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PRESENTS

# PRINCIPLES OF SHEAR SLITTING

There are three basic mechanical types of web separation, or slit methods employed today.

1. Burst or Razor Slitting
2. Score or Crush Cut Slitting
3. Shear Slitting

1. **Burst Slitting** - This type of slitting uses only one knife to slit the product.

### *Advantages*

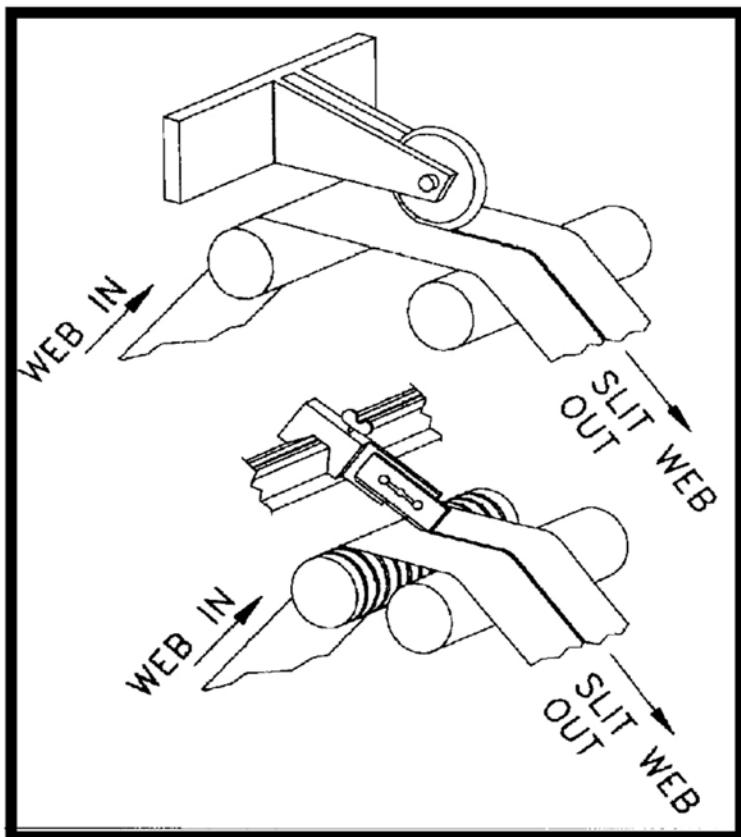
1. Less expensive to set up and operate.
2. Easy to adjust slit width.

### *Disadvantages*

1. Difficult to attain close slitting tolerances.

Types of materials using this process:  
foils, films, textile products

## **BURST SLITTING**



Notes:

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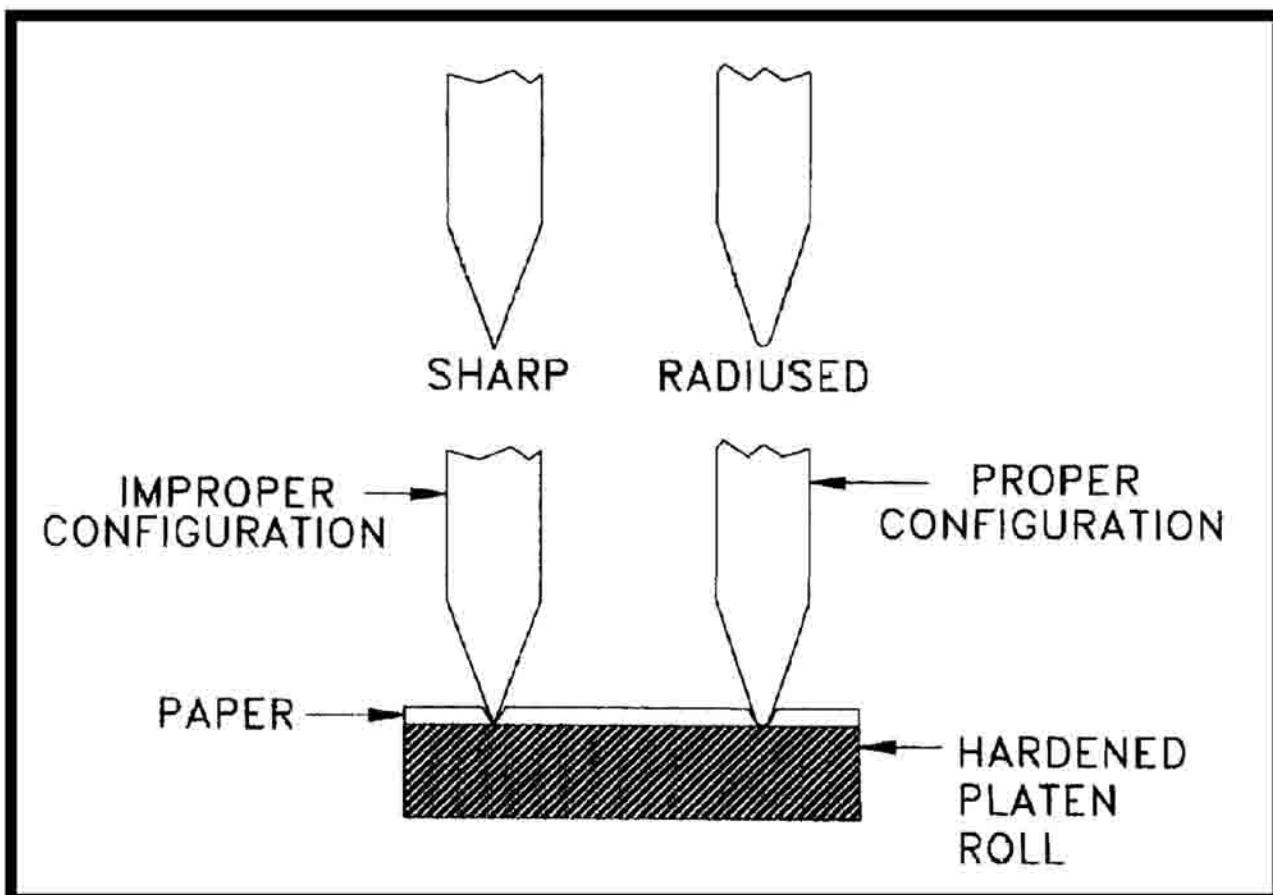
2. **Crush Cutting** is the second method of web separation. In this process only one knife is used to accomplish the web separation. The web is actually pinched or scored apart. The cutting blade pinches against a hardened platen or bottom roll at about 70 PSI of downward pressure.

***Advantages***

1. Less expensive to set up and operate

***Disadvantages***

1. Poor cut quality - runs slower feet per minute.



**CRUSH CUT SLITTING**

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3. The third type of mechanical web separation is **Shear Slitting**.

In shear slitting there are top and bottom knives. The two knives work in conjunction to form a scissor cutting action that separates the web.

***Advantages***

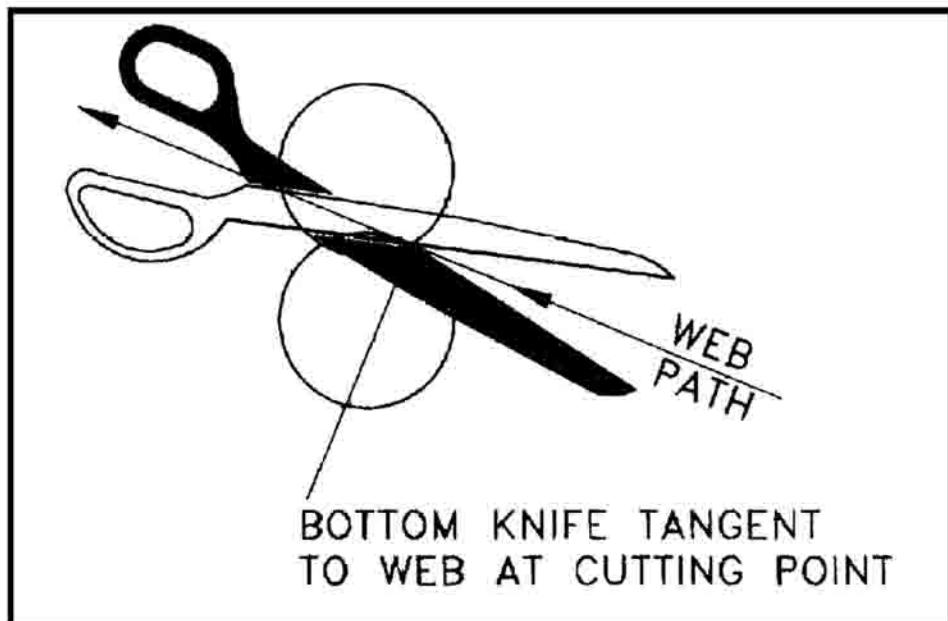
1. High speed rates of cutting are possible.
2. Finest edge cut quality attainable with this method of slitting (less dust generated).

***Disadvantages***

1. More costly to install and maintain.
2. More difficult to set up and maintain properly.
3. Requires two knives per slit.

Types of materials slit by this: fine paper, foils, films.

**SHEAR  
SLITTING**



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Shear slitting can be further broken down into its two basic types, **Tangent Slitting** and **Wrap Slitting**.

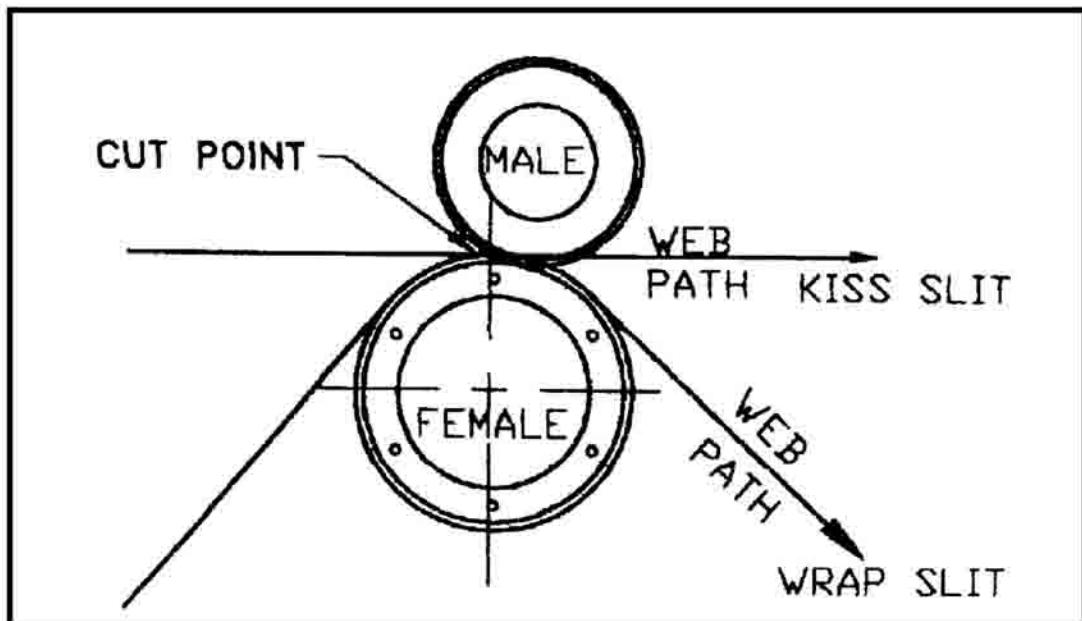
In tangent slitting, the web kisses the top tangent point of the bottom knife only.

In wrap slitting, the web wraps around the bottom knife. Some products will not wrap and therefore must be tangent slit.

Examples:

1. Tissue (will tear)
2. Some laminated materials (will not bend)

## TANGENT vs. WRAP SLITTING



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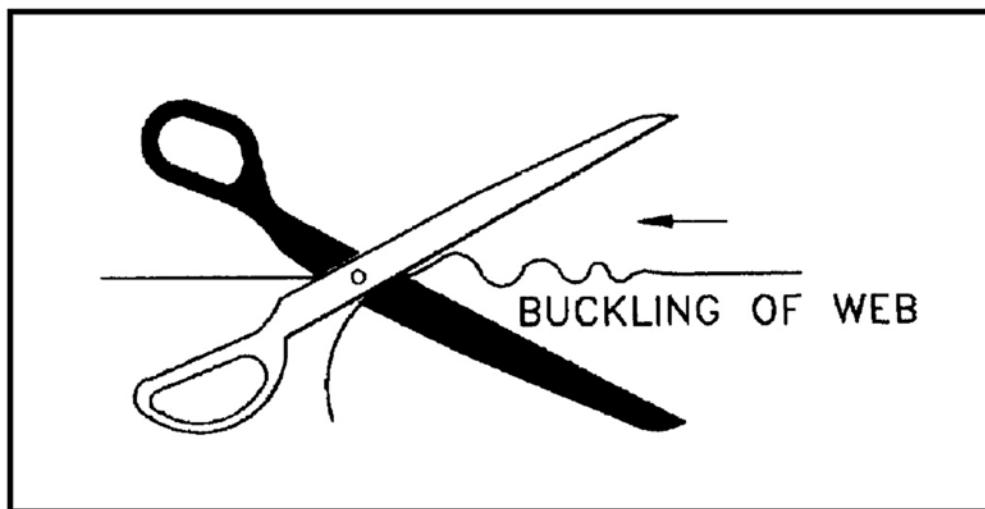
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## OVER-SPEEDING

In order to obtain scissor action in the rotary shear, the bottom knives must be **over-sped** by 3 to 5 % faster than the top knives. Otherwise, your web will begin to buckle. It is not being cut as fast as it is being fed into the cut point. Technically stated, you have to be running at synchronous or slightly greater than synchronous for your knives to shear cut at optimum efficiency.

You want to over-speed your bottom blade so that your top knives, which are powered from your bottom knives, are at synchronous at all times during the slitting process. Because slitting the web will have a slowing effect on your top knives, and they are powered off your bottom knives, you must over-speed your top knives to keep your whole system at or above synchronous.



## OVER-SPEEDING

Notes:

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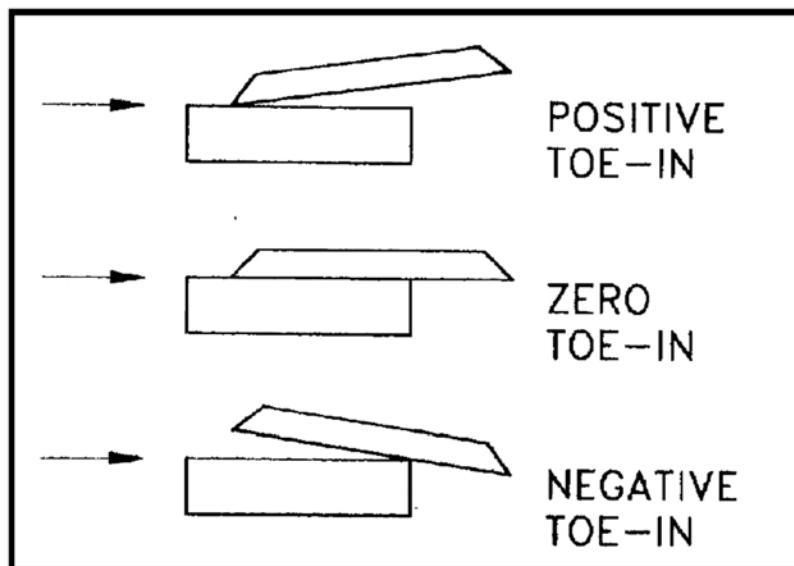
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# KNIFE SET FOR SHEAR SLITTING

In shear slitting, there are four basic principles, the consistent utilization of which is necessary to obtain a top-quality cut. They are:

1. Cant angle or toe-in
2. Side loading pressure.
3. Blade overlap or penetration.
4. Rake angle setting on your top knife.

## 1. CANT ANGLE OR TOE-IN



Cant angle is needed in the shear slit process, to establish a positive point for web separation.

Once the proper cant angle is established - the top knife should be set to that angle - and never changed from it. Check the predetermined proper cant angle after blade changes to insure that it is still set properly. **Experimenting arbitrarily with other cant angles can cause slitting problems.**

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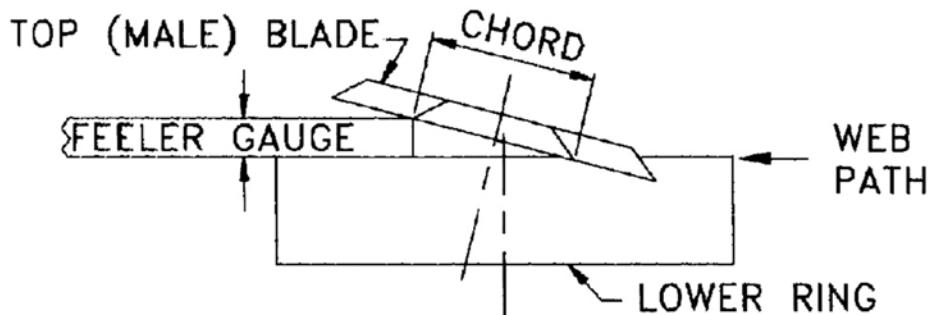
Many new-style knife holders have provisions to set the cant angle to precise settings. These should be in your machine manual.

If this area is not thoroughly covered by your holder or machine manufacturer, you may want to use the feeler gauge method. **Keep in mind, however, the more cant angle, the faster your blade will be dull.**

### CANT ANGLE

#### SET WITH FEELER GAUGE

1. SET GAP NEEDED
2. SLIDE FEELER GAUGE IN
3. TIGHTEN HOLDER INTO POSITION



CANT ANGLE	CHORD LENGTH - IN.		
	0.50	1.00	2.00
MEASURED GAP			
0.25°	.002	.004	.009
0.50°	.004	.009	.017
1.00°	.009	.017	.035

### *Recommended Cant Angle for Materials Being Slit*

0.25 Degree	0.5 Degree	0.75 Degree	.05 - 1 Degree
1. Light Gauge	Paper	Synthetic	Fabrics
Metals			
2. Foils	Laminates		Unbonded
3. Plastic Sheet	Plastic		Non-Wovens
Films			
4. Non-Fibrous			
<b>2.</b> Webs			

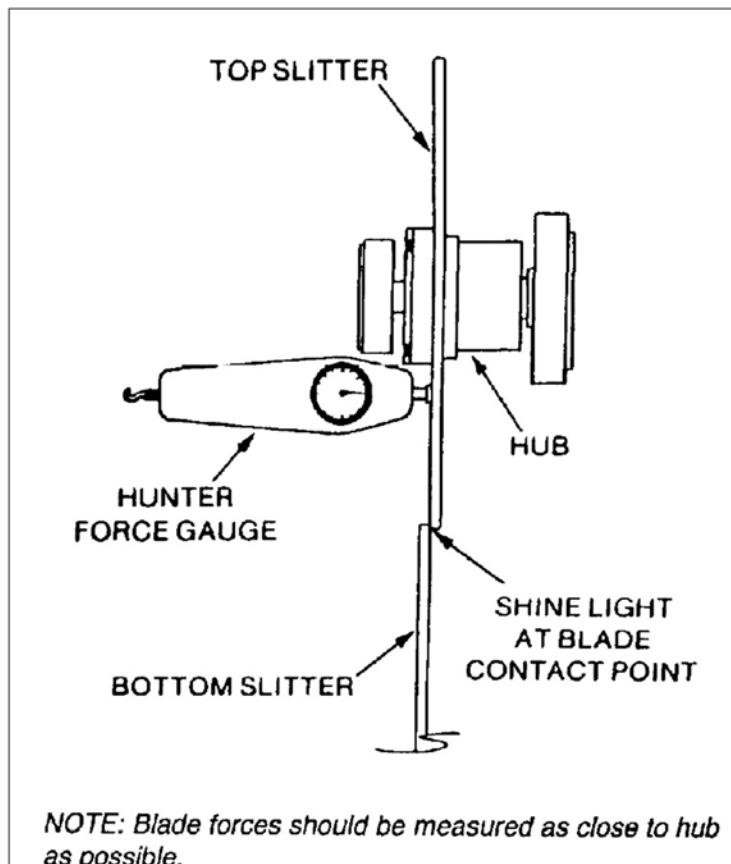
## 2. SIDE LOADING PRESSURE

Side loading pressure is simply the amount of pounds per square inch of pressure your top knife is pushing against your bottom knife. The **least amount** necessary to cut is the amount to use.

It may take more pounds of pressure than your system calls for. If this is the case then you are compensating for worn bolts, slides, gibbs, gears, bearing holders, seats, etc., that need attention. This is one way to identify whether your system needs maintenance or not.

It is always good to check your side pressure with a "Hunter" force gauge to be sure you do not have excessive pressure on your cutting knives. **Note:** Excessive side pressure will cause your blades to dull prematurely. Also, increasing or decreasing side pressure will not correct mismatched, dull blades or slitter blades will excessive run-out. Check machine manual for correct setting. Typically, most pneumatic slitter assemblies will have side loading pressures of 2 to 7 lbs., not to vary more than  $\frac{1}{2}$  lb.

Notes: \_\_\_\_\_

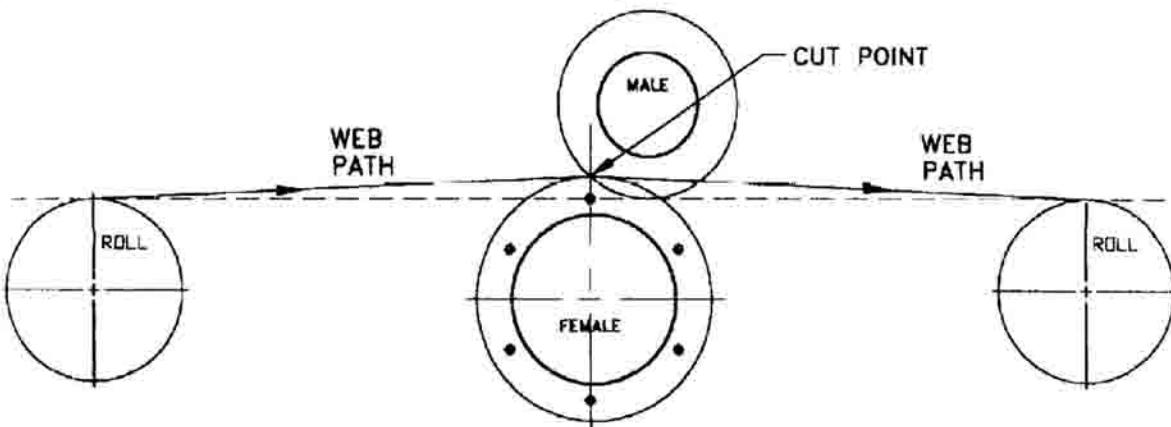


*NOTE: Blade forces should be measured as close to hub as possible.*

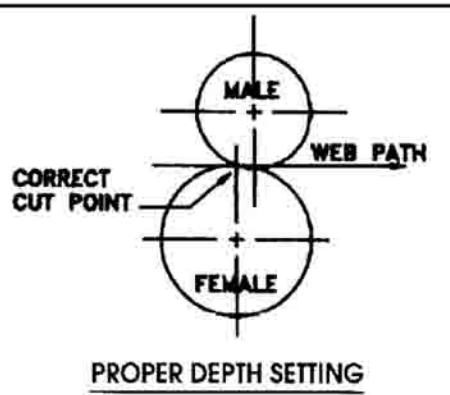
## 3. BLADE OVERLAP OR PENETRATION

In shear slitting your knives overlap. The amount of overlap depends upon your system and what material is being cut. In tangent slitting there is only one possible cut point designed into the system. That cut point is at the topmost tangent area of your bottom slitter. In wrap slitting it can be anywhere along the wrap area.

## BOTTOM SLITTER BAND HEIGHT ADJUSTMENT



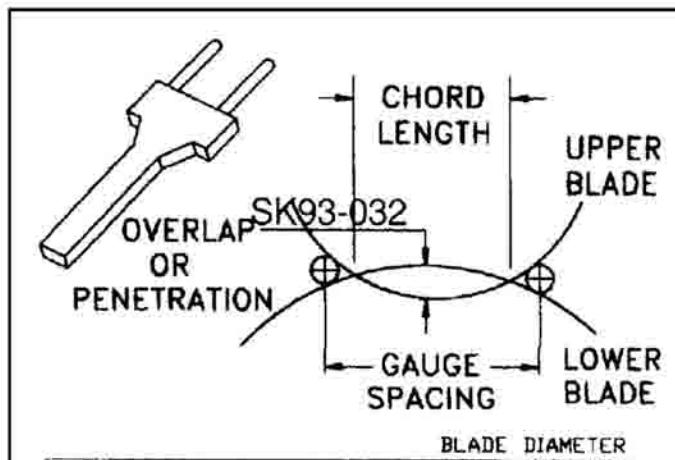
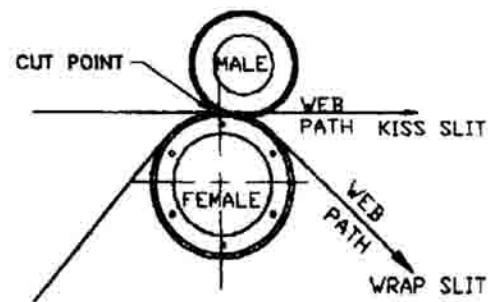
It is sometimes necessary to recheck your alignment with the top most point of your bottom knife. This can be done by stretching a string or wire along the projected cut path and inspecting visually.



In tangent slitting, to set and reset your top knife to the exact cut point, a chord gauge should be used.

This will give you the exact and repeatable settings to the cut point.

## TANGENT VS WRAP SLITTING

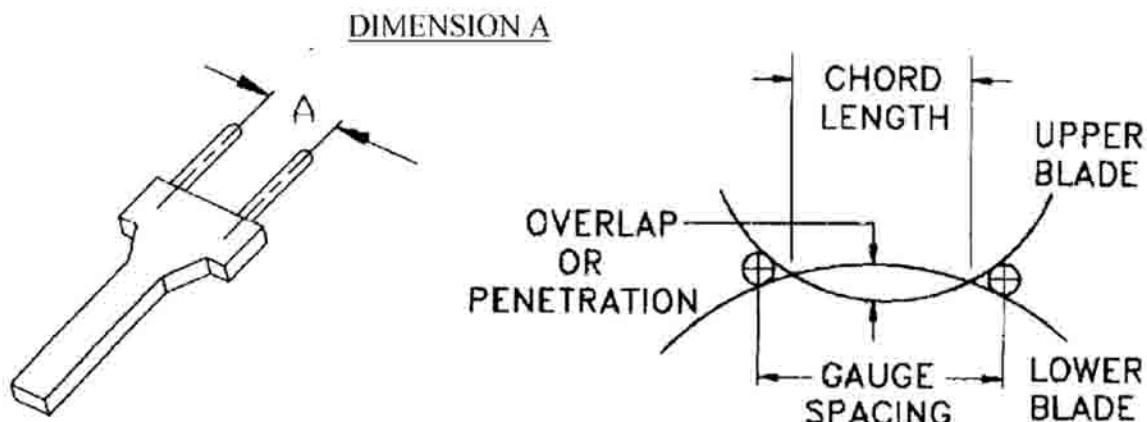
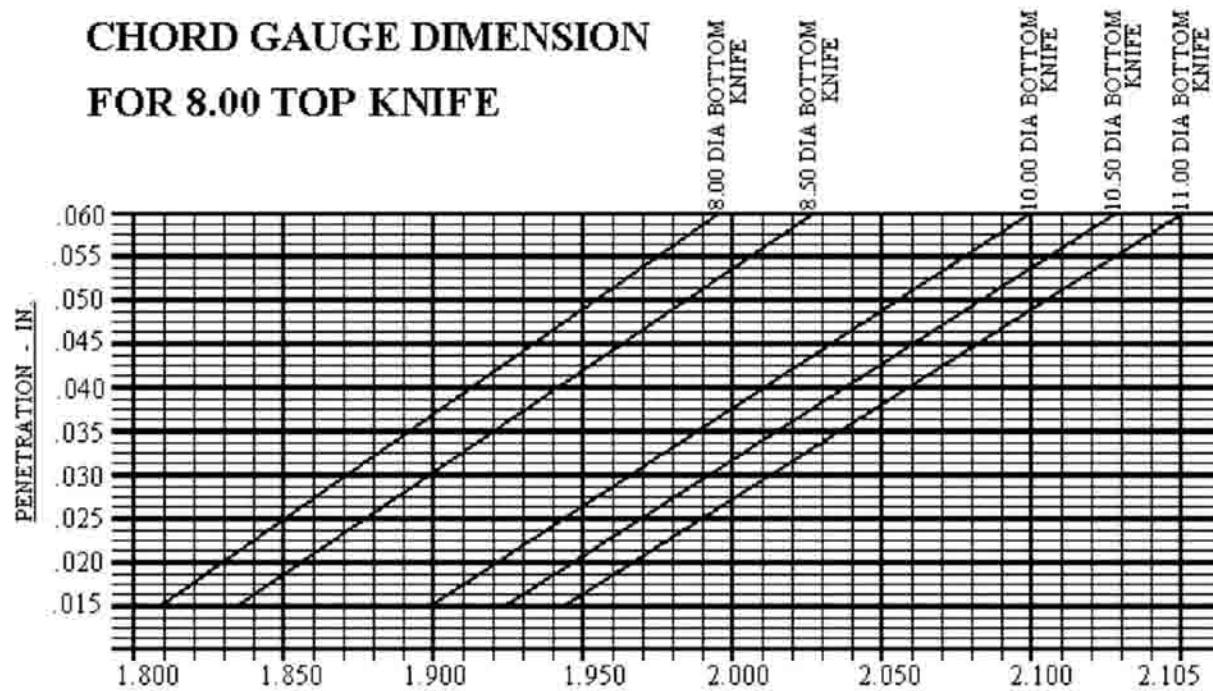


MATERIALS	RECOMMENDED PENETRATION	BLADE DIAMETER			
		5	6	7	8
TISSUE	.015	.388	.421	.458	.490
FINE PAPERS	.020	.446	.489	.528	.565
HEAVY PAPERS	.025	.500	.547	.592	.632
HEAVY PAPERS	.030	.546	.599	.648	.692
BOARDS	.040	.632	.692	.748	.799
HEAVY LAMINATES	.060	.772	.845	.914	.978

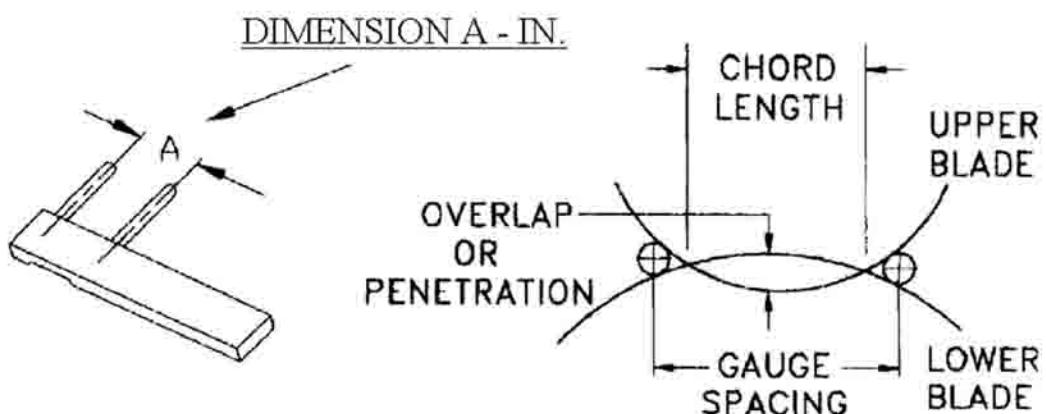
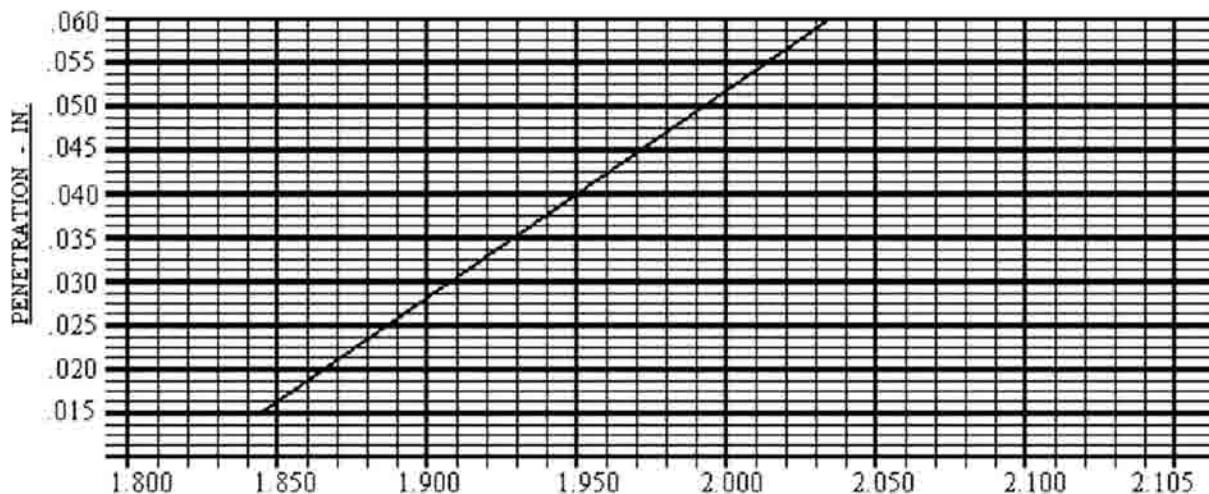
CHORD LENGTH

## CHORD GAUGE

## CHORD GAUGE DIMENSION FOR 8.00 TOP KNIFE

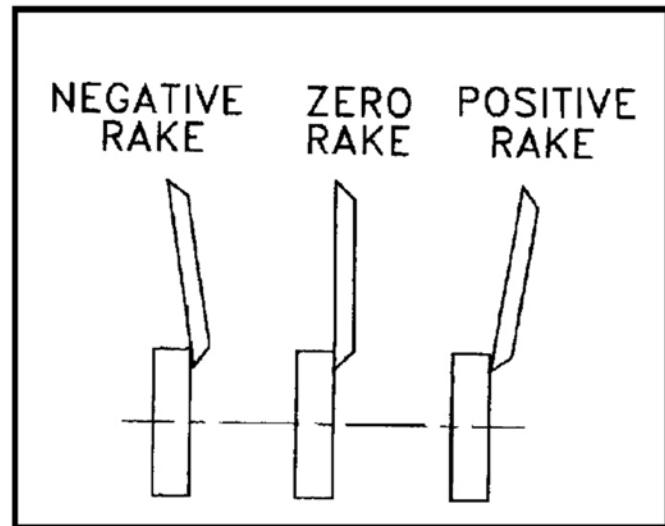


CHORD GAUGE DIMENSION "A" FOR E.C.H. WILL 8.656 DIA. TOP  
KNIFE AND 7.953 DIA. BOTTOM KNIFE

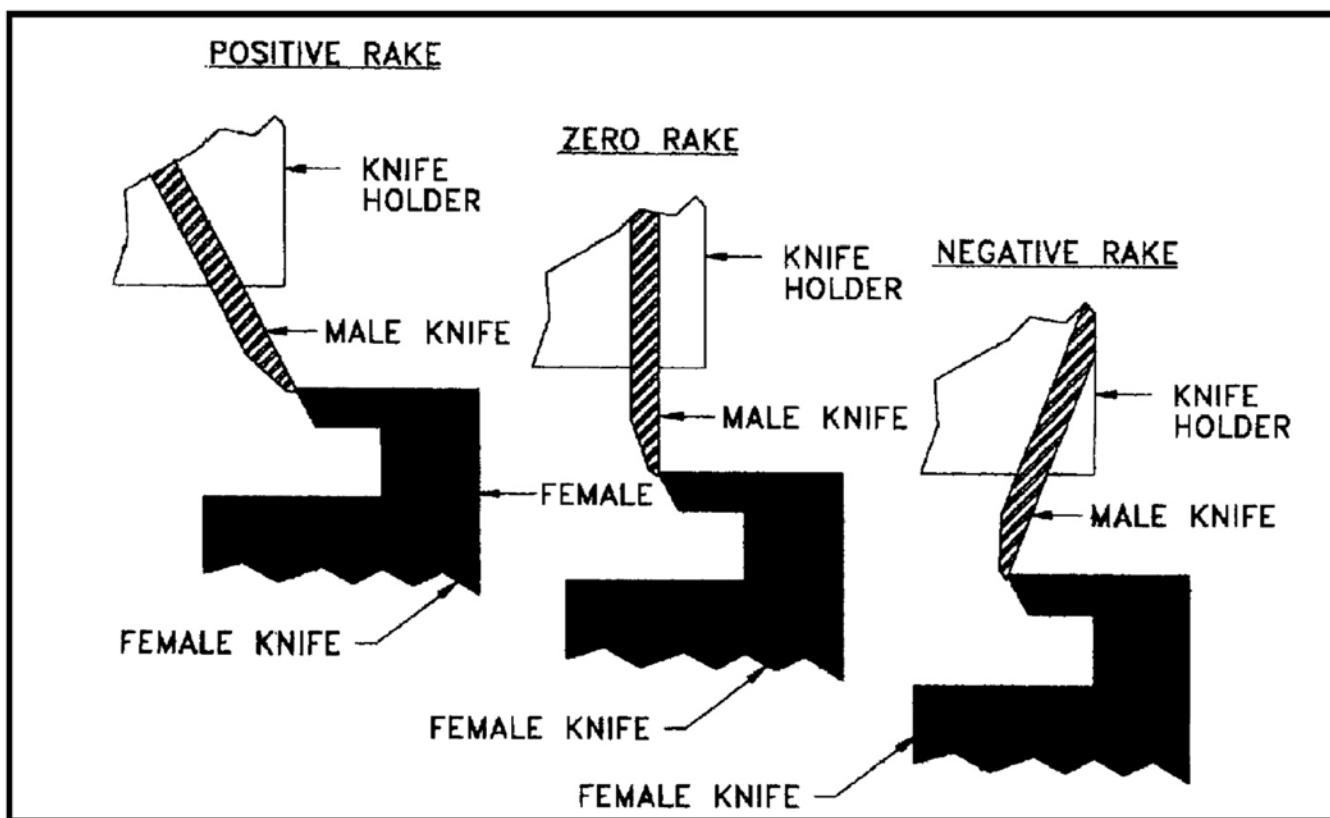


#### 4. RAKE ANGLE

##### RAKE ANGLE SETTING OF YOUR TOP KNIFE



Like cant angle, there are three rake angle possibilities for the top knife.



Rake angle is often built into the top knife.

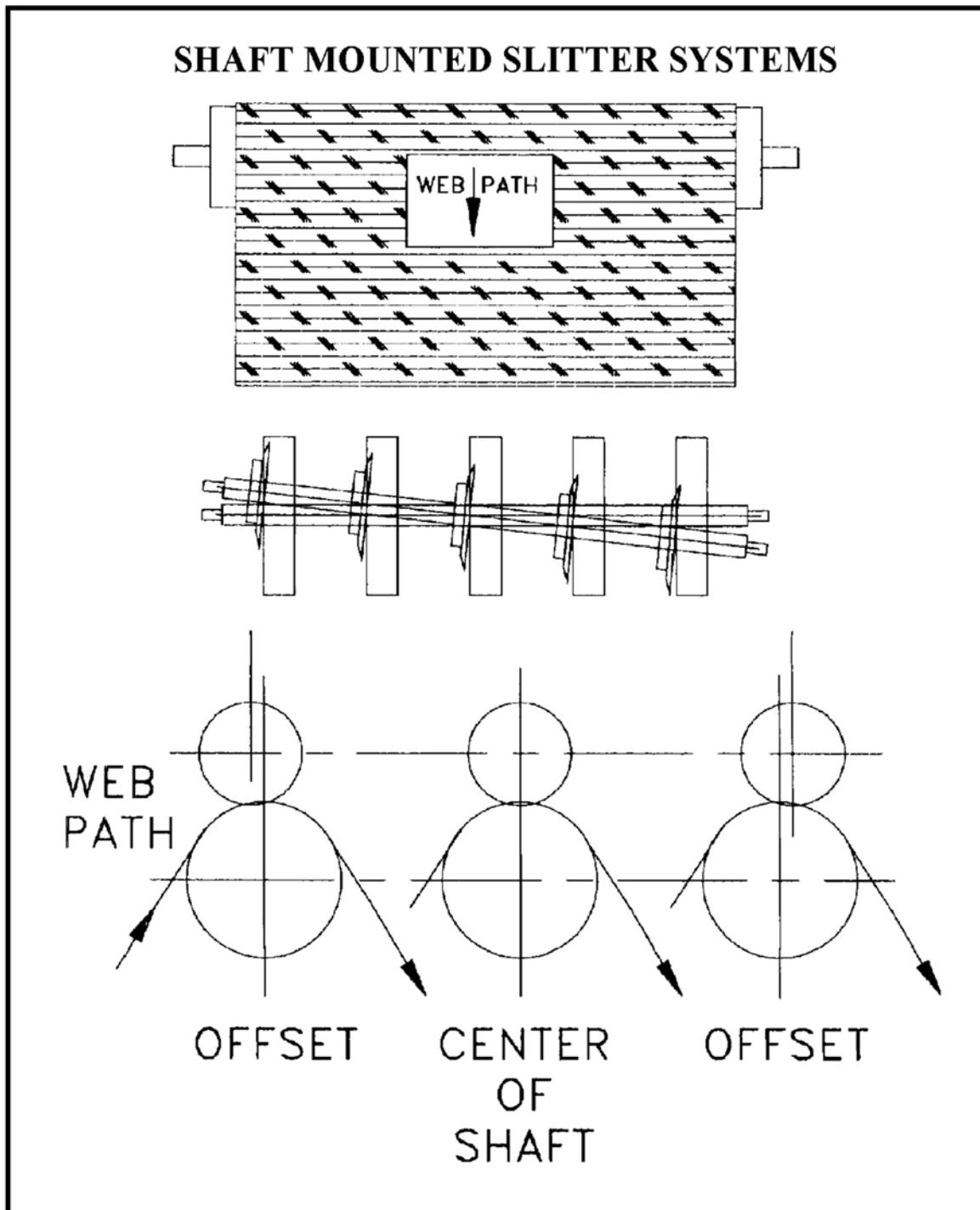
Notes: \_\_\_\_\_

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## SHAFT MOUNTED SLITTER SYSTEMS

### For Wrap Slit Setup

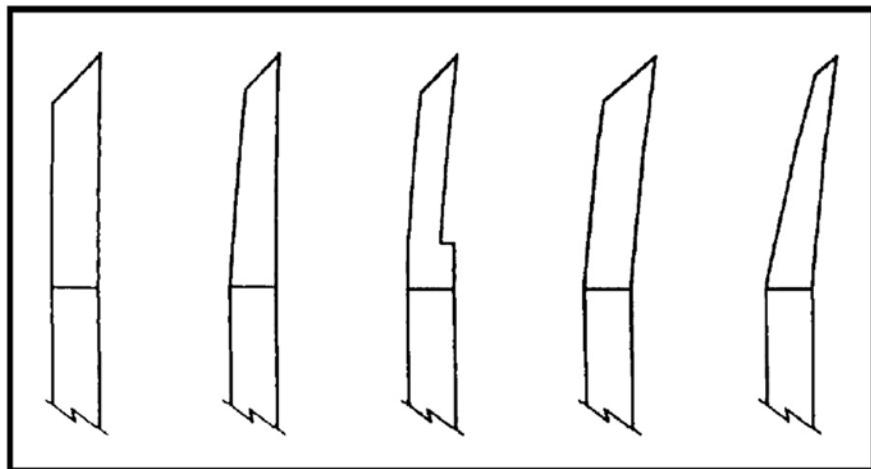
On shaft-mounted systems, you have to move the entire top knife shaft to accomplish side pressure and depth of cut settings. The cant angle is usually "neutral".



## KNIFE BLADES IN THE CUTTING PROCESS

Machinery manufacturers have designed different blade profiles for web separation.

### BLADE PROFILE & CHARACTERISTICS

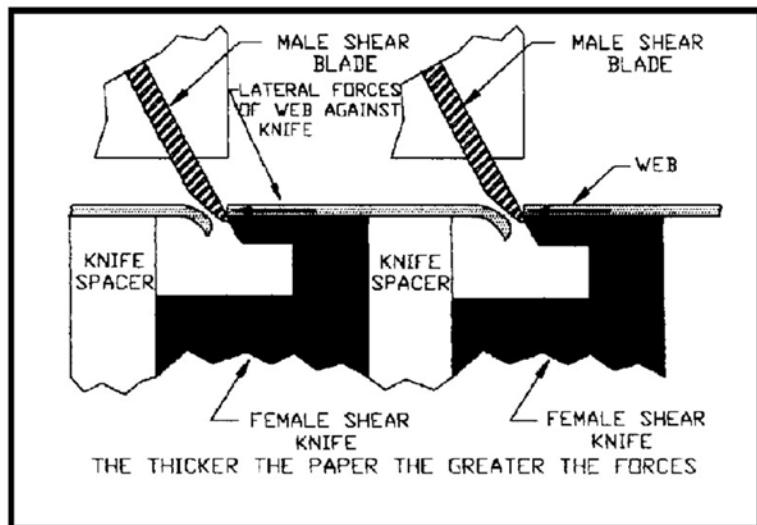


## KNIFE BEVEL RULE OF THUMB

- 1) The steeper the angle - the sharper the knife - the faster it will dull.  
**CONVERSELY**
- 2) The more shallow the angle - the less sharp the knife - the slower it will dull.

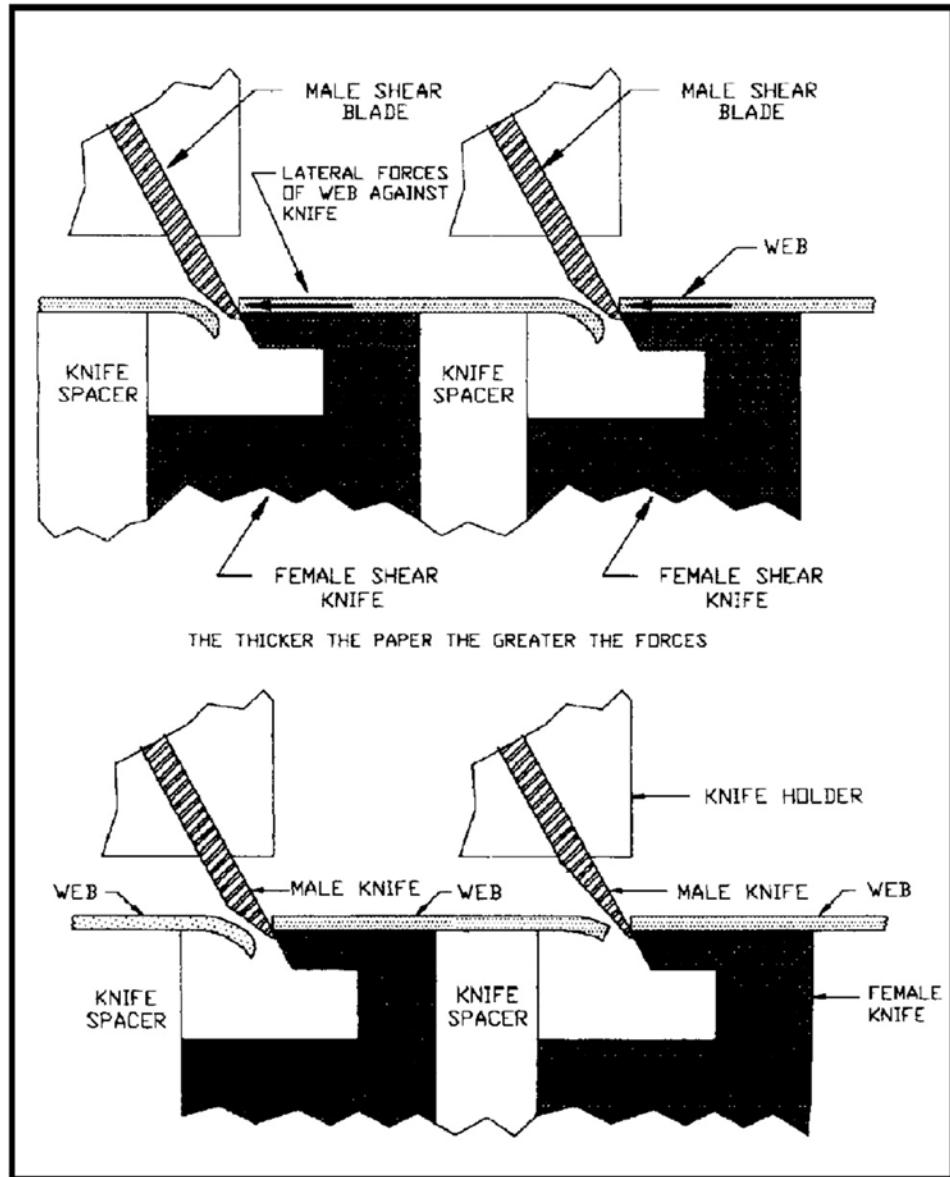
## LATERAL FORCES ON SHEAR BLADE

Below you see a slitting operation that has been properly set up. But something more is needed. Note the lateral web pressure that is always existent in the web separation process.



## LATERAL FORCES ON SHEAR BLADE

A secondary bevel in this particular operation helps alleviate lateral forces that are generated through web separation.



### LATERAL FORCES ON SHEAR BLADE

Notes: \_\_\_\_\_

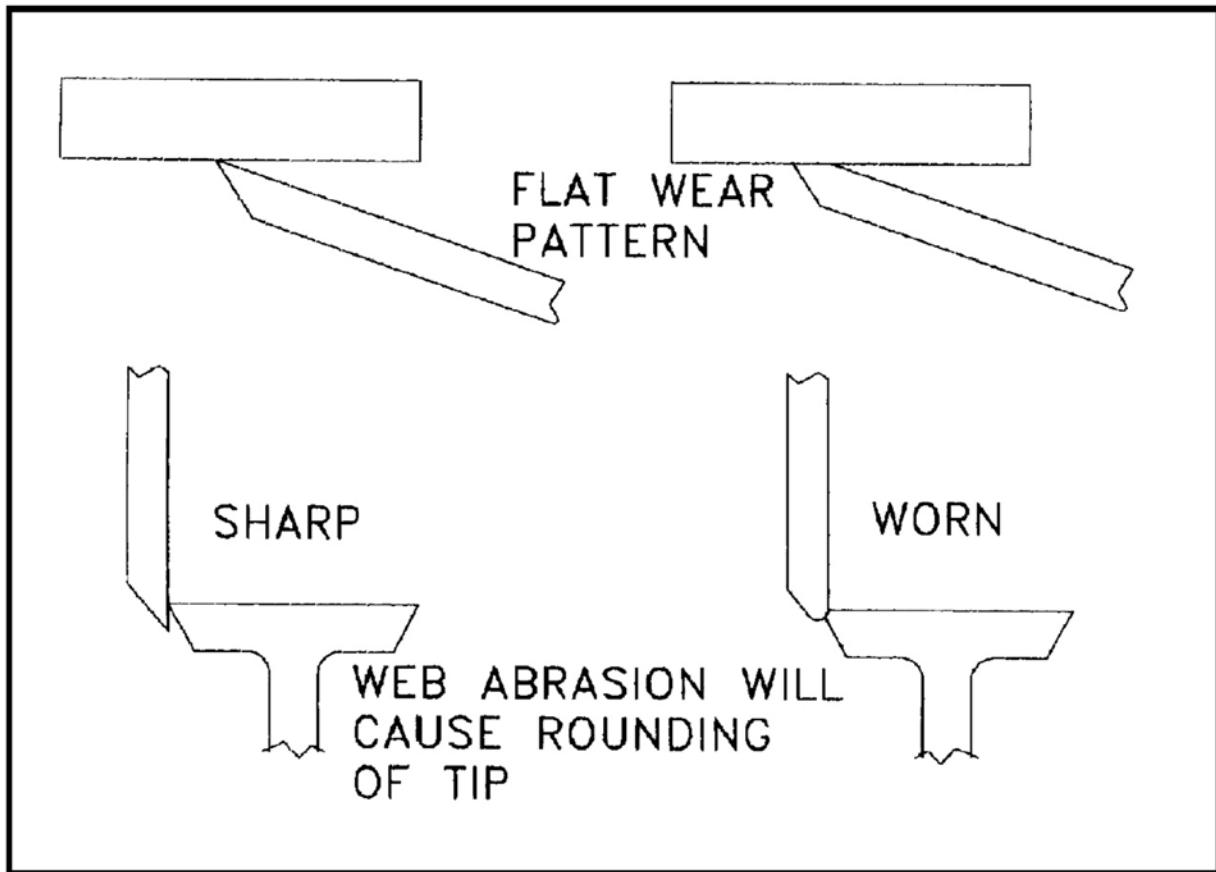
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## WHY BLADES DULL

1. The dynamics of the shear slitting process always will cause blade dulling.
  - A. Keep to the minimum:
    1. Side pressure
    2. Cant angle
2. The abrasiveness of the material you are cutting.
3. Corrosive environment

When your machine and holders are in perfect working order, and your setup has been made according to predetermined specifications, your blades will dull for the above reasons only. Can you identify what is wrong with the bottom half of the picture?



Notes: \_\_\_\_\_

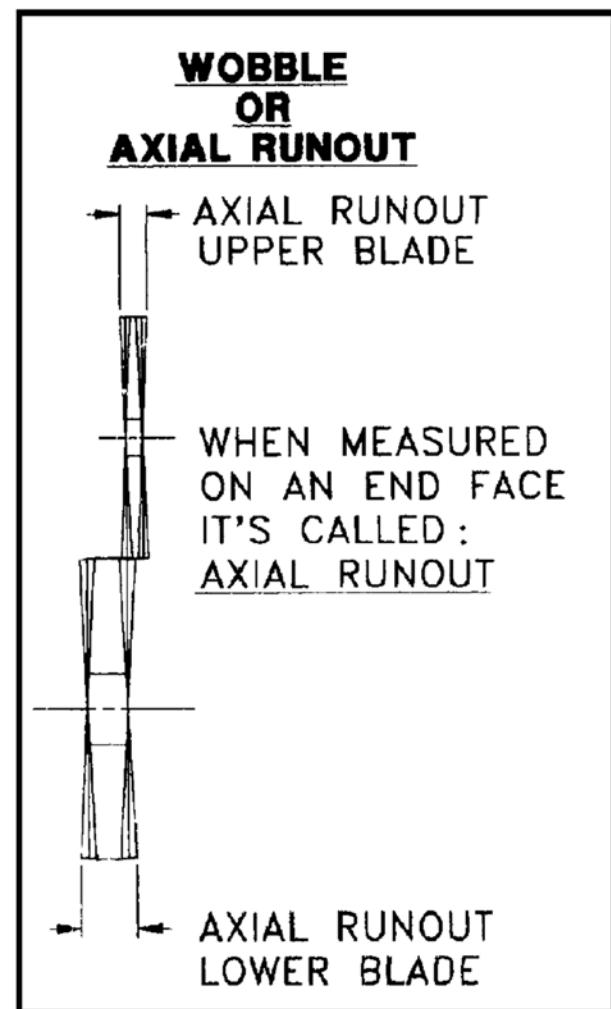
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There are items other than normal dulling forces, that can go wrong with your slitting process, that are identifiable and correctable. **Axial runout** of your knives is side-to-side wobble in either the top knife or the bottom knife.

Axial runout is caused by a number of factors:

1. Warped blade.
2. Bent knife shaft or axle.
3. Worn bearings.
4. Debris under mounting hubs or blades.
5. Warped or damaged knife hub or holder.
6. Blade inside diameter too large.
7. Blades inaccurately ground.

## Axial Run-Out



Notes: \_\_\_\_\_

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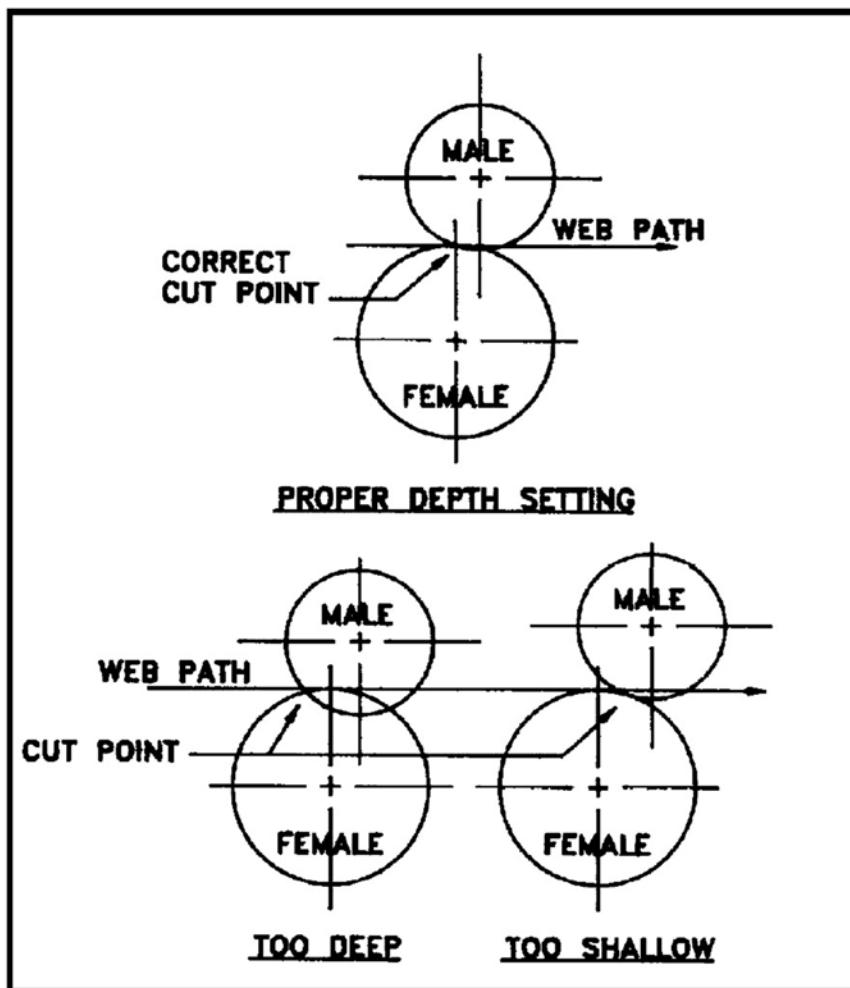
**Radial Runout** is an out-of-round condition displayed by knives during operation.

Radial runout is caused by a number of factors:

1. Bent slitter shaft.
2. Blades manufactured or resharpened improperly.
3. Knife bores are not concentric with O.D.'s.
4. Running blades faster than critical speed or machine design speed.
5. Bores of knives too loose on the arbor they mount.

Radial and axle runout, as well as improper cant angle, depth of cut, side load pressure and rake angle settings, will cause premature failure of your web separation efforts. You must review your machine manual to maintain required settings in all of these areas.

### **OUT-OF-ROUND CONDITION (Radial Runout)**



Notes: \_\_\_\_\_

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## COMMON MATERIALS USED FOR CUTTING BLADES

ALLOY STEELS	TOOL STEELS	EXOTIC MATERIALS
<b>0186, L6, 01, 52100</b>	<b>A-2, D-2, M-2, M-4</b>	<b>Powdered Metals</b> <b>Carbide &amp; Ceramic - Bottom Knives Only</b>

1. Quality, expense, and wearability increases from left to right in the above chart.
2. Recommended combination for maximum cutter life: powdered metal for top knife, carbide for bottom knife.

*Top quality material will not make up for improperly set slitters.*

Notes: \_\_\_\_\_

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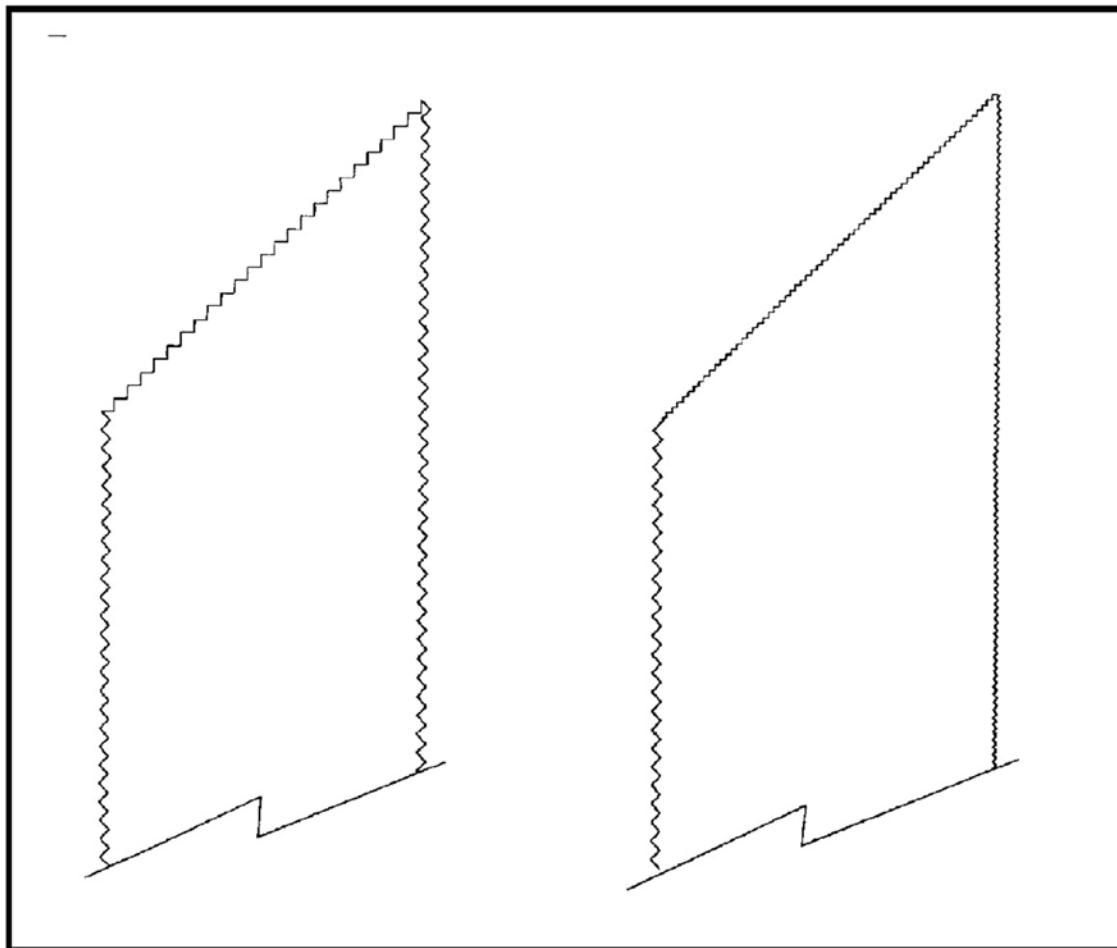
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## KNIFE SURFACE FINISHES and WEB CUT QUALITY

The surface finish of a knife will affect the surface finish of your cut material. Rougher surface finishes act as “sanding” agents against the web you are slitting, causing frayed, rough, or jagged edges. Critical surfaces should be polished if optimum edge quality is expected.



## SURFACE IMPERFECTIONS

Notes: \_\_\_\_\_

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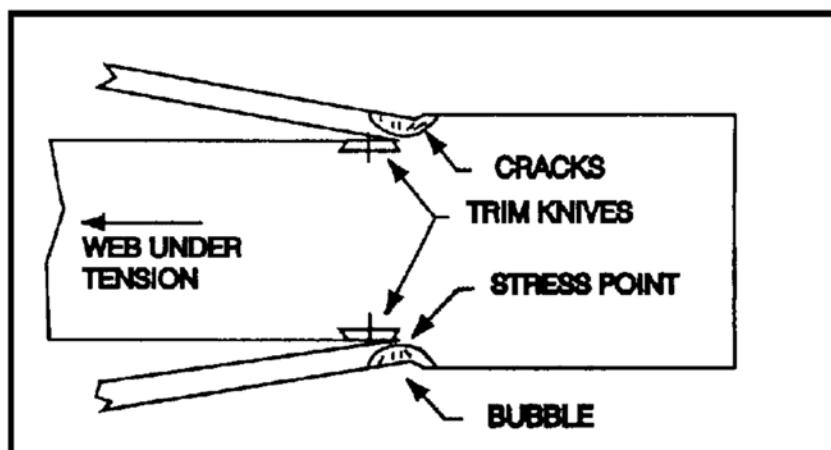
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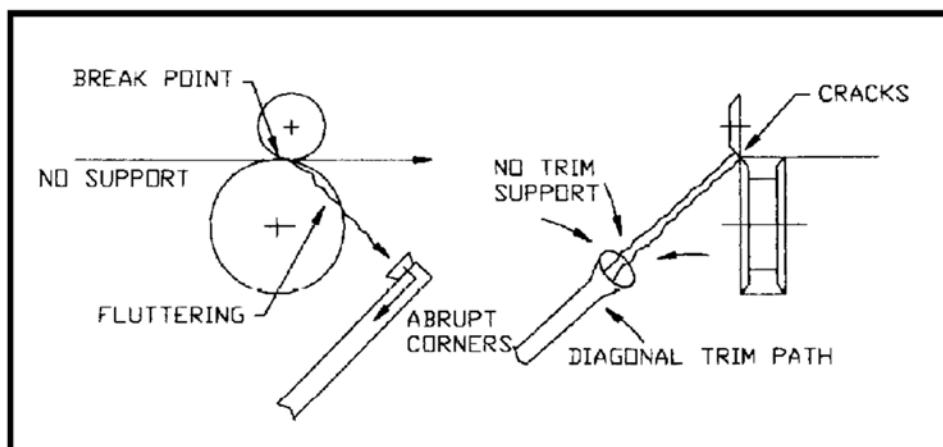
## TRIM DYNAMICS

Sometimes in cut quality questions, the machine and/or the blades are not the culprit. Sometimes the trim system needs to be scrutinized.

1. The trim must be supported, under tension, and horizontal during exit.
2. Trim must be drawn away straight ahead and in line with the web path.
3. Trim must not be permitted to flutter at the slit point.
4. Trim must not be pulled directly off the slit point.
5. Trim must not be forced into abrupt changes of direction.
6. Trim suction speed should match web speed.
7. Fluttering trim will aggravate break-off tendency.
8. Avoid abrupt corners on trim pickup systems.



## TRIM DYNAMICS



## TRIM PROBLEMS

## **OPERATORS CHECKLIST AND SLITING SETUP**

1. Are your cutting blades in acceptable condition?
  - A. Top Knife
    1. Is it flat within .002?
    2. Is the cutting edge concentric with the ID to within .002?
    3. Are the cutting edges nick- and burr-free for installation?
    4. Is the surface finish what engineering specifies to achieve the cut quality your customer desires?
    5. Is the blade sharp?
    6. Does the blade have the correct angle on it to achieve the desired cut?
2. Top Knife Holders
  - A. Are seats for both holder mounting to the machine and blade mounting to the holder burr-free to allow for accurate setting?
  - B. Does the bearing in the holder show excessive radial or axial runout?  
(should not exceed .0003/.0005)
3. Is the cant angle set to the proper degree?
  - A. Use the minimum amount necessary to achieve the quality cut desired.
4. Is side pressure set correctly?
  - A. Use the minimum amount necessary to achieve the quality cut desired.
5. Is your trim being removed in such a fashion that causes stress on your cut points? If so - correct it.
6. Is your machine capable of cutting material you are slitting? (check with the manufacturer)
7. Do you have the proper hand tools to safely and correctly change and/or adjust the knives?

## PROBLEM

### 1. Too much dust generated from slit process

## POSSIBLE CAUSE

1. Excessive side pressure
2. Excessive cant angle
3. Excessive blade penetration
4. Dull or incorrectly resharpened blades
5. Excessive radial runout
6. Vibration at high operating speeds (arbor balance bearings)

### 2. Top knives chipping

1. Excessive cant angle
2. Excessive side pressure
3. Too little blade overlap
4. Radial runout in the top knife
5. Top knife jumping out during operation

### 3. Blade life too short

1. Blade incorrectly resharpened (burred cutting edges - heavy burrs)
2. Excessive blade penetration too deep - too shallow
3. Excessive side pressure
4. Excessive cant angle
5. Radial runout
6. Axial runout or wobbling in lower knife

### 4. Ragged edge on one side of cut only

1. Cant angle much too steep
2. Blade penetration too deep
3. Blade cutting angle incorrectly selected and/or sharpened

## PROBLEM

### 5. Ragged edge on both sides of cut

## POSSIBLE CAUSE

1. Blade angle incorrectly selected
2. Cant angle much too steep
3. Blade penetration too deep
4. Blade cutting angle incorrectly selected and/or sharpened
5. Incorrect offset
6. Radial runout
7. Heavy vibration at high speed

### 6. Scallop slit line ring

1. Axial runout on lower knife

### 7. Web folds between blades - is not cut

1. Negative cant angle
2. Blades improperly reground
3. Side pressure too light

### 8. Tearing of web at cut point

1. Incorrect trim removal
2. Blade penetration too deep. Web not truly tangent to top point of bottom knife

### 9. Interrupted slitting

1. Nicked or damaged cutting blades
2. Radial runout of either top knife or bottom knife or both
3. Side pressure too light

### 10. Web breaks

1. Nick on any edge of knife (usually a top knife)
2. Web tensions too high
3. Web not truly tangent