In either U or Z layouts, the web enters and exits perpendicular to the displacement plane.

How important is good web-to-roller traction? Displacement guides are relatively insensitive to web-to-roller traction. However, some small variations in guiding, especially relative to the exit span asymmetrical twisting, can be eliminated by using rollers designed to have good traction at all running conditions.

What other factors are important to this type of web guide? The displacement guide should be a twist-displace-twist geometry. The displacement-guide pivot frame should be installed so the pivot point is centered over the entry span. Though displacement is usually completed between two parallel rollers, alternate designs will displace the web over a single larger roller or any number of rollers mounted on the displacement framework. Displacement guides, with proper setups, are relatively trouble-free compared to the other intermediate guiding option—the steering guide.

Steering Guides

An intermediate steering guide is used where you need to control the position of a long span. Most steering guides have one roller, but the location of three additional rollers that determine the entry, pre-entry, and exit span are critical to their proper setup.

Where should the web sensor be? See Displacement Guides. Sensor position and minimum exit span rules are the same for steering and displacement guides.

What are recommended web span lengths? There are three web spans important to a steering guide's performance: the entry span, the exit span, and the pre-entry span. Con-

trolling the web in the entry span should be viewed as the primary function of any steering guide. Steering guides should be used only when a displacement guide won't meet your needs.

Steering guides work by bending the web in the entry span. If spans are too short, this creates high stress on one edge and slack web on the other. The minimum entry span equations are used to avoid excessive edge stress or a slack edge based on web strain and the guide's correction range.

The classic application of a steering guide is at the exit of a long, unsupported span in a drying or curing oven. Long spans are flexible and prone to large lateral web shifts from web bagginess, roller misalignments or diameter variations, and external forces, such as oven air flow. A steering guide at the end of a long span will actively control the position of the long oven span, preventing the web from tracking off the roller face or crashing into the oven walls.

The minimum exit span is the same calculation as minimum displacement guide entry and exit spans.

What are the recommended wrap angles? The most stable steering guides have a 90-deg turn between the entry and exit spans. Usually, this is a 90-deg wrap on a single roller, but for cases requiring more traction or other functions, a steering guide may have two or more rollers. The pivot plan should be perpendicular to the exit span, creating a twisting action in the exit span (similar to the exit span of a displacement guide). For 90-deg wrapped steering guides, this will make the pivot plane parallel to the entry span.

How important is good web-to-roller traction? Good traction is critical to steering guides, more critical than for the other guiding options. To be able to bend the web in the entry span, a steering guide needs to apply a lateral force to the web. Tensioned webs are like beams and require force to bend. If there is insufficient force to bend the web, the lateral shift will be less than expected, leading to poor control and unstable web guiding.

What factors are important to this type of web guide? A steering guide has a unique motion combining lateral translation and rotation of the pivoting roller(s). The ideal steering unit is setup up to have a pivoting motion perpendicular to the exit span, parallel to the entry span, with a phantom pivot point with a radial arc length equal to roughly two-thirds into the upstream entry span. If the radial pivot radius is too long or too short, the steering guide will have poor control, either under-steering or over-steering the web.

The pre-entry span length should be shorter than the steering guide's entry span length. Steering guides may become unstable if the entry span is short relative to the pre-entry span. The mechanism of this instability is complex, but involves the entry span's tension variations crossing over the upstream roller and creating a web shift in the pre-entry span.

This instability is easily avoided by following the recommended minimum entry spans, ensuring good traction on the roller upstream of the steering guide, and making the pre-entry span length relatively short. Since steering guides typically have long entry spans, this is rarely a problem but should be noted.

Winder Sidelay

Where should the web sensor be? As a chasing system, the sensor serves a different function that the other three web-guiding options. In chase guiding, the sensor seeks the web and is a reference to where the chasing element should be. For a winder sidelay, the sensor moves with the sidelay actuating winder. For more stable control, the sensor should detect the web upstream of the last stationary roller so the winder actuation doesn't interfere with measuring the incoming web's position.

What are recommended web span lengths? The corrections span, between the last stationary roller and first roller on the actuating winder is usually 0.5 to 1.0 web widths in length, but since there is no intentional twisting or bending, these spans can be as short as 25 percent of the web's width.

What are the recommended wrap angles? Since sidelay guiding has no significant twisting or bending, there are not critical wrap angles.

How important is good web-to-roller traction? To prevent upsetting the winding roll, there should be enough traction on a roller or rollers to isolate the winding roll from any tension variations in the correction span.

What other factors are important to this type of web guide? See Unwind Sidelay Guides. ■

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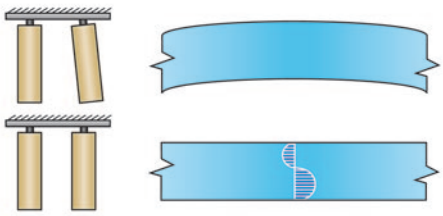
10 Rules of Web Guiding

GUIDING RULE 1
THE NATURE OF THE WEB PROCESS



There are no perfect webs or machines.

GUIDING RULE 2
WEB ALIGNMENT

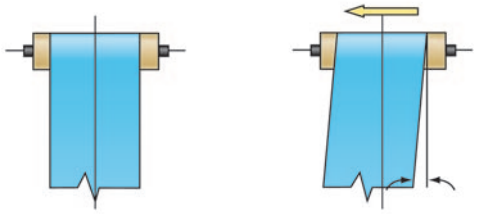
Webs tend to align themselves perpendicular to the approaching roller's axis of rotation. (Also known as the perpendicular entry rule.)

(This can also be described as tending toward entry parallel to the surface vector of the downstream roller or parallel entry rule.)

GUIDING RULE 2 continued
WEB ALIGNMENT

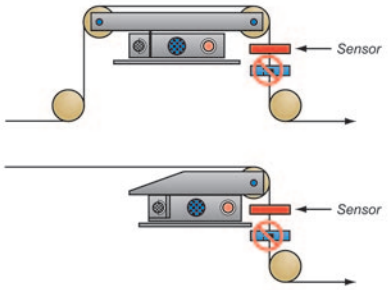
Incoming web is perpendicular to the rotating axis.

Incoming web is moving to become perpendicular to the rotating axis.



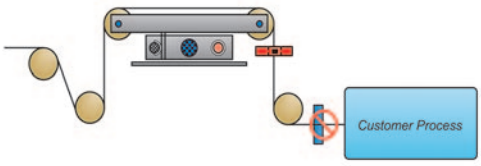
Note:
Velocity is a function of the magnitude of the angle, based on tractional engagement of the roller to the web (lack of traction will cause slippage).

GUIDING RULE 3
SENSOR PLACEMENT



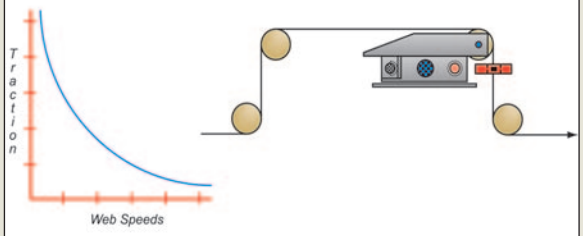
Sensors should be placed immediately after the guide exit rollers, no more than 1/3 of the length down the exit span.

GUIDING RULE 4
GUIDE PLACEMENT



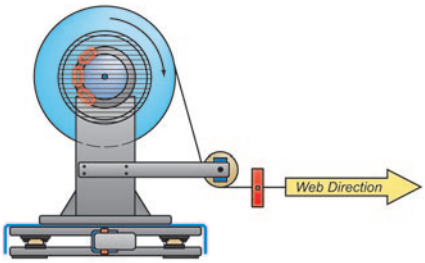
The guide should be placed immediately upstream of where accuracy is required. If the sensor is not located in the upper 1/3rd of the exit span, the control loop will have excessive time phase lag, which will create unsatisfactory guiding results.

GUIDING RULE 5
WEB TRACTION



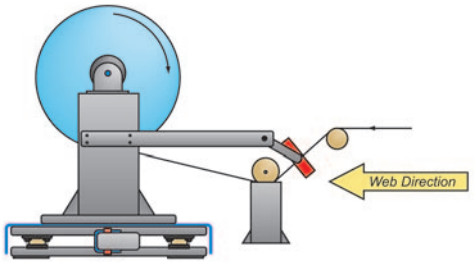
As the graph indicates, the web must not slip on the guide rollers if the guide is to position the web. As web speeds increase, traction on the rollers will decrease.

GUIDING RULE 5 continued
WEB TRACTION



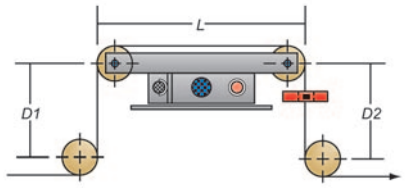
Tension / Hold Back Force at the beginning of the process is an absolute must; without a Hold Back Force accurate web guiding is almost impossible to achieve.

GUIDING RULE 6
WINDER SIDELAY



Winder sidelay guiding is not lateral control of the web, but is chasing the web. The sensor must be located immediately upstream of the last fixed idler.

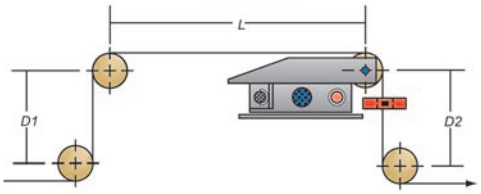
GUIDING RULE 7
DISPLACEMENT GUIDES



D1 = Entry Span *D2 = Exit Span* *L = Guide Span*

The entry (D1) and exit (D2) spans of a displacement guide (a.k.a. offset pivot guide) are 1/2 web width to 15 web widths long, depending upon the guide span and stiffness of the web. For example, thin, flexible materials like plastic require 1/2 web width, while heavier materials like board or steel require 10 or more.

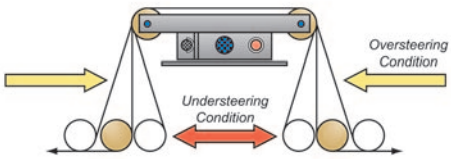
GUIDING RULE 8
STEERING GUIDES



D1 = Entry Span *D2 = Exit Span* *L = Guide Span*

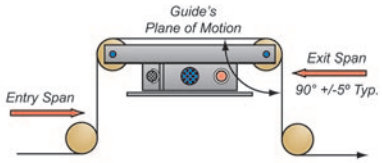
The entry span (L) of a steering guide is 5 to 50 web widths long, depending on the lateral stiffness of the web material. For example, woven textiles require 1 to 2 web widths, while metals require 10 or more. The exit span (D2) is similar in length to the offset pivot guide (see rule 7).

GUIDING RULE 9
ENTRY AND EXIT SPANS



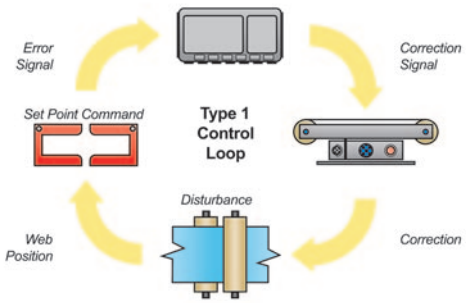
A displacement guide will have the best performance if the entry and exit spans are perpendicular to the guide's plane of motion. Oversteering and understeering results in decreased accuracy.

GUIDING RULE 9 continued
ENTRY AND EXIT SPANS

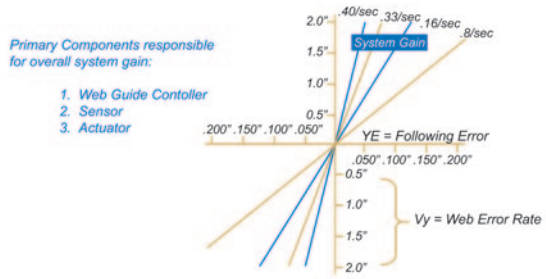


Entry and exit spans can deviate +/-5° from the perpendicularity (90°) of the guide's plane of motion, and typically still deliver acceptable performance.

GUIDING RULE 10
RESPONSE AND GUIDING ACCURACY

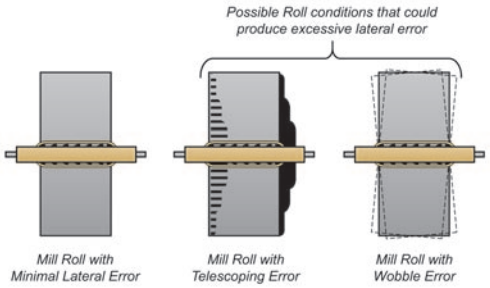


GUIDING RULE 10 continued
RESPONSE AND GUIDING ACCURACY



The higher the system gain, the better the dynamic accuracy of the control system. Click here for examples

GUIDING RULE 10 continued
RESPONSE AND GUIDING ACCURACY



WHAT SHOULD WE LOOK FOR IN A GUIDING SYSTEM?

We should look for a total system that has the ability to achieve a high system gain, with a stable control loop, and a low error following rate.

Mechanical integrity of the guiding components.
- Quality bearings for moving parts.
- Mechanically designed for reliablity, durability, and longevity.

Very little backlash or none at all in the actuator.
- Reduce backlash or none at all will help create a system that can produce high dynamic response, with a stable control loop.

High sensing resolution for high frequency response.
- Proper sensor selection (IR, Ultrasonic, etc.).
- Minimal sensor calibration for quick setups, or material changes.