MetalForming LIVE

JULY 2022

Optimizing Press-Stroke Rate Without Investing a Lot of Money!

Optimizing Press Stroke Rate (SPM)
Without Investing a Lot of Money

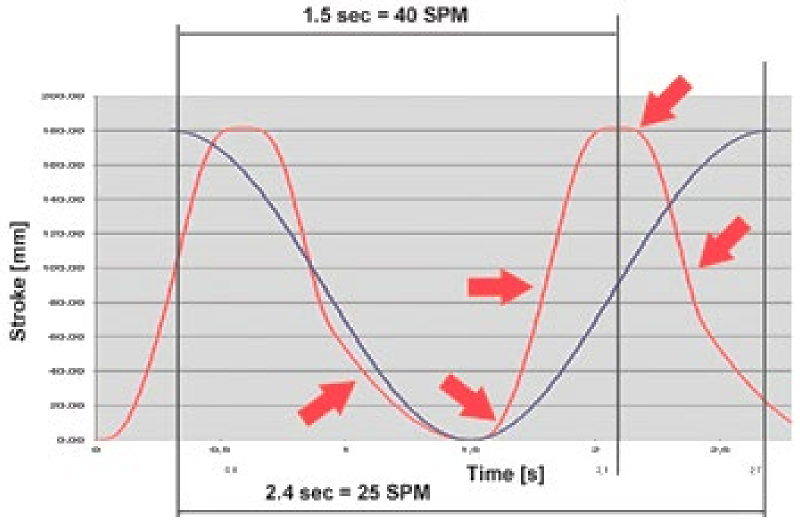
WHAT IS THE IMPACT OF 1 SPM?

- 60 parts per hour
- 480 parts per day
- 115,200 parts per yr. (8 hr. shift x 240 days per yr.)
- 207,360 parts per yr. (2 shifts @ 90% efficiency)

(at $0.08 per hit, that's $16,500 per yr.)

- How many presses do you have?

(30 presses = nearly $500,000 per yr.)



https://www.metalformingmagazine.com/magazine/article/?/2008/8/1/Servo-Press_Technology:_Drive_Design_and_Performance

Optimizing Press Stroke Rate (SPM)
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CONTROLLING PROCESS VARIABLES

10 possibilities

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10,000 different combinations

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CONTROLLING PROCESS VARIABLES

- Set Up Accuracy
- Straightening/Feeding
- Equipment Maintenance
- Die Protection/Timing

10,000 different combinations

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CONTROLLING PROCESS VARIABLES

Set Up Accuracy

Straightening/Feeding

Equipment Maintenance

Die Protection/Timing

10,000 different combinations

Documentation

100,000 combinations

Not understanding and communicating accurately (documenting) the variable parameters that produce the best outcome usually is the root cause for inconsistency.

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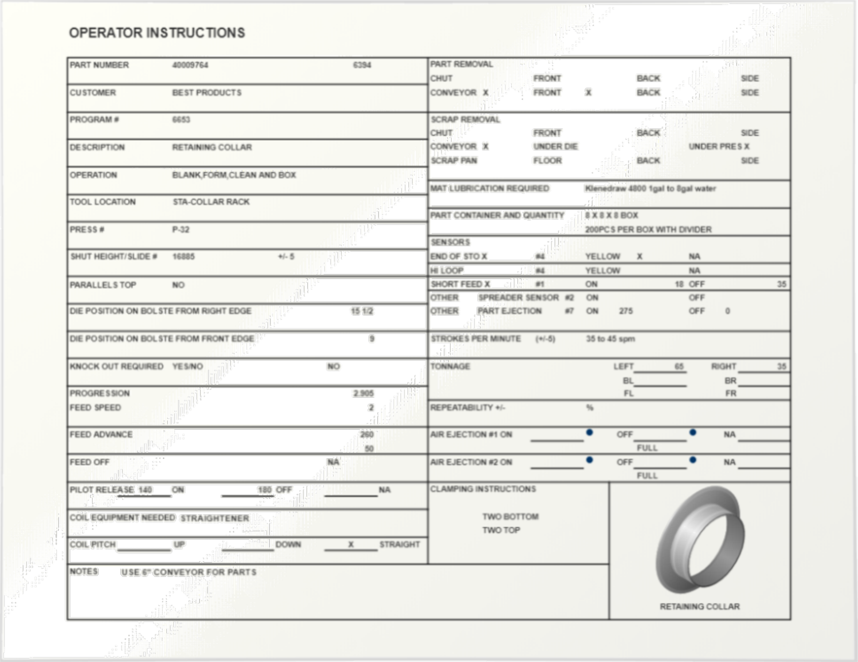
DOCUMENTATION CONTROL

- Die Placement (Alignment)
- Shut Height (Methodology)
- Tonnage Monitor Settings
- Counterbalance Pressure
- Feed Line
- Pitch Length
- Roll Pressure
- Lubrication (type/application)
- Stroke per Minute (SPM)

- Pilot Release (Roll Lift)
- Feed Angle
- Feed Rate
- Slack Loop Depth
- Straighteners Roll Depth
- Die Protection
- Drag Brake Setting (Reel)
- Scrap Removal, Parallels
- Etc., etc., etc.



OPERATOR INSTRUCTIONS

PART NUMBER	40009764		6394
CUSTOMER	BEST PRODUCTS		
PROGRAM #	6653		
DESCRIPTION	RETAINING COLLAR		
OPERATION	BLANK,FORM,CLEAN AND BOX		
TOOL LOCATION	STA-COLLAR RACK		
PRESS #	P-32		
SHUT HEIGHT/SLIDE #	16885	+/- 5	
PARALLELS TOP	NO		
DIE POSITION ON BOLSTE FROM RIGHT EDGE			15 1/2
DIE POSITION ON BOLSTE FROM FRONT EDGE			9
KNOCK OUT REQUIRED	YES/NO	NO	
PROGRESSION			2.905
FEED SPEED			2
FEED ADVANCE			260 50
FEED OFF		NA	
PILOT RELEASE 140 ON	180 OFF	NA	
COIL EQUIPMENT NEEDED	STRAIGHTENER		
COIL PITCH ___ UP	___ DOWN	X STRAIGHT	
NOTES	USE 6" CONVEYOR FOR PARTS		

PART REMOVAL				
CHUT	FRONT		BACK	SIDE
CONVEYOR X	FRONT	X	BACK	SIDE
SCRAP REMOVAL				
CHUT	FRONT		BACK	SIDE
CONVEYOR X	UNDER DIE			UNDER PRES X
SCRAP PAN	FLOOR		BACK	SIDE
MAT LUBRICATION REQUIRED	Klenedraw 4800 1gal to 8gal water			
PART CONTAINER AND QUANTITY	8 X 8 X 8 BOX 200PCS PER BOX WITH DIVIDER			
SENSORS				
END OF STO X #4	YELLOW	X	NA	
HI LOOP #4	YELLOW		NA	
SHORT FEED X #1	ON	18	OFF	35
OTHER SPREADER SENSOR #2	ON		OFF	
OTHER PART EJECTION #7	ON	275	OFF	0
STROKES PER MINUTE (+/-5)	35 to 45 spm			
TONNAGE	LEFT 65		RIGHT 35	
	BL		BR	
	FL		FR	
REPEATABILITY +/-	%			
AIR EJECTION #1 ON	OFF	FULL	NA	
AIR EJECTION #2 ON	OFF	FULL	NA	
CLAMPING INSTRUCTIONS	TWO BOTTOM TWO TOP			

RETAINING COLLAR

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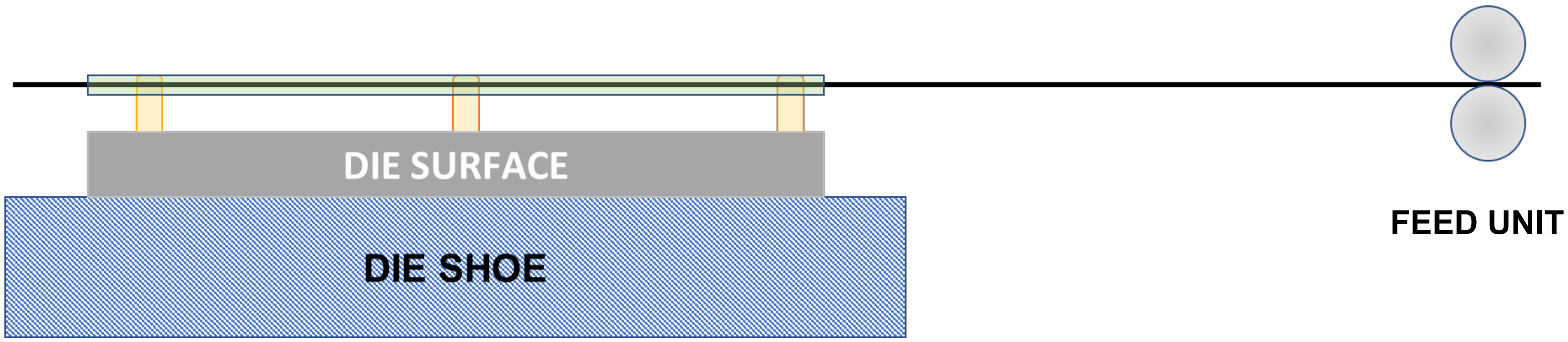
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

The pass line should be adjusted (verified) at each set up so the feed introduces material to the die exactly parallel with the height of the lifters in the raised position…



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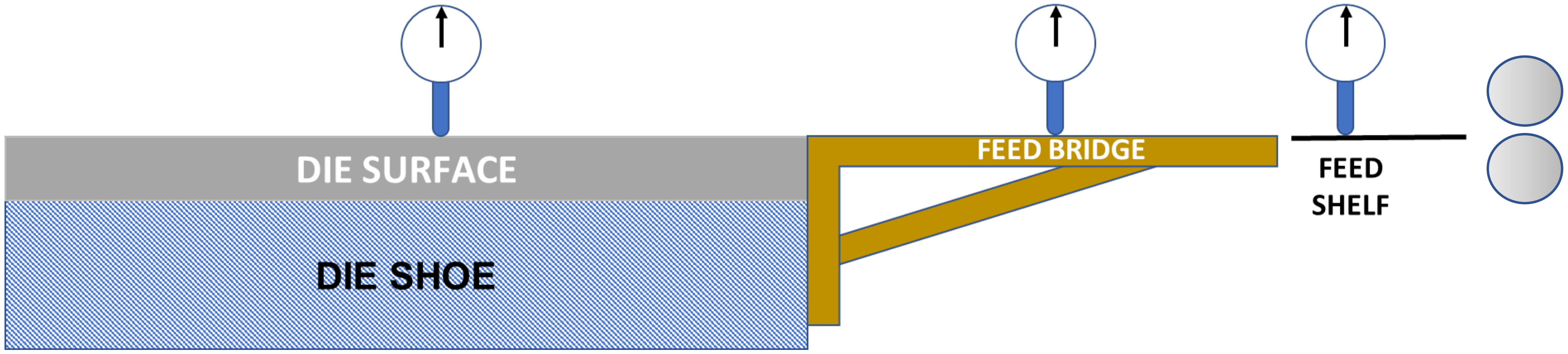
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

… or the lower die surface for dies with little or no lift.

The stock strip must be level, with no change in direction, for optimum feeding



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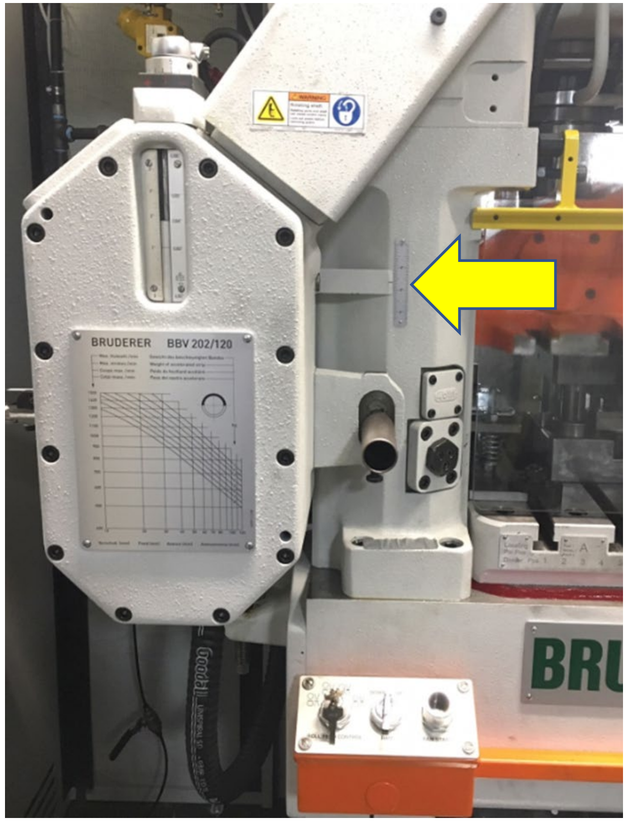
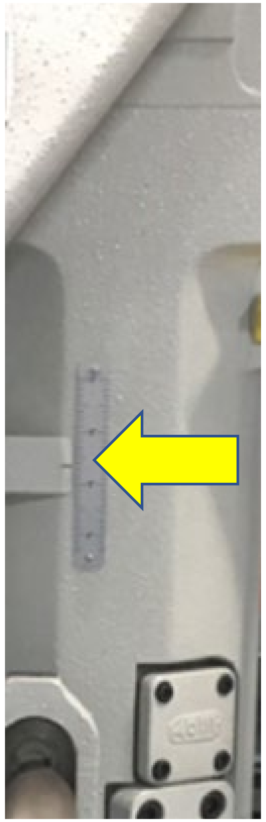
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Manual machines should have a scale mounted for adjustment of the pass line height.





Courtesy of Todd Wenzel, TCR Integrated Metal Stamping Solutions

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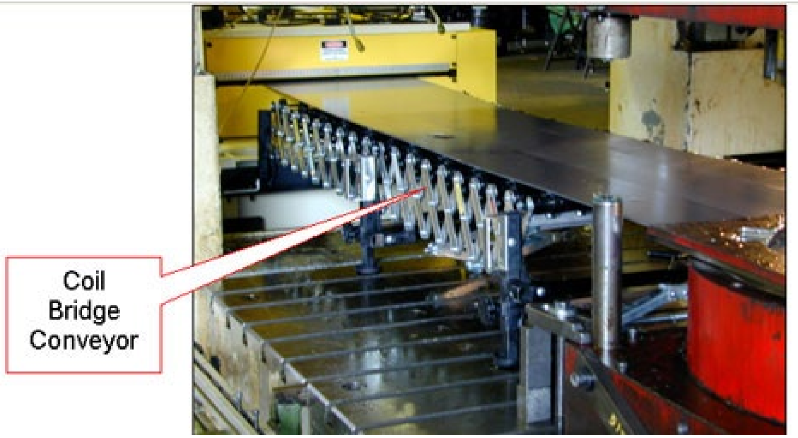
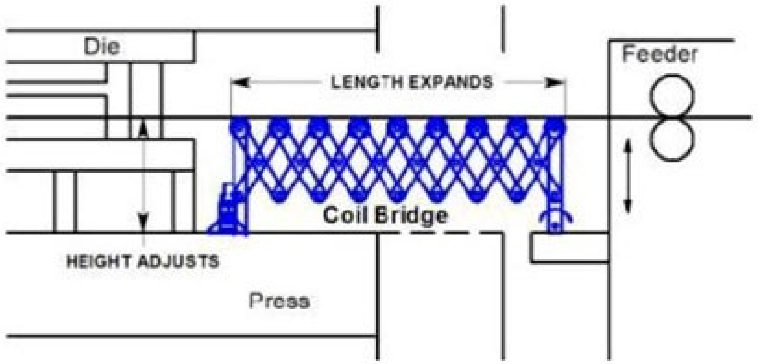
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Use an adjustable coil bridge to support the coil strip between the feed and the die when coil support is required in this area.

Pictured with Poly No-mar top rollers





https://www.metalworking-machinery.com/coilbridge.html

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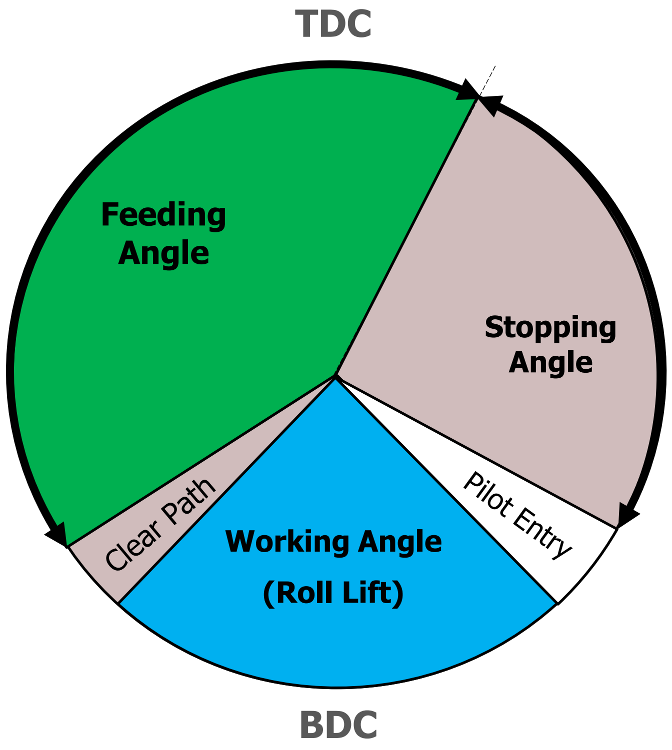
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Feed Angle

The total number of degrees out of 360 degrees of shaft rotation, available for feeding.

Sometimes referred to as feed cycle.

- Older feeds had relatively fixed feed angles
- The advent of servo feeds, die sensors, and servo presses, has made feed timing much more complex



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FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

In general, you will want the feed line to run as slow as possible – use as much of the feed window as possible.

- Increase accuracy
- Reduce potential for roll slippage
- Better loop stability
- Reduce probability of buckles and die jams
- Reduce feed line maintenance costs

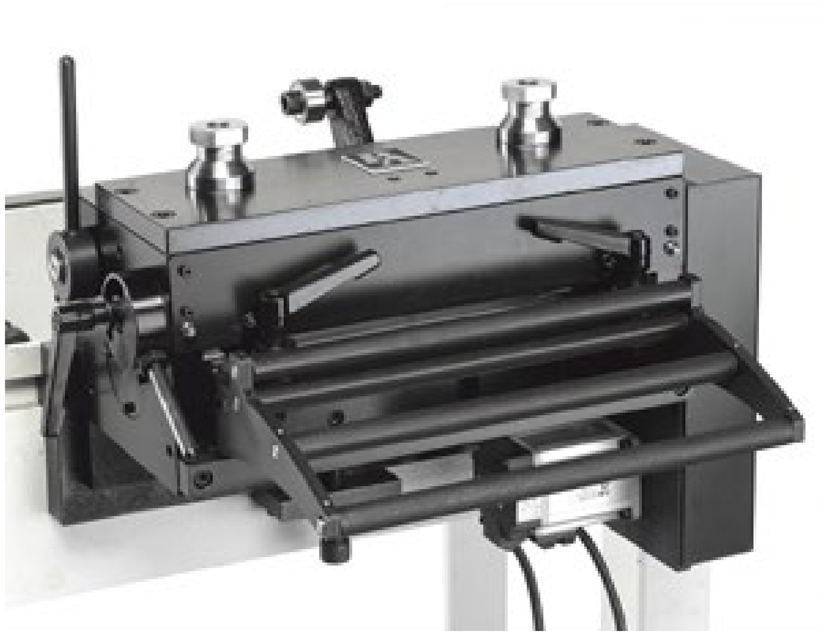

Image: P/A Industries, Inc

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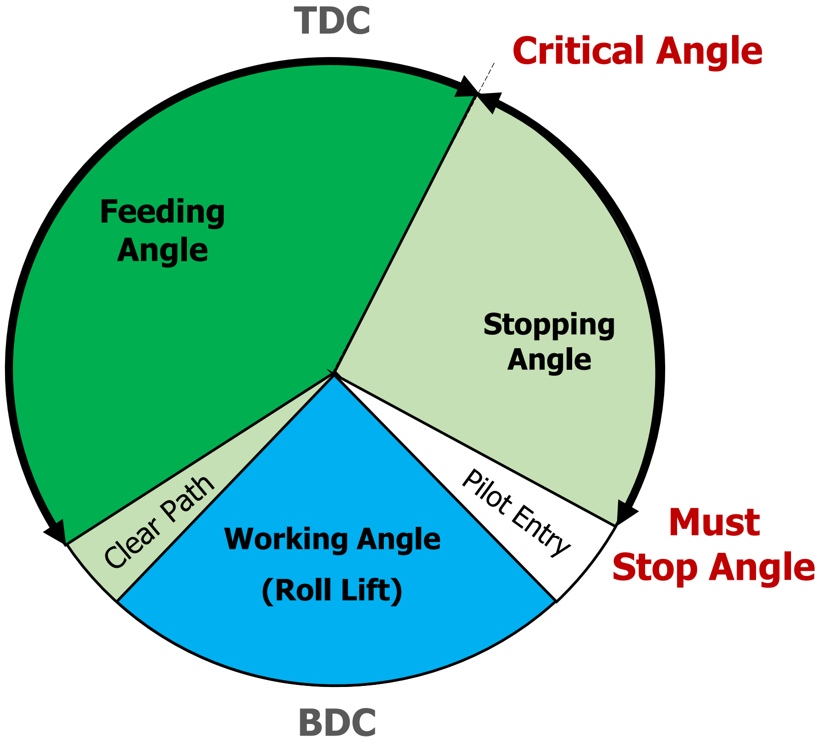
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Critical Angle

Last degree (angle) a fault can be **initiated** so that the press will stop before the die closes on strip

- Press speed (SPM)
- Slide and die weight
- Counterbalance pressure
- Condition of clutch/brake
- Where in the stroke the stop signal is initiated



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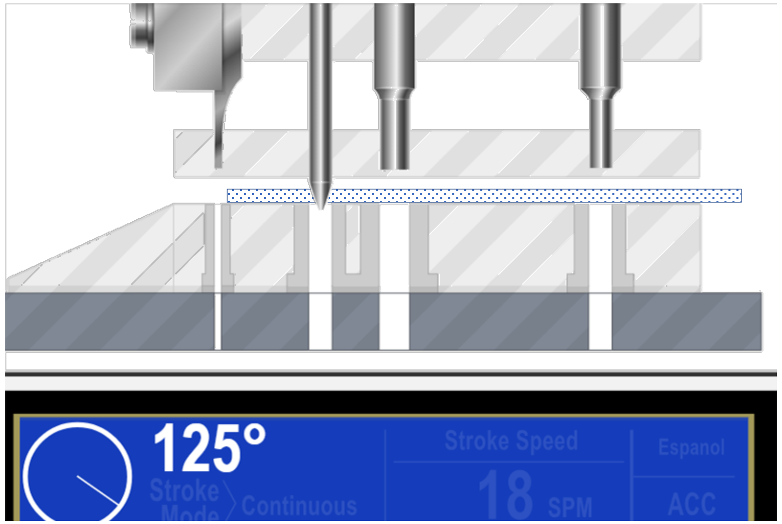
Determining the Critical Angle

1. Inch the press to observe and record the die closure angle (125º for this example)
2. Disable the sensors, and with no material present run the die at its normal operating speed
3. Select "BRAKE MONITOR" option form the press control display (or remote brake monitor)
4. Select "90° BRAKE TEST." This test will give you the worst-case stopping performance.



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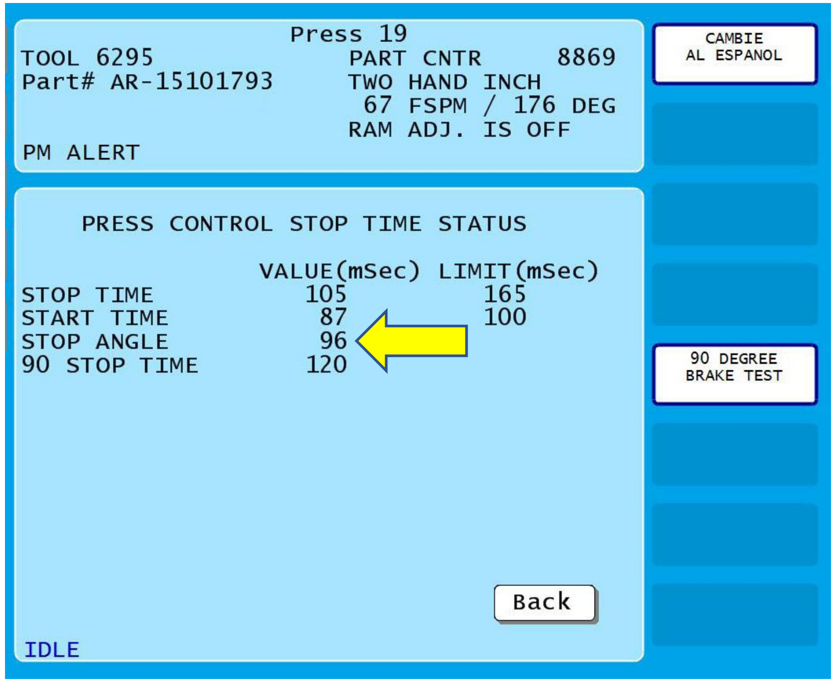
Determining the Critical Angle (cont.)

5. After the press stops, record the STOP ANGLE
6. Subtract the stopping angle value (96^{o}) from the die closure angle (125^{o}) observed in Step 1.



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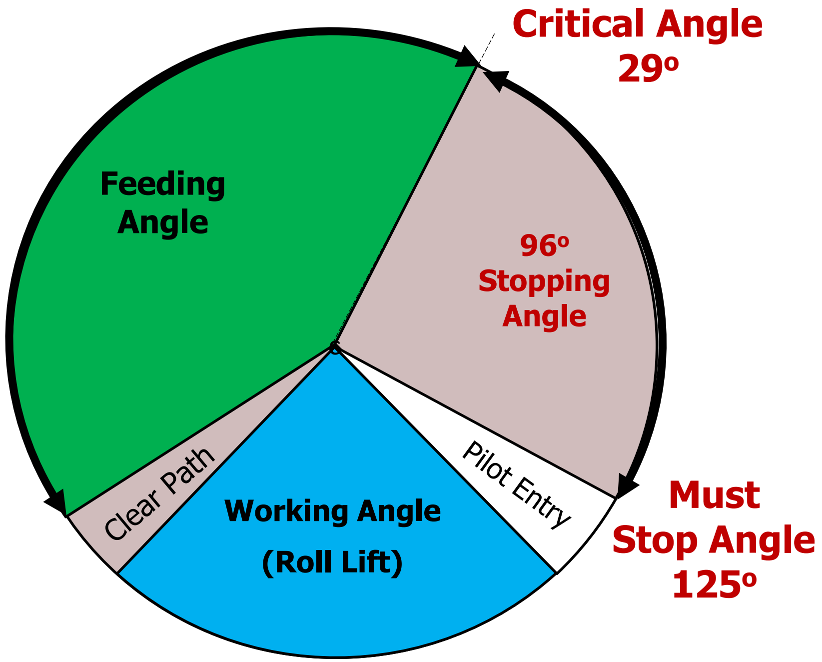
Determining the Critical Angle (cont.)

5. After the press stops, record the STOP ANGLE
6. Subtract the stopping angle value (96º) from the die closure angle (125º) observed in Step 1
7. The result (29º) is the critical stopping angle

Note: The critical angle changes with press speed due to stopping time



Sensor Window Setup

Sensor Location	Sensor Type	Stop Type	ON	OFF	Details / Notes
Short Feed	Green Constant	E-Stop	5	25	Small window to decrease feed related incidents
Cam 1	Green	E-Stop	215	235	Small window to prevent feeding if cam does not return
Cam 2	Green	E-Stop	215	235	Prevent strip from feeding if cam does not return
Material Buckle	Green Constant	E-Stop	250	25	Normal sensor window
Pad Return	Green Constant	E-Stop	140	220	Normal sensor window to detect pressure pad return (lift)
Part Ejection	Green	E-Stop	180	235	Normal sensor window to detect part ejection from die
End of stock	Green Constant	E-Stop	5	25	Small window to decrease feed related incidents
Other Related Events					
Critical Angle = 29° Must Stop = 125°	(determined by 90° Brake Test) (determined by die closure angle)				**Critical angle established for this tool running at 30 SPM** in 600-ton press (#135) with 48 psi C/B pressure
Pilot Release			120	230	Set to pilot tip entry; mirror angle on upstroke; minus 5° for roll lift/closure lag time. **Lag time based on running 30 SPM**
Feed Angle			245	0	Set to feed after cam return "OK" signal and ends before short feed detection begins.
Lube Spray			NA	NA	

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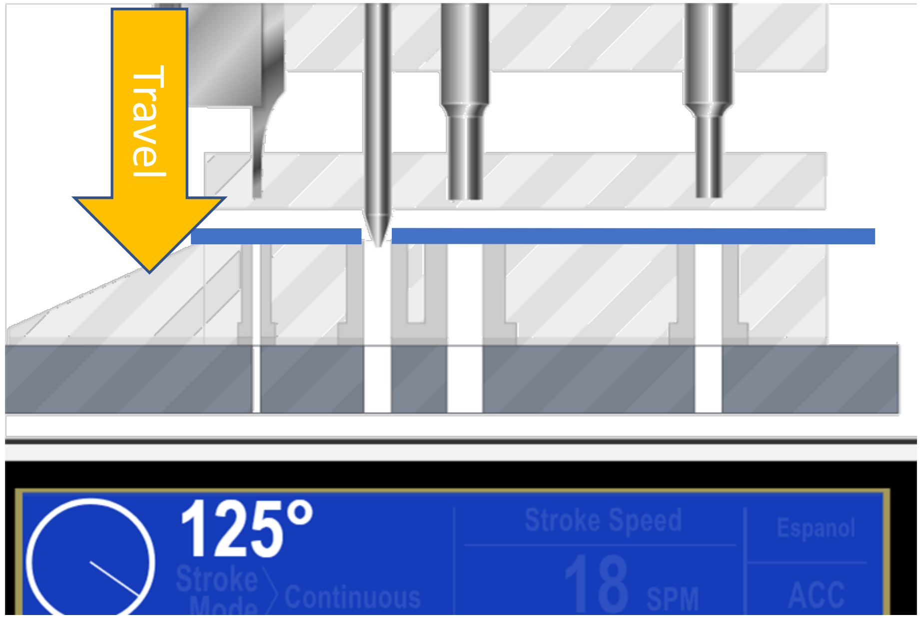
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Pilot Release Timing

The feed rolls should open after the tip of the pilot punch is deep enough in the material to prevent the strip from slipping backwards, but before the full diameter of the pilot punch has entered the material.

If the feed rolls open too early on the down stroke, the strip can pull backwards. If the feed rolls open too late, the pilot punch can break, oblong the hole, or wear very fast.



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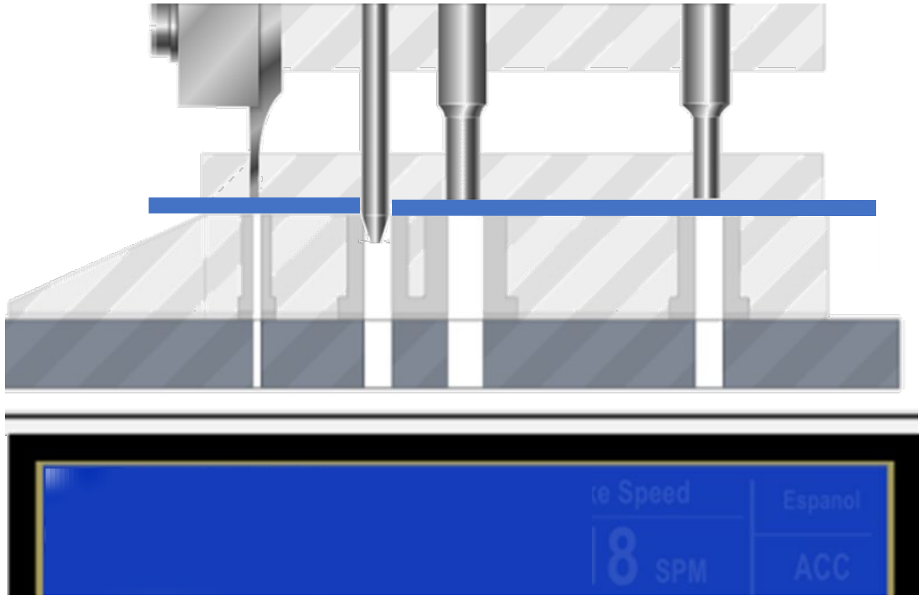
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Pilot Release Timing

If the die has little or no lift, the feed roll can close when the stripper contacts the strip - at or near the bottom of the press stroke (180°)



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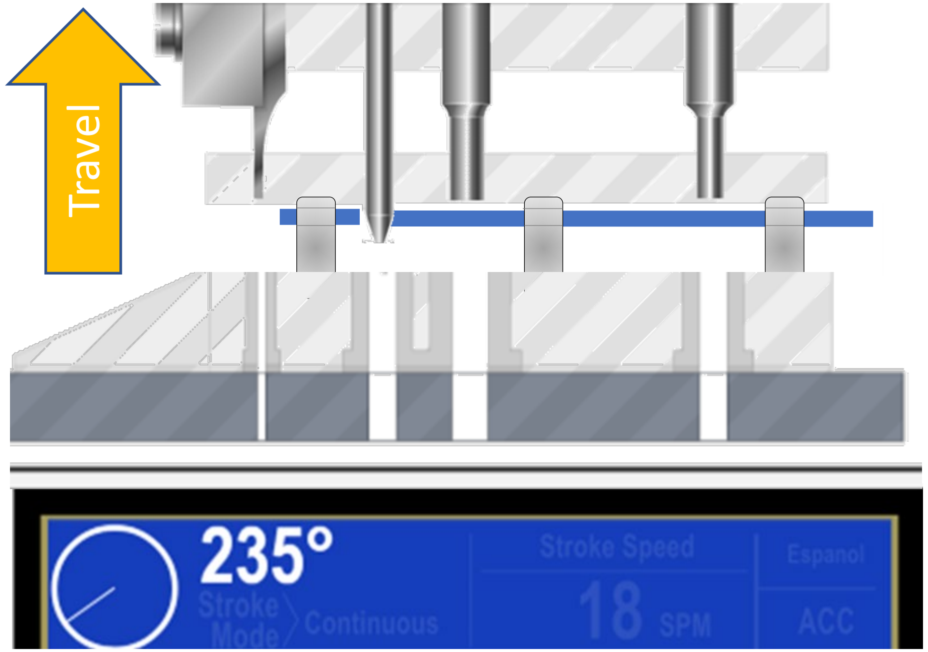
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Pilot Release Timing

If the die has no lift, the feed roll can close when the stripper contacts the strip - at or near the bottom of the press stroke (180º).

If the die has stock lifters, the feed rolls should close when the lifters have returned to their full up position and just before the full diameter of the pilot pulls out of the strip.

The feed roll should close at the last possible instant.



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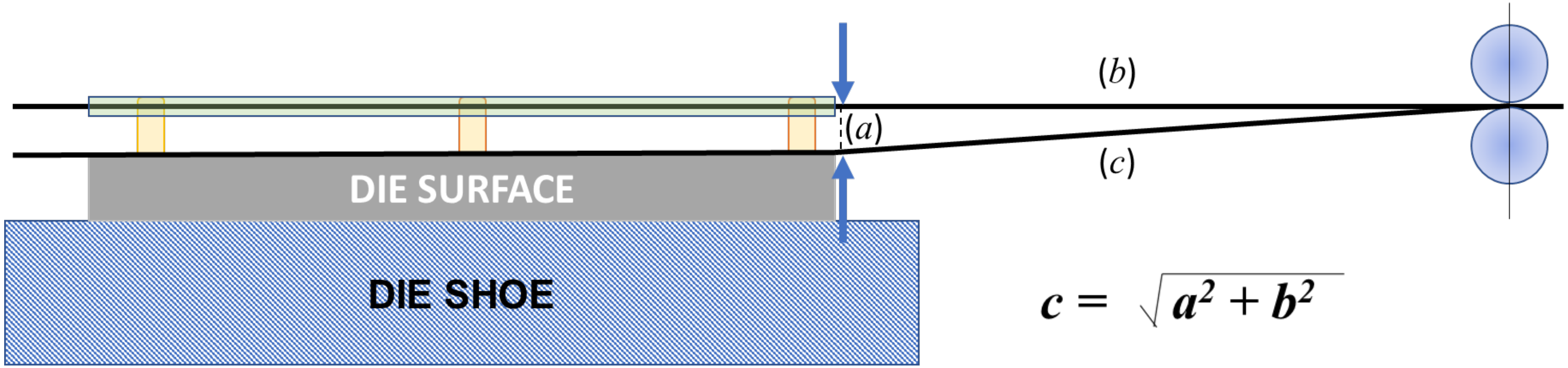
FACTORS IMPACTING PROGRESSIVE DIE PERFORMANCE

Increased pitch length (c > b) occurs when the pilot release closes at or near BDC in die with stock lifter travel



$$c = \sqrt{a^2 + b^2}$$

Lifting Distance (a)	Distance (*b*) from Die-to-Feed	Length Increase (*c*)
4”	36”	36.222

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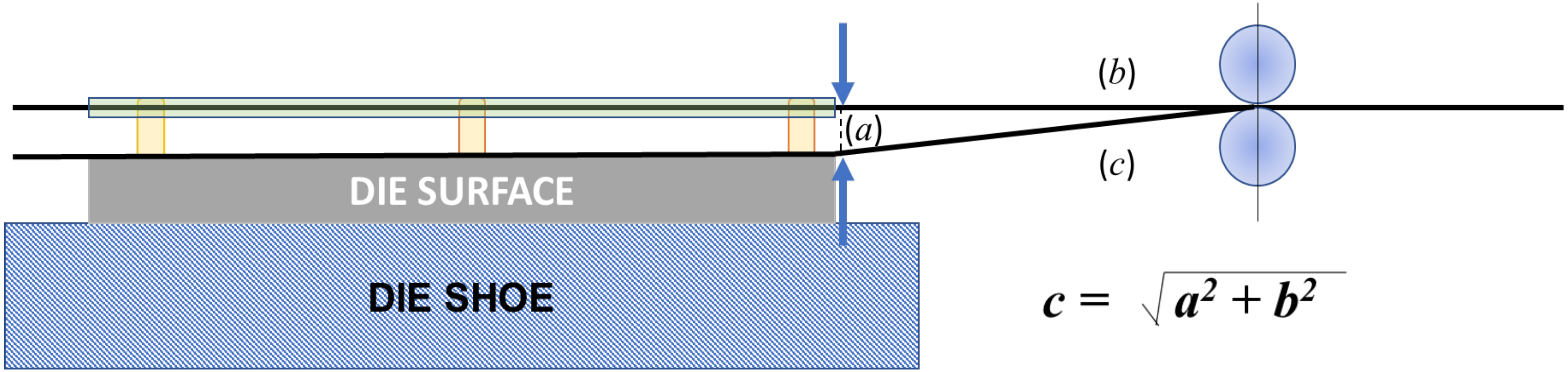

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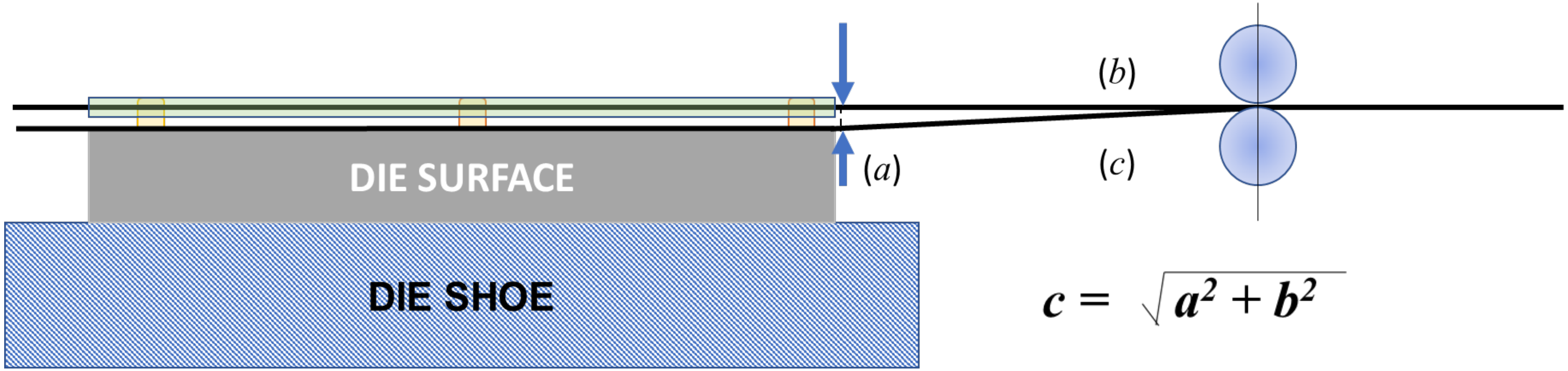

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1”	24”	24.021

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Lube Spray			NA	NA	

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Pilot Release Lag Time

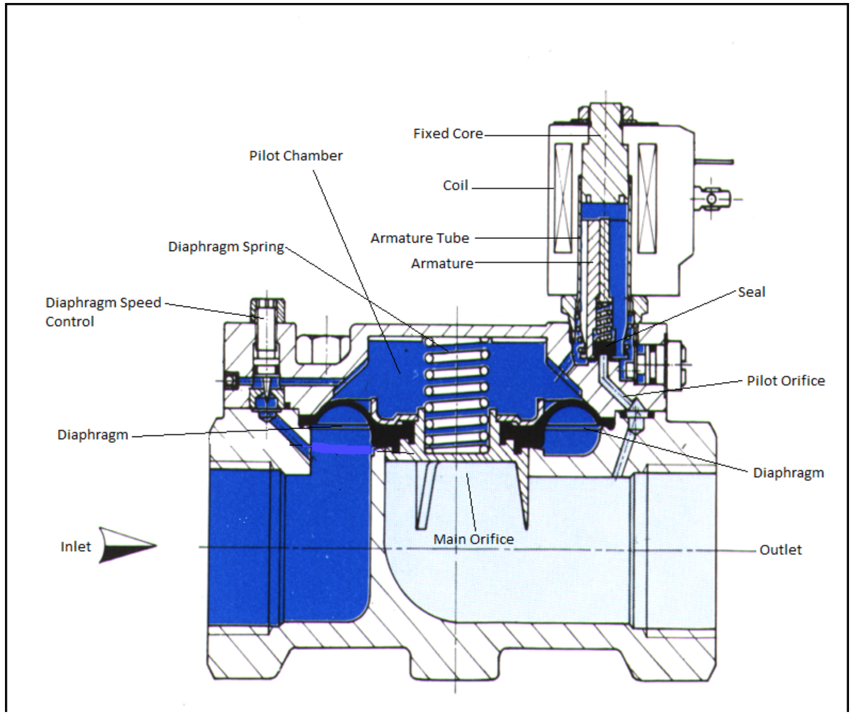
One reason pilot timing can be troublesome is “lag time”

For example:

A relay may take 13ms to charge the coil and cause the switch to activate.

The solenoid also has a reaction time of 13ms before it redirects air from one side of the air cylinder to the other.

There is yet more delay for air to exhaust from one side of the air cylinder to fill the opposite side.



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Pilot Release Lag Time

In total, there may be 35ms to 45ms of delay from the activation signal to when the roll actually lifted or closed.

The table below assumes 60 SPM takes approximately 2.8-milliseconds (ms) for the crank to turn 1°

Strokes per Minute (SPM)	1° rotation (ms)	Signal delay (ms)	Total delay (° rotation)
60	2.8	35	12.6
60	2.8	45	16.2

60 SPM = 1 stroke per second

1 stroke = 360° rotation

1 second = 1000 milliseconds (ms)

1000-ms/360° = 2.8-ms per 1°

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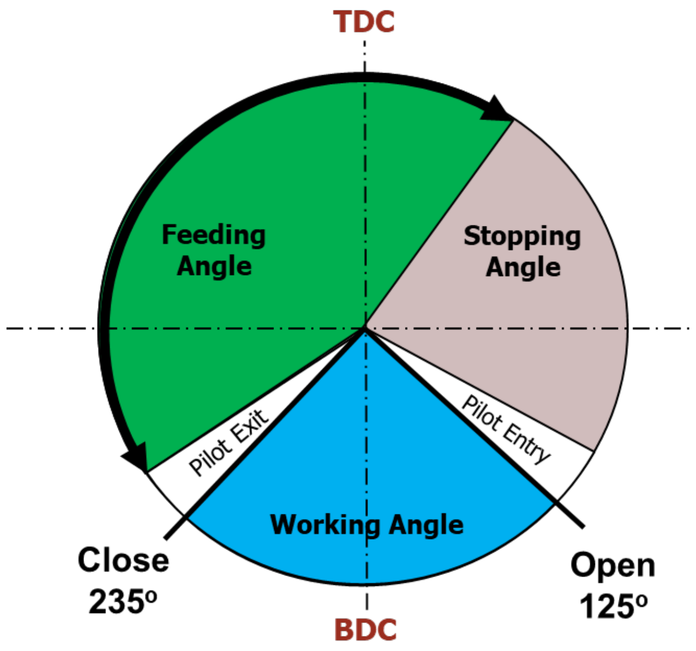
Pilot Release Lag Time

If you programed the feed roll to lift at 125°, it will not actually lift until 138° to 141° degrees. The same lag will occur when signaling the feed roll to close.

If you increase or decrease SPM, this will change

Strokes per Minute (SPM)	1° rotation (ms)	Signal delay (ms)	Total delay (° rotation)
60	2.8	35	12.6
60	2.8	45	16.2
55	3.1	35	11.3
65	2.6	35	13.4



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OTHER AREAS TO LOOK FOR IMPROVEMENT

The impact of servo press technology on feed synchronization and feed timing. Programming distances in place of angles

Optimize & couple transfer system motion profiles. Implement anti-vibration strategies

Rethinking the required/desired skills for press operator training

Improve uptime through improved maintenance and standardization