

# P.E.P. TECHNOLOGY<sup>©</sup>

## Automated Manufacturing with High Tech Software

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### What does software really cost?

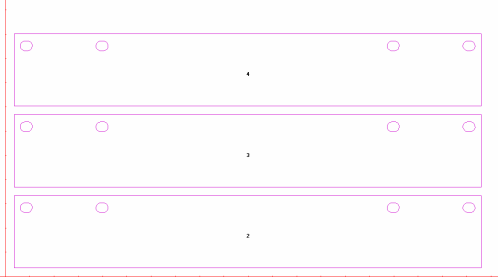
#### AUTOMATIC - COMMON & COMBINE CUTTING

P.E.P.'s Automatic Nesting software analyzes the external geometry of parts and AUTOMATICALLY rotates parts aligning the common geometry to maximize the common cutting opportunities.

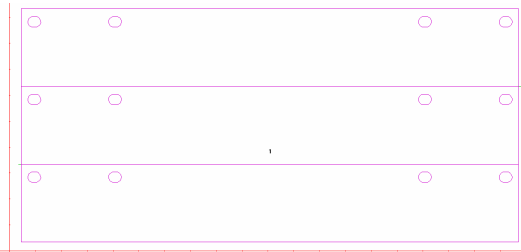
The combining of two passes into a single slice between parts will save 12.5% to 40.9% of the total cutting distance. The wide range of savings (12.5% to 40.9%) is explained in this document.

#### RECTANGULAR AND SQUARE PARTS

From this ...



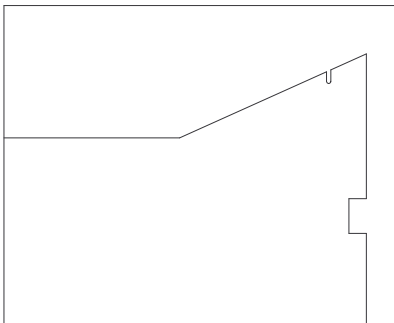
To this...AUTOMATICALLY!



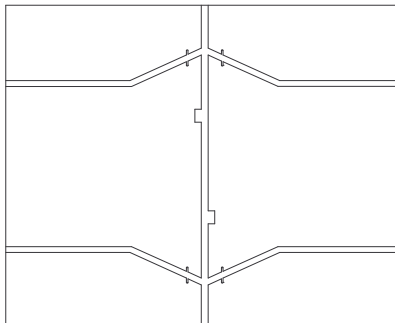
#### ODD SHAPED PARTS with geometries at angles other than 0 & 90 plus notches.

The nest below is an example of a part that was nested with the “Combine Cut” logic for the airbag industry. The part in the nest has been automatically nested and interlocked with itself in columns and rows at 0 and 180 degrees. The enlarged views show the common geometries before and after combine cutting.

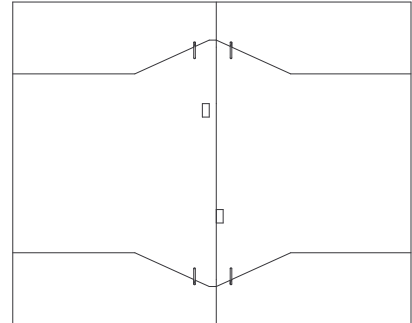
**Notches along part edge**



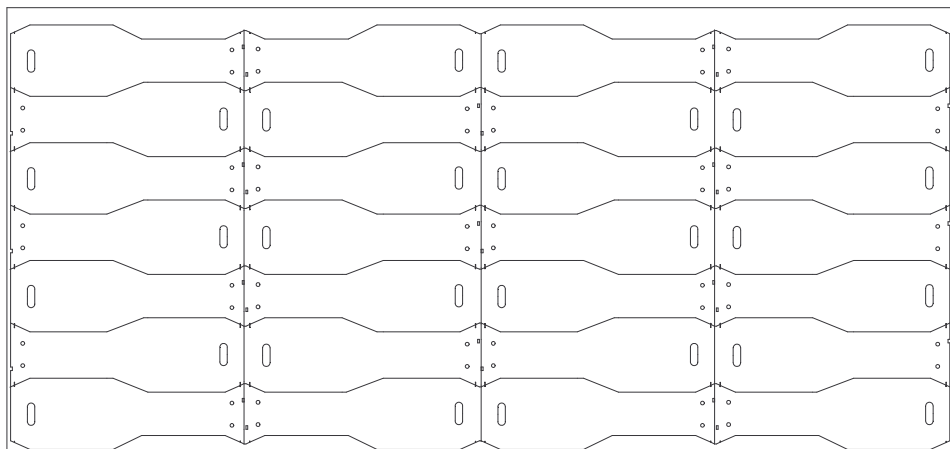
**Enlarged view before combine**



**After combining parts**



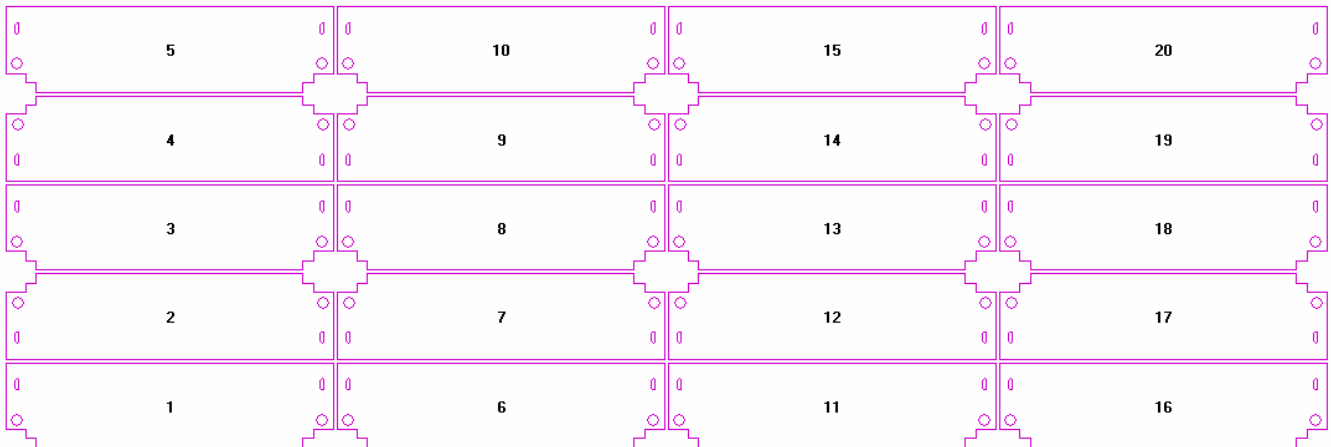
**The Combined Nest**



## COMBINE CUTTING vs. COMMON CUTTING

### WHAT THE AUTOMATIC NESTING AND COMBINE CUTTING LOGIC DOES!

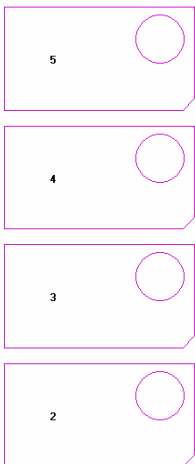
The intelligence of the Automatic Nesting software is profound. The logic analyzes the parts, categorizes them and then nests columns of parts rotating the parts to maximize the amount of common and combine cutting. In the nest below the logic recognized that the part could be common or combine cut, however, to maximize the savings the 1<sup>st</sup> part of each column must be nested upside down and every other part rotated 180 degrees to the previous part, column after column. Rotating the 1<sup>st</sup> part upside down pairs the longest geometry maximizing the savings. Having nested the parts in columns, the logic then combine cuts the first columns and saves it as a sub program that is called four times reducing the control memory required to cut the nest.



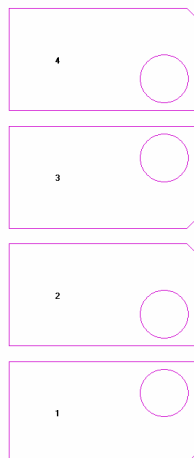
### Organizing the parts in the nest matters.

The P.E.P. nesting logic will produce all three types of nests below based upon the part attributes and the type of cutting ( laser, plasma, gas, waterjet, punch ). When common or combine cut scenarios exist, P.E.P. will nest the parts as shown in the middle and right column. Orientating the parts as P.E.P. does for common and combine cutting will eliminate head crashes, improve edge quality, reduce heat buildup and minimize burn spots.

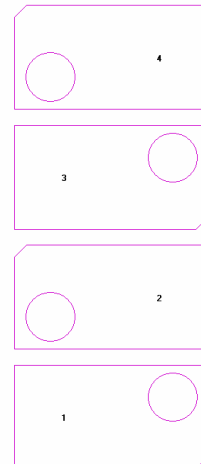
**Cut as solo only**  
No common geo.



**Combine Cut**  
If Mirrored = Yes



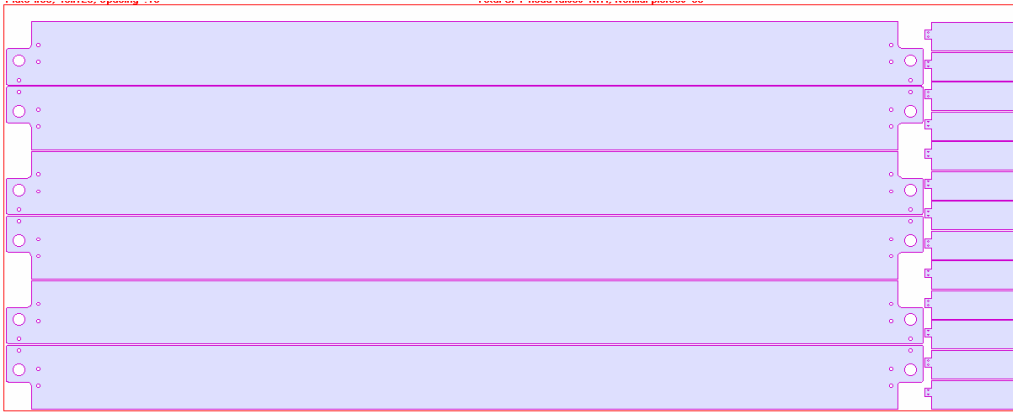
**Common Cut**  
Rotated 180 = Yes



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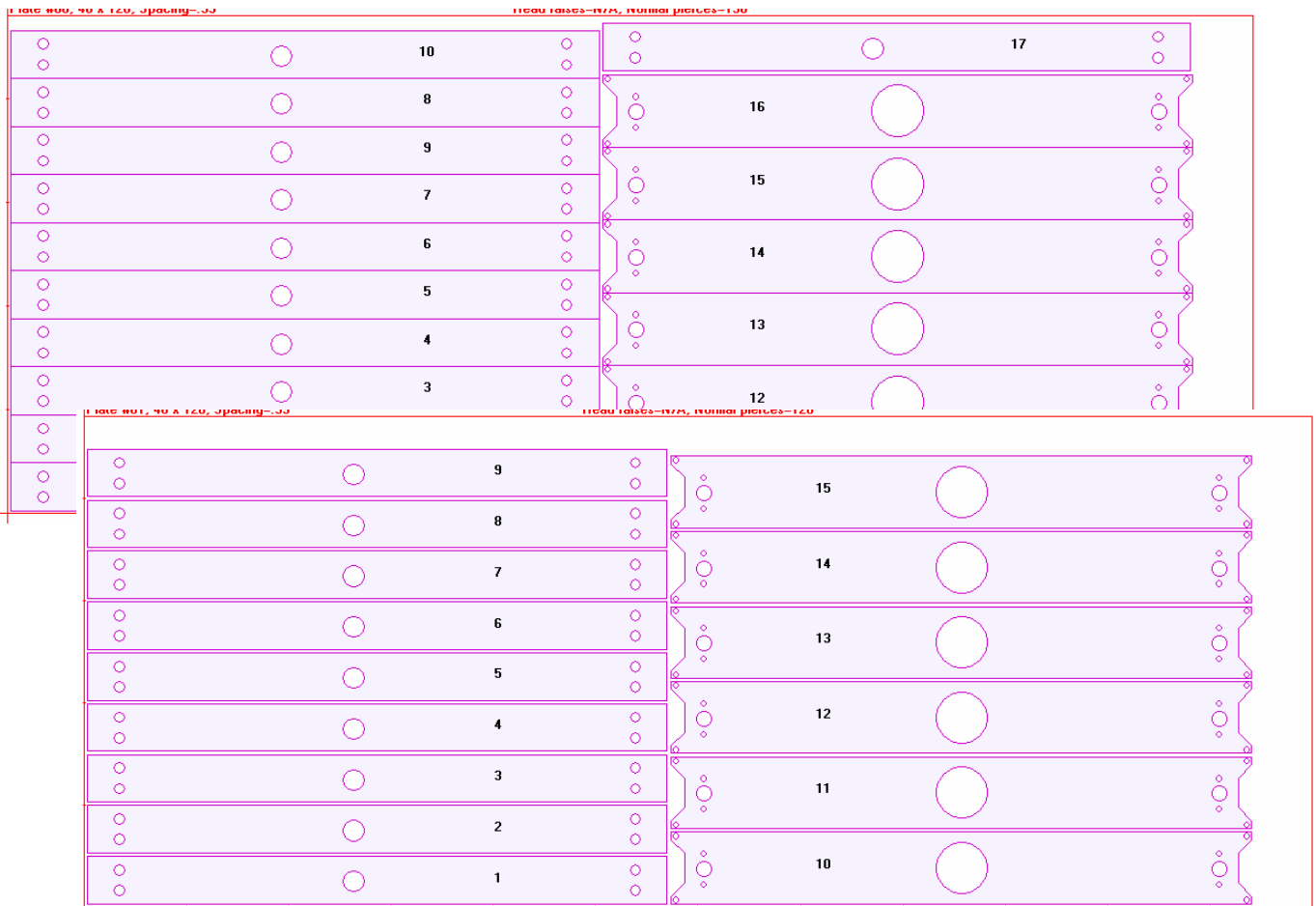
## Material Yield Savings with Common and Combine Cutting

The CUT savings derived by common and combine cutting are well documented as shown in the top nest.



An added benefit to combine cutting is the material savings. Rather than nest the parts at the normal part spacing, the software knows when to nest parts at the kerf spacing used by the Combine Cutting logic. The accumulated material savings between parts allows the software to nest more parts down per sheet. As seen in the top nest below, the software was able to nest an extra large part in each of the columns because of the accumulated savings between parts. The material at the top of the bottom nest was wasted.

**The top nest was nested with the Combine Cut logic – 2 extra parts went down**

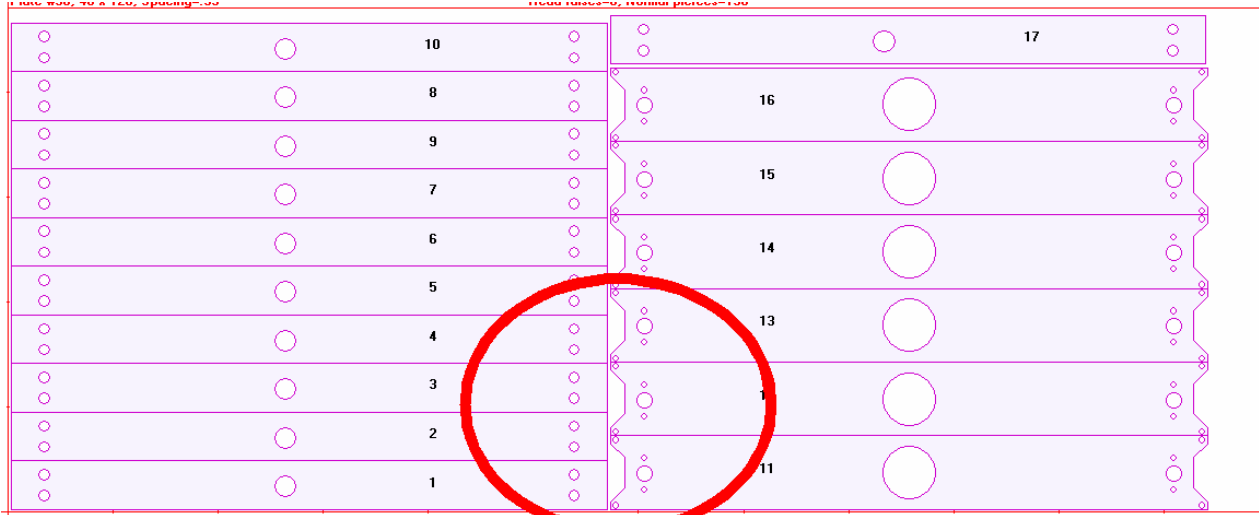


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## Head Raise and Rapid Travel Distance Savings

The CUT SEQUENCE of the internal cutouts in a combine cut part are automatically output in vertical columns or horizontal rows snaking up and down and back and forth. As shown in the enlarged view, the cutouts are sequenced using the shortest path. Then the lead-ins are assigned to the cutouts so that the cutter path moves away from the previous cutout so that the head can stay down. All of this is done automatically.

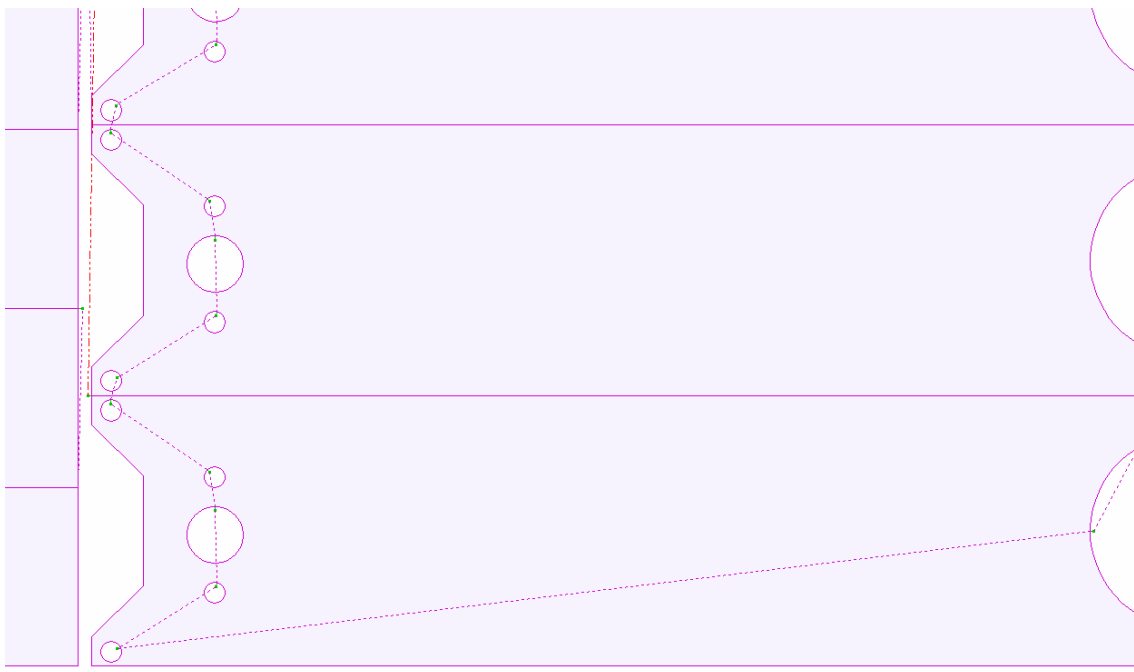
**Combine cutting the parts reduces the rapid travel distance from 1728 inches to under 700 inches.**



## CPT Logic Keeps the Head Down Automatically

The magenta dashed lines represent rapids where the head is kept down. The red dashed lines represent rapids with head raises. The crash protection logic ( CPT ) automatically outputs a mandatory head raise when the head travels over a cutout or a part that could damage the head.

**CPT required only ONE head raise out of 136 rapids, the head raise savings alone were \$8.33 per sheet based upon a machine time of \$100.00 / hour and a cutting speed of 175 ipm.**



## CREATING THE CUTTER PATH

The P.E.P. software automatically creates the finished cutter path. The following are some of the cutter path considerations built into the logic.

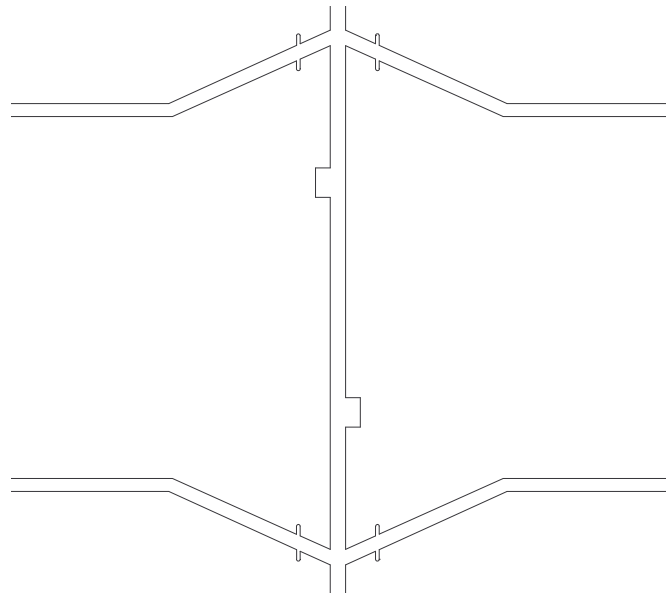
### Angle Deviation

Cad products save the starting and ending points of lines drawn at an angle as X/Y coordinates and not as a line drawn at a specific angle ( i.e. 45 degrees ). The calculated X/Y coordinates representing the line are normally correct; however, sometimes the coordinates are off by .002” or more. The error in the part geometry creates a problem when rotating and nesting the part with itself because the lines you would expect to be parallel are not perfectly parallel to each other. P.E.P. recognizes this and outputs the cutter path within tolerance.

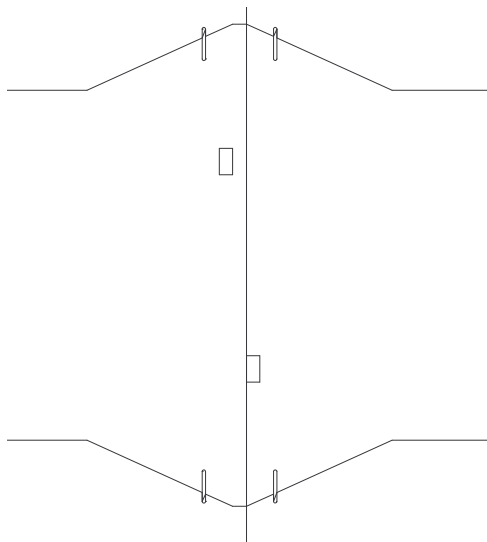
### Cutouts and Notches

The part geometry on the right is an example of a part with notches along the vertical and horizontal slices. Since the notches along the horizontal slice line up, the notches will be combined as one cutout. The notches along the vertical slice will be output as two cutouts.

BEFORE COMBINE CUTTING



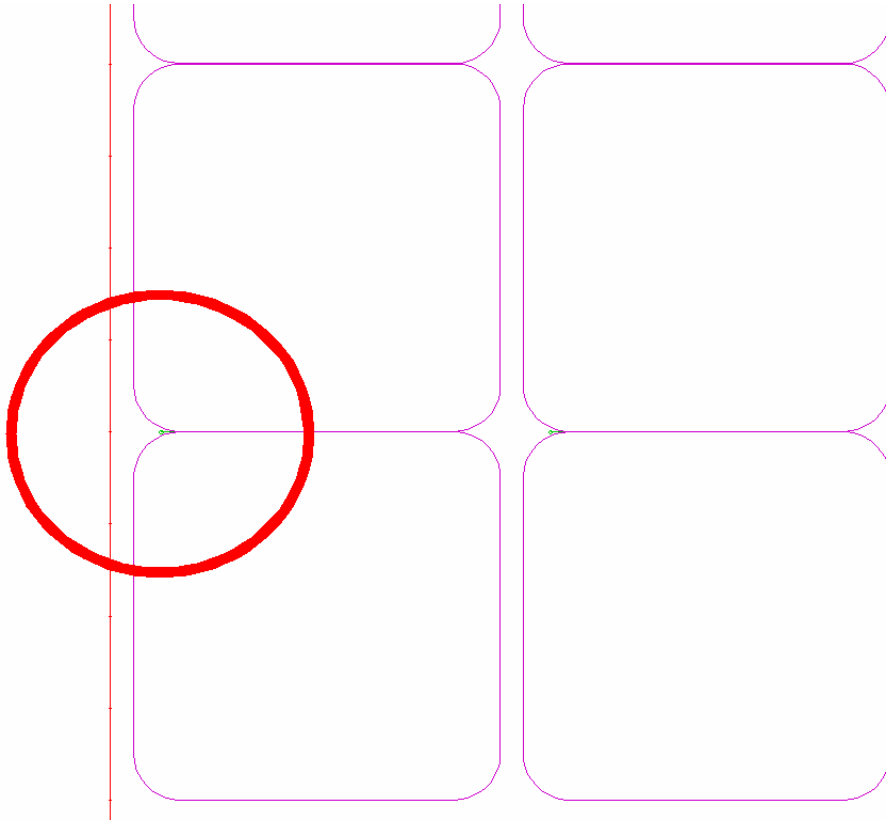
AFTER COMBINE CUTTING



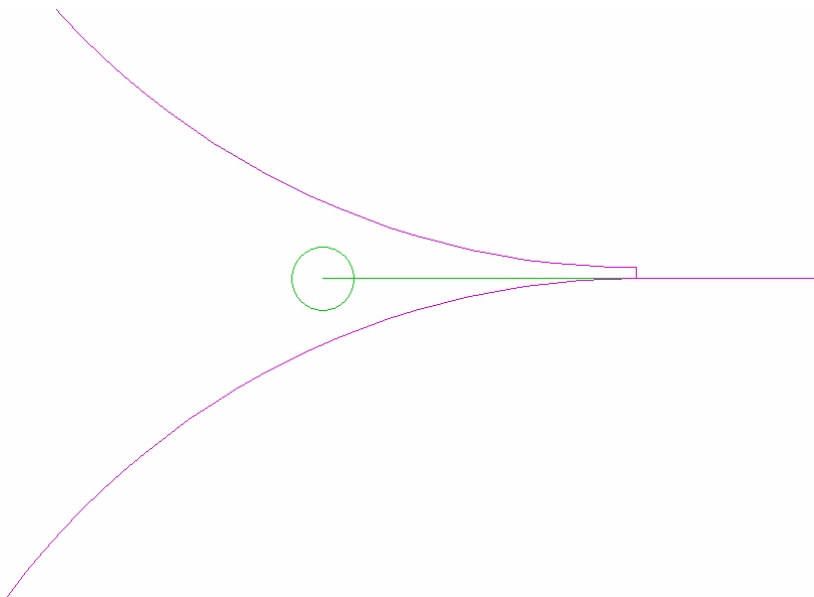
The results to the left show how the notches along the boundary of the part have been turned into cutouts and the boundary itself is now a single pass offset for kerf.

## Pierce Interference

To reduce pierce splatter on the finished part when common and combine cutting, lead-in's are checked for interference and extended up to twice the regular lead-in length entered in the material database to ensure that the heat effected area does not effect the edge quality.



ENLARGED VIEW OF PIERCE AND LEAD-IN WITH THE EXTENDED LEAD-IN LENGTH.



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## COMMON CUT SAVINGS

P.E.P. recognizes that some parts can only be common cut!

Whether a job requires 10 parts or a 100 parts, the common cutting saving derived from cutting two geometry in a single pass are:

#	Type of Part	Part Example	Distance Calculation	Cutter Path Savings
1	All Squares	10 x 10	40"x2"-10"	12.5 %
2	10 x 20 rectangle	10 x 20	60"x2"-20"	16.6 %
3	2 x 20 rectangle	2 x 20	44"x2"-20"	22.7 %

## COMBINE CUTTING SAVINGS

The COMBINE cutting savings derived from cutting the same part quantities ( i.e. 10 parts ) and making one common cut between both the top and bottom of multiple parts is:

#	Type of Part	Part Example	Distance Calculation	Cutter Path Savings
4	All Squares	10 x 10	40"x2"-10"	22.0 %
5	10 x 20 rectangle	10 x 20	60"x2"-20"	30.0 %
6	2 x 20 rectangle	2 x 20	44"x2"-20"	40.9 %

## DO THE MATH

We don't know how much common and combine cutting your doing now, however, if your software does not output the nests correctly and you missed as little as 8 hours of common and combine cutting per week, per machine, your software could cost you an additional 10 weeks of machine time per machine each year. The table below shows the MINIMUM you would have lost per machine.

#	Method	Machine time	# of Wks.	Years	Distance Saved	Machine Cost	Lost Co. Income Low & High
1	Common Cut	8 hr./wk	50	5	12.5 % to 22.7 %	\$100./hr.	\$25K to \$45.4K
2	Combine Cut	8 hr./wk	50	5	22.0 % to 40.9 %	\$100./hr.	\$44K to \$81.8K

**Please recognize that PEP does both common and combine cutting automatically and that the savings shown in the right column do not take into account any engineering or programming savings. The numbers in blue are the increased machine savings derived by rotating parts for ONE machine cutting ONE shift a day!**

If you engineering staff is manually rotating parts and manually creating the cutter path then the savings would be more than twice what you see.

If you are not common cutting and combine cutting at all, then you could be losing more than twice what the amount displayed in the table shows.

The PEP software is the ONLY software which will AUTOMATICALLY analyze each part and then automatically nest the parts to take advantage of COMMON & COMBINE cutting technology.

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## **So what does software really cost?**

I would suggest you look closely at the software and consider how the software will drive the machine.

- If the nesting software your shop is using does not create a finished cutter path automatically you are wasting a lot of engineering time and or machine time.
- If you're nesting parts that the engineering department put together manually your company is wasting a lot of material.
- If the nesting software will automatically or manual allow the user to create a common cut path you need to ask whether the automatic nesting software will nest the parts at the rotation they need to be rotated to maximize common and combine cutting.
- If the automatic nesting software does not know how to analyzes, rotate and align parts in columns to maximize the common and combine cutting, then you may be doing less than 15% of the common cutting that you could be doing.
- The PEP automatic nesting software will automatically analyze and then nest parts down orientating the parts to the correct spacing resulting in the maximum number of the parts per column that can be nested in the column. This increases the material yield of the sheet while simultaneously maximizing the amount of common cutting that can be done on a sheet.
- The P.E.P. software also nests parts to do what we call Combine Cutting, the nesting and cutting of multiple geometry on multiple parts. To the best of our knowledge, only PEP does this automatically on the fly based upon the sheet size and the location of the part in the nest.

**We hope that this document will help your company make a software decision that helps your bottom line. We believe the actual cost of the software must include engineering time, programming time, material waste and the machine time a company spends over the life or ROI for the machine.**