Coursework – ProNest® 2017

Teacher's aid

Contents

Introduction

Nearly 50 years of cutting excellence

At Hypertherm, our sole focus is cutting. Every Associate – from our engineers to our manufacturing and service teams – is completely focused on providing our customers with the best cutting solutions in the industry. It's a mission stretching back nearly 50 years to our first industrial cutting patent. Today, our patent wall continues to expand as we innovate tirelessly to introduce new plasma, laser and waterjet technologies and services that will help industry achieve optimal cutting outcomes that support their business objectives. So, whether you're cutting precision parts in North America, constructing a pipeline in Norway, fabricating agricultural machinery in Brazil, gouging out welds in the mines of South Africa, or building a skyscraper in China, you can count on Hypertherm. No matter what you cut, where you cut, or how you cut, we are here to guide you toward the cutting solution that is right for you.

ProNest is an industry leading CAD/CAM nesting software for advanced mechanized cutting. It provides a single solution for profile cutting needs including plasma, laser, waterjet, and oxy/fuel. It is specifically designed to help fabricators and manufacturers increase material savings, boost productivity, lower operating costs, and improve part quality.

Why does industry choose ProNest?

Process expertise

ProNest does more than any other software to automatically embed cut process expertise into the NC code. Whether it's material type, thickness, or grade, ProNest is drawing on years of research and development to deliver the optimal adjustments including leads, separations, kerf, feedrate, and cutting techniques.

Breakthrough technologies

ProNest is brought to you by the cutting experts at Hypertherm. This allows you to leverage breakthrough cutting technologies like True Hole® and Rapid Part™, which are delivered automatically without operator intervention, and True Bevel™ which greatly reduces bevel set up time.

Ease of use

Users agree that ProNest is surprisingly easy to learn and use, particularly compared to other advanced nesting products. Our intuitive software only requires one interface, and users do not have to switch between different programs to complete the job. Production teams will be up and running faster, and will be able to complete the job in fewer steps.

Notes:

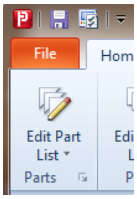
This material has been provided specifically for Hypertherm Educational Partners to act as a teacher's aide. This material is not intended to represent a complete ProNest® training document.

The following tasks are based on a Hypertherm plasma machine set-up. The "EdgePro 9_74 HPR400XDa ArcGlide (All, TrueHole, N2M, N2CM) ArcWriter" machine configuration/setup file is provided with this curriculum and is recommended for this program. Students should add this machine to ProNest and set as the default. Also required is the demo oxyfuel machine which is already included in the initial ProNest installation. If other machine configurations are used to administer this program, the actual results will be different than the documented results. Please consult with your Hypertherm CAM representative for assistance with making the required modifications.

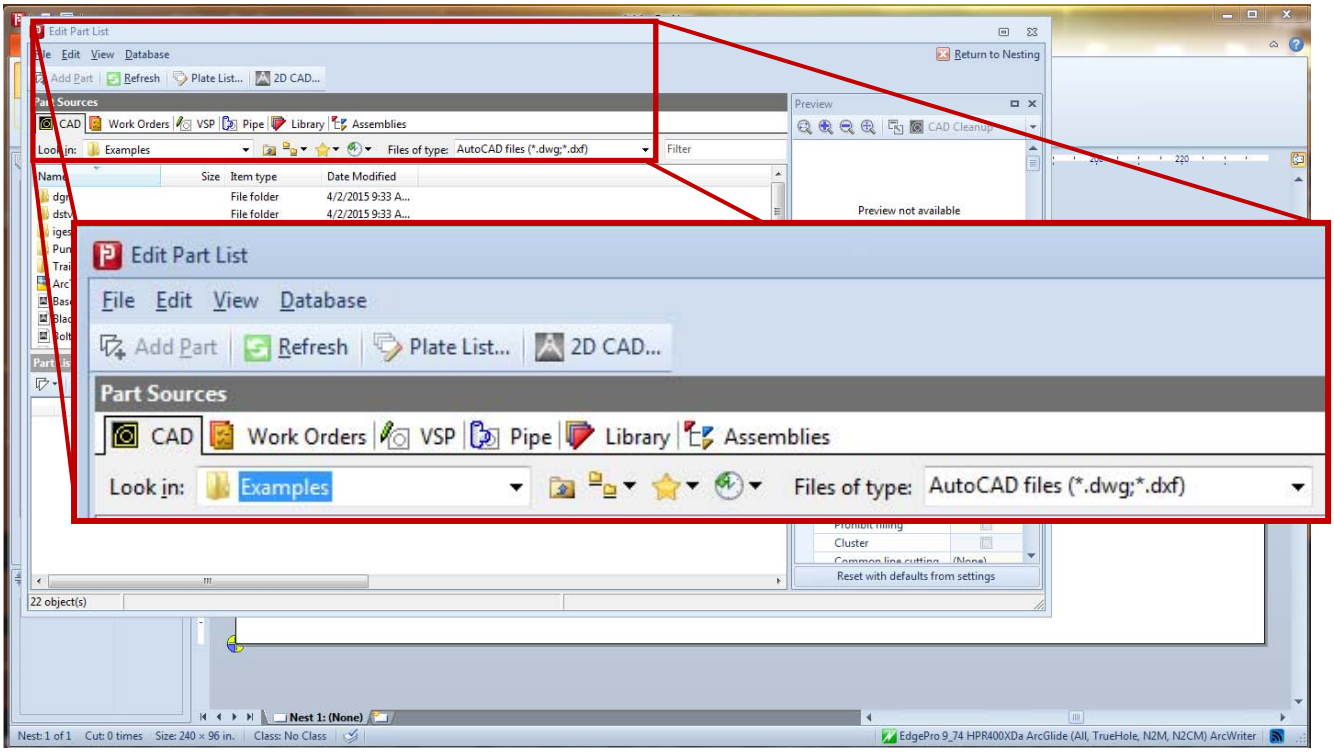
CAD GEOMETRY – understand how to bring geometry into ProNest.

The Parts List

The ProNest part list contains all of the parts that you have added to your job. When you import part files into your job from a part source, ProNest processes these files and then adds them to the part list. Added parts contain all of the information from the source file as well as the nesting information that was added when the part was imported.



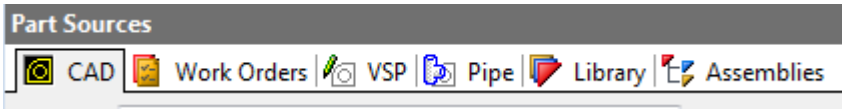
The editing of a job's part list is done in the Edit Part List window. From this window you can build a part list for your job by importing part source files into ProNest and adding properties to those parts.



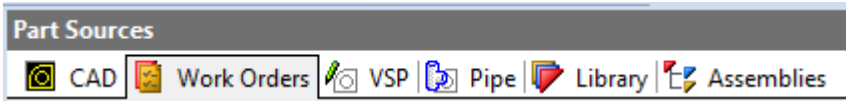
Part Geometry

There are six (6) methods for bringing geometry (parts) into the ProNest Parts List including:

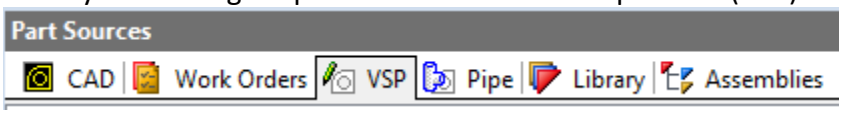
1. Draw in AutoCAD or other compliant software and bring into ProNest as a .dxf or other file format.



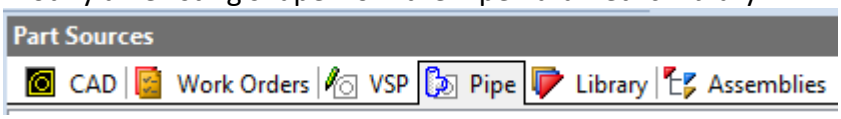
2. Import parts through an MRP/ERP interface to create Work Orders.



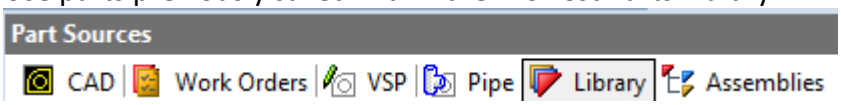
3. Modify an existing shape from the Variable Shape Parts (VSP) Library.



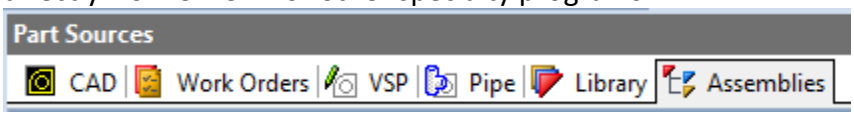
4. Modify an existing shape from the Pipe Parametric Library.



5. Use parts previously saved within the ProNest Parts Library.



6. Use one of ProNest's "Optional Interface Modules" to import profiles or assemblies directly from 3D CAD or other specialty programs.



TASK – The Parts List: For methods 1, 3, 4 & 5 above, write down the procedures and basic steps taken to create and import each into ProNest.

1. Extract a part from your assignment and save it as a *.**dxf** file, import into ProNest for use in a nest.
    - Open ProNest, open the edit part list, navigate to the folder containing the *.dxf, add the file to the part list.

3. Modify a General Rectangle 4” x 8” in ProNest VSP for use in a nest.
    - Open ProNest, open the edit part list, click the VSP tab, open the General Rectangle, edit the dimensions, add to the part list.

4. Open the Pipe module in ProNest. Modify O/D to 12” I/D to 5” and define 5 holes of 1” dia. on a 5 1/2” dia. Flange. Next, modify a Segmented Elbow in the ProNest VSP with a 90° angle. Make both parts available for use in a nest.
    - Open ProNest, open the edit part list, click the Pipe tab, open the Flange and/or the Segmented Elbow, edit the dimensions, add to the part list.

5. Open the Parts Library in ProNest. Make the part Circle.dxf available for use in a nest.
    - Open ProNest, open the Part Library in the Database tab. Click on “new”. Navigate to the “Program Data\Hypertherm CAM\ProNest 2017\Examples” directory. Select Base Plate.dxf and Circle.dxf and click OK. Within the properties select MS .375 and a QTY of 5 each. Close the Parts Library window. Select Circle.dxf and add to the Parts List.

DEFINE PART LIST (1) – understand the most common ways to define the part list and related job specifications in ProNest.

TASK - Parts: For this task, use the provided Hypertherm plasma machine set-up (it may be useful to set this machine as your default). Open PN and go to the Edit Part List. Under the CAD tab, navigate to the Examples folder (Program Data -> Hypertherm CAM -> ProNest 2017 -> Examples).

Select the ArcTrap and add it to the Parts List. List three different ways that you can move this part to the part list in PN:

- Select the part and press the *Add Part* button
- Double click on the part
- Drag the part to the Parts List and drop it

TASK - Quantity: Change the quantity of ArcTrap to 20.

Choose three more parts from the examples folder, add these parts to the part list and assign quantities of 20 to each part.

In addition to the quantity, explain which two additional part attributes (part list fields) must be assigned a value, before plate nesting can take place:

- **Material and Class**

  Material = The material assigned to the selected part.
  Note: When spreadsheets are used for the Process Parameters, the list of available materials comes from the materials found in your Process Parameters spreadsheet. When spreadsheets are not used, the list of available materials comes from your material database.

  Class = The cutting parameters for the selected part.
  Note: Class can be used to organize your materials using specialized information such as cutting gas or amperage. Parts with the different classes can't be placed on the same nest. Available classes come from the Process Parameters spreadsheet.

TASK - Material: Set Material to MS 0.375 in. and Class to 130Amp 02/Air (True Hole).

TASK - Leads: To display the leads for a selected part, first highlight the part, click the leads tab in the Properties window (lower right), and then click on an exterior lead in the Preview window (top right).

Fill in the following lead information from the ArcTrap outer profile:

Lead-in

Style	Linear
Size (in.)	0.375
Angle	0
Extension (in.)	0.000
Quality	Inherit

TASK – Editing Leads: Leads in PN are assigned automatically based on the built in process parameters spreadsheets and settings; however leads can be edited if desired.

While Hypertherm parameters are factory tested, what is one reason why you might want to edit the leads of a part before continuing on to nesting?

- The software sometimes places leads on the sides of parts, but if a small radius corner is present, this may be a better location for a lead. (This would potentially cause a surface blemish on the side of the part.)
- If part quality is not an issue then manually adjusting the leads to a shorter length, while increasing the potential for part defects, will allow the potential for more parts to be placed on a nest.
- Using lead styles such as lock, diagonal step, spiral, wiggle and various others can be beneficial depending upon the cutting process or material being cut.

Describe one other method for editing leads in PN:

- Select a part in the Parts List, open Advanced Edit, select Entity->Modify Leads

TASK – Special Leads: Why might someone choose to apply Corner Loops to a part?

- To increase the sharpness of the finished cut corner

What is one downside of using a corner loop?

- Increased part separations (resulting in decreased plate utilization)

Where in ProNest can corner loops be added?

- Advanced edit

Special Attributes

TASK - Costs: Select the ArcTrap in the Part List. The total cost of the part can be automatically calculated by PN under the "Utilization and Costing" tab (lower right). While working with costing, keep in mind that real world ProNest users have their own unique costs and tracking methods that must be entered into the ProNest setup before accurate costing results can be produced. The examples below rely on sample data supplied in the standard configuration/setup installed for this class and are for demonstration purposes only.

Note the total cost and production time difference that occurs as the material thickness changes:

MS 0.500 in. (130 AMP O2/Air TH)	Time 0:00:46	$3.86
MS 0.750 in. (260 AMP O2/Air TH)	Time 0:00:43	$5.42
MS 1.000 in. (400 AMP O2/Air TH)	Time 0:00:48	$7.22

Perform the material thickness cost test again, but this time change your machine from the provided Hypertherm **plasma** machine to the demo **oxyfuel** machine. Record your results below:

MS 0.500 in.	Time 0:03.05	$12.05
MS 0.750 in.	Time 0:04.24	$16.83
MS 1.000 in.	Time 0:05.47	$21.08

Name at least two other variables besides material thickness that could also affect the cost of production:

- Material type, Cutting process, labor rate, material handling equipment

TASK - Grain: In the Edit Parts List, see *Grain restraint angle* under Nesting -> *Attributes* in the lower right window. Why might a part require the *Grain restraint angle* applied?

- When bending, setting the part bend lines perpendicular to the material grain will help avoid fracture.
- For aesthetic requirements, ensure that the part is set in the desired orientation relative to grain.

Describe when it's ok, in terms of part quality, to use the *Mirror* option:

- When the resulting edge angle is not important, e.g. when welding is the next operation.

TASK - Kerf: Kerf is applied in ProNest via the process parameter table, Kerf values will automatically change based on certain factors. Name one factor that will cause kerf values to change:

- Material thickness, speed of cut, amperage use in plasma process, KW used in laser process, nozzle size of oxy/fuel torch, nozzle size and abrasive used in waterjet.

TASK: Define the final dimensions of a square hole which was drawn 10" x 10" and has no kerf compensation applied assuming the actual kerf width is 0.14".

- 9.93" x 9.93"

What size would the square hole need to be drawn in order to achieve a finished hole of 10" x 10" assuming actual kerf width of 0.14"?

- 10.07" x 10.07"

TASK – Part Import: The faster, automatic way to build a part list in ProNest is to import a previously created part list, or one that is derived from an ERP or MRP system. Describe the steps / commands used to import a standard part list file created by an external software system into ProNest and identify the file extension:

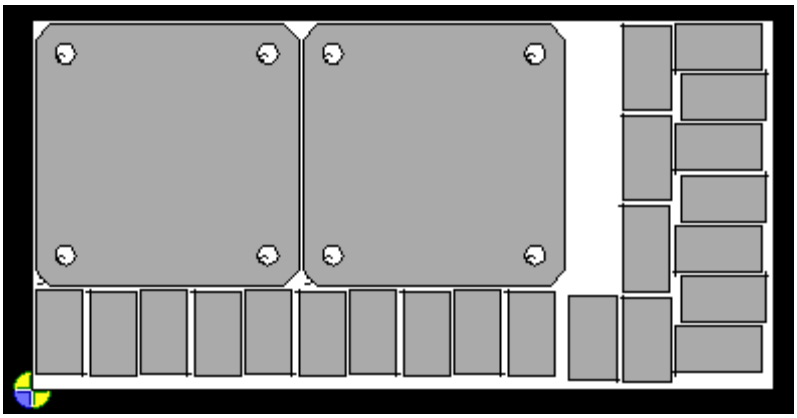
- Go to File-> Open, select Files of type: = ProNest Part List (*.pnl), navigate to the file and click OK.
  *.PNL

NESTING – understand how to nest the part list and what variables are involved in nesting.

What is a nest?

Nests are comprised of parts that have been positioned on a plate in a particular orientation. In order to create output for a nest in ProNest, a nest must have at least one part added to it.

Below is an example of a nest with 24 parts nested



Nesting can be done manually, where parts are added to the plate one at a time. A part or group of parts can also be arrayed onto a nest. Nesting can also be done automatically.

Nests are created and modified after parts have been added to the part list. The first phase of nesting involves adding parts to your nest. Once the parts are nested, many features used to modify the nest will become available.

TASK – Modifying Parts: What functions can be used to modify parts once they have been added to a nest?

- They can be moved, rotated, clustered, tabbed, duplicated, and mirrored; cut direction can be changed; and leads can be adjusted. The plate can be cropped and the cutting sequence can be changed.

TASK: What is the final function to be used once parts have been added and the nest is finalized?

- When all modifications have been made, the nest can be saved with your job and then output as a CNC file.

Creating a new nest

In the main ProNest window, there is always a default plate to begin nesting on. You can begin nesting on this plate immediately without explicitly creating a new nest. However, you can create a new nest at any time using the plate of your choice.

TASK – Nest Creation: What the two (2) methods to create a new nest

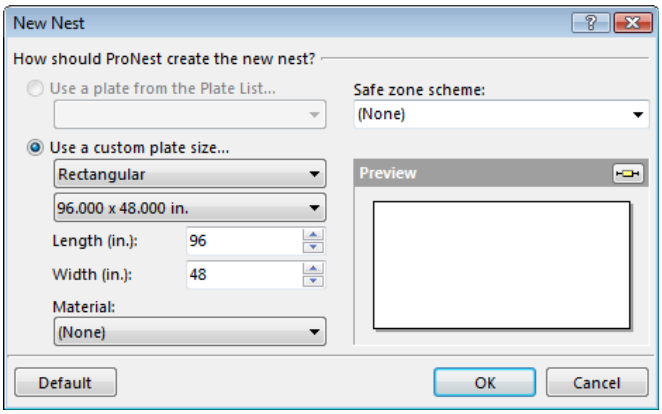
- On the Nest tab, click New Nest. 
- -or-
- Click the New Nest tab. 

  Select the plate and safe zone scheme (if applicable) that you want to use.

  Click OK.

Insert a nest

The New Nest / Insert Nest dialog



TASK – Inserting Nests: With the "Insert Nest" function, you can create a new nest and specify where it should be inserted in the nest order in the job. Describe the three (3) steps to insert a nest that would become nest three (3) in a job with five (5) nests.

- 1. Right-click the nest tab () to the right of where you want to insert the nest.
- 2. Select Insert.

  The Insert Nest dialog will appear.

- 3. Select the plate and safe zone scheme (if applicable) that you want to use.

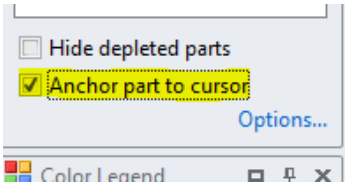
  Click OK.

Adding parts to the nest manually

With interactive nesting, parts are added from the part list to the nest manually.

TASK – Positioning Part 1: What are the two program components that will affect how parts are initially positioned when they are manually nested. What default setting must not be selected to allow these features to function correctly?

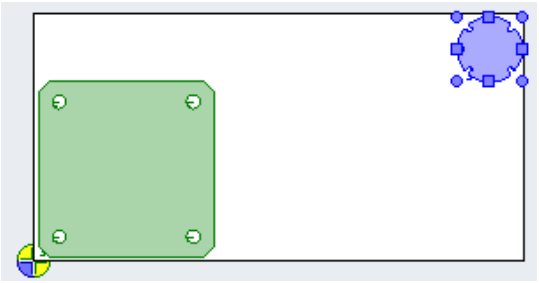
- Unselect the "Anchor part to cursor" option below the Part List window.



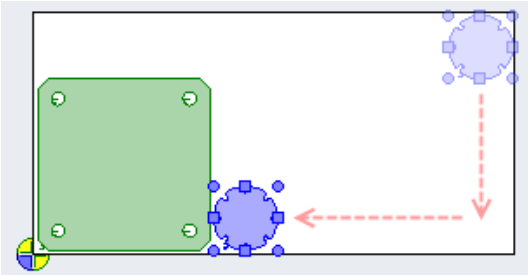
- The AutoDrop zone and AutoBump settings (on the Nesting settings page):

- With AutoDrop, parts are initially added to the nest in the same relative spot (in one of the corners or the center of the plate). The part may be added by Double-clicking the part in the part list or select the part in the part list and then press ENTER. The part will initially be placed in the region specified in the AutoDrop zone setting.

  Example: If you have AutoDrop zone set to "Upper Right" and AutoBump is off, your part will automatically be placed in the upper right area of the nest.



  If you have AutoDrop zone set to "Upper Right" and AutoBump is active with directions set to "Down" and "Left", the part would initially be placed in the upper right and then would be automatically bumped up and then left.

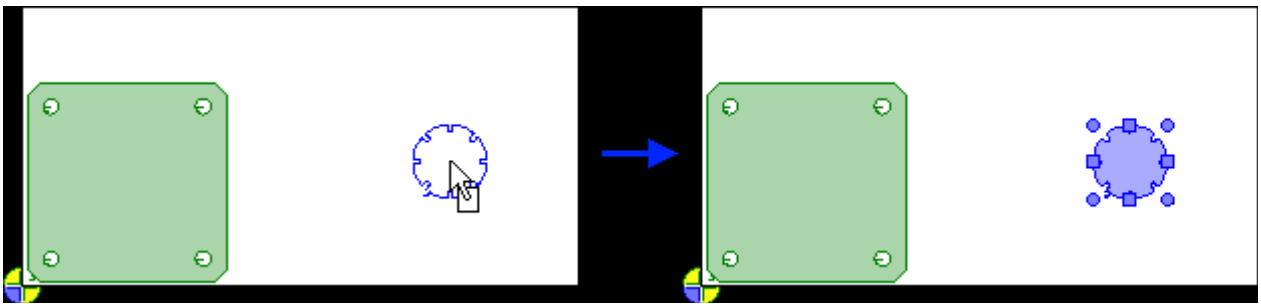


- Add a part to the current nest without AutoDrop

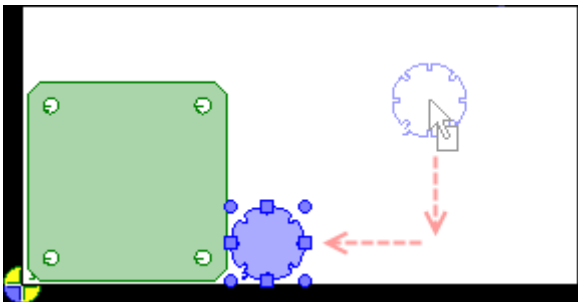
  Click and drag the part from the part list onto the nest. The part will initially be placed where you release the cursor.

  Example:

  Because the click and drag method doesn't use AutoDrop zone, as long as AutoBump is off, your part will automatically be placed on the nest where you release the cursor.



  If AutoBump is active, the part will be moved from where you release the cursor in the AutoBump direction specified in settings.



  These settings only control the initial positioning of manually nested parts. Once parts have been nested, you can move them around freely on the nest.

TASK – Positioning Part 2: Using the array feature, you can automatically place multiple copies of a part or group of parts onto a plate, in a specific arrangement. Arrayed parts are placed as close as possible to one another, based on the part separation value in your settings, in order to maximize material utilization. Arrays can be applied either automatically or interactively on a nest.

With what feature can you quickly place parts in a pattern array inside of a rectangular region on the nest? What benefits does this provide to the operator? that will provide fast manual nesting with greater control over the size and direction of the array.

- Please see the ProNest 2017 help file for detailed instructions on the use of this feature (Help -> Nesting -> Arraying Parts -> Dragging to create an array)
- With drag array, you can quickly place parts in a pattern array inside of a rectangular region on the nest. You can create different array configurations as you drag the mouse around and see the results on the nest instantly.
- This provides fast manual nesting with greater control over the size and direction of the array.

Removing parts from the nest

TASK – Removing Parts: Describe the several ways in which parts can be removed from a nest. What happens to the part properties when it is removed from the nest?

- With the part selected, press the DELETE key
- Click and drag the part from the nest back onto the Part List task pane
- Right-click the part and select Delete.
- When a part is removed from the nest, it is returned to the part list and quantities are reset to reflect the return.

Part/Nest Seperation Properties

TASK - Seperations: Separation values are applied automatically upon nesting. Identify where the automatically applied separation values are stored in ProNest:

- Process Parameter Spreadsheets

What are the three different types of separation values?

- Part (to part), pierce (to part), and plate (to part)

Describe why separation values change as material thickness changes:

- Allows greater nest rigidity to counteract thermal movement; provides room for increased lead sizes; provides sufficient distance between parts to prevent defects caused by the cutting process, provides distance between parts to protect from spatter (especially with oxyfuel).

Where can the separation values be changed (if desired) at the nest level?

- In the Separations pane (lower left side of the nesting screen) or in the Process Parameters XLS (see separations tab).

TASK - Autonest: Proceed to the nesting screen and use the Autonest button 

to nest the previously created part list.

TASK - Seperations: Separation values are applied automatically upon nesting. Identify where the automatically applied separation values are stored in ProNest:

- Process Parameter Spreadsheets

TASK - Values: What are the three different types of separation values?

- Part (to part), Pierce (to part), and Plate (to part)

TASK - Material: Describe why separation values change as material thickness changes:

- Allows greater nest rigidity to counteract thermal movement; provides room for increased lead sizes; provides sufficient distance between parts to prevent defects caused by the cutting process, provides distance between parts to protect from spatter (especially with oxyfuel).

TASK - Inputs: Where can the separation values be changed (if desired) at the nest level?

- In the Separations pane (lower left side of the nesting screen) or in the Process Parameters XLS (see separations tab).

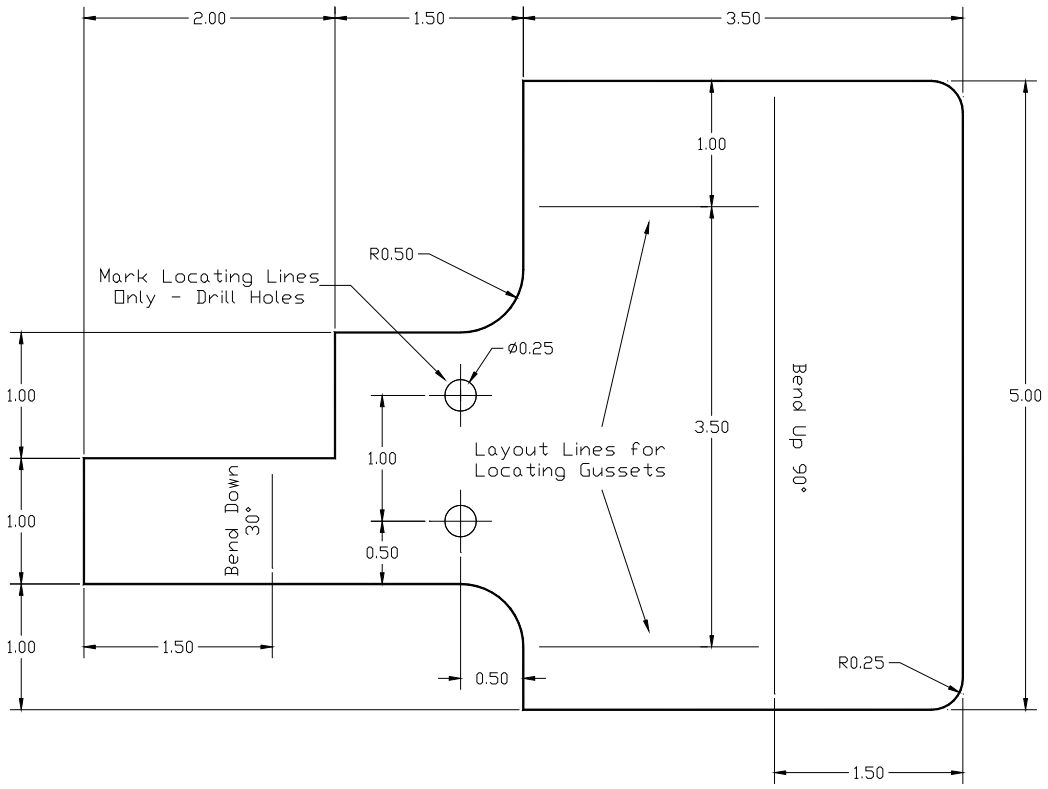
DEFINE PART LIST (2) – developing new parts for use in ProNest.

TASK – CAD Drawing: Draw the part shown below in CAD (ProNest 2D CAD if desired) using proper layer format, ensuring that the ends of the bend line and the locating lines are 0.50" from the edge of the part and do not touch one another.

(Place bend and location lines on separate layers and ensure that layer mapping to the appropriate ProNest machine set-up processes has been completed – see CAD import settings.)

Plot a hard copy to hand in with this assignment.

Also save a digital copy as a *.dxf file in which the dimension layer, notes, and frame are turned off**.** Place in a folder for import into ProNest.



TASK - Processing: For this task ensure that the Hypertherm plasma machine set-up has been selected. Import the drawing into ProNest and assign the following parameters: Quantity 5, Material MS, Thickness 0.500 in., Class 130 Amp 0_2/Air (True Hole).

Name one parameter that is automatically updated in the geometry by ProNest after assigning the material thickness:

- Lead length

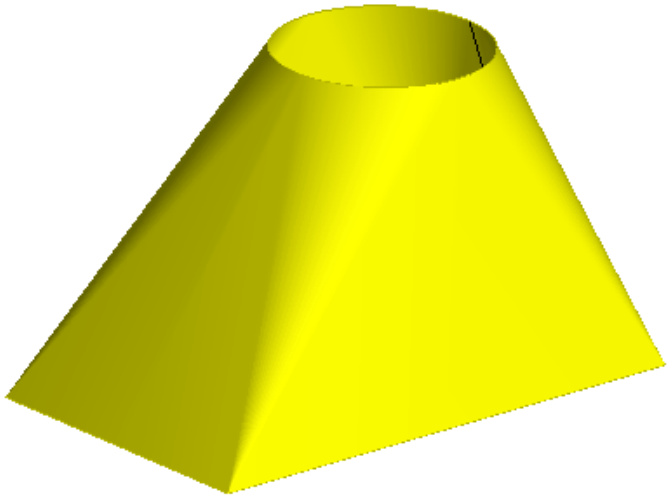
State the total cut length and cutting time for this part as defined in PN:

Do the figures above include the marking of the bend and locating lines?

TASK - Information: It is often necessary for the programmer to share information with the machine operator, or other members of the team after creating the nest. Identify the feature in PN which allows users to most easily share and communicate information such as cut length, cut time, nest plot, and other nest information:

- Reports

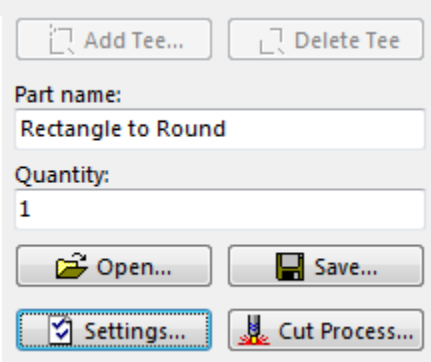
TASK - Parametric: In a new workspace import an Offset Rectangular to Round transition Flat Pattern development from the Pipe module:



Use these parameters in Pipe:

Rectangle to Round	
Dimensions	
Max Segment Size	2
Rectangle Length	20
Rectangle Width	12
Transition Height	12
Exit Diameter	8
Exit Center X Offset	2
Exit Center Y Offset	0
Exit Tilt Angle	0
Exit Rotation Angle	0
Rectangle Tilt Angle	0
Joint Type	Side
Skirt Length 1	0
Skirt Length 2	0
Skirt Length 3	0
Left Hand Side Lap	0
Right Hand Side Lap	0
Top Side Lap	0
Weld Gap	0
Top Collar	0
Number of Pieces	1
Inside Base / Outside Top	No
Length of skirt at point 3	

TASK - Modification: Using the provided Hypertherm plasma machine, using the Pipe Settings function, define the material for the part using 0.125".



In the Edit Parts List, define the Material to match MS and the Class for the part using "30Amp 02/02"

List the total cut length and production time:

- 116.046; 0:00:35

Recalibrate and record values for MS 0.50", Class 80Amp 02/Air length and time:

- 116.234; 0:02:23

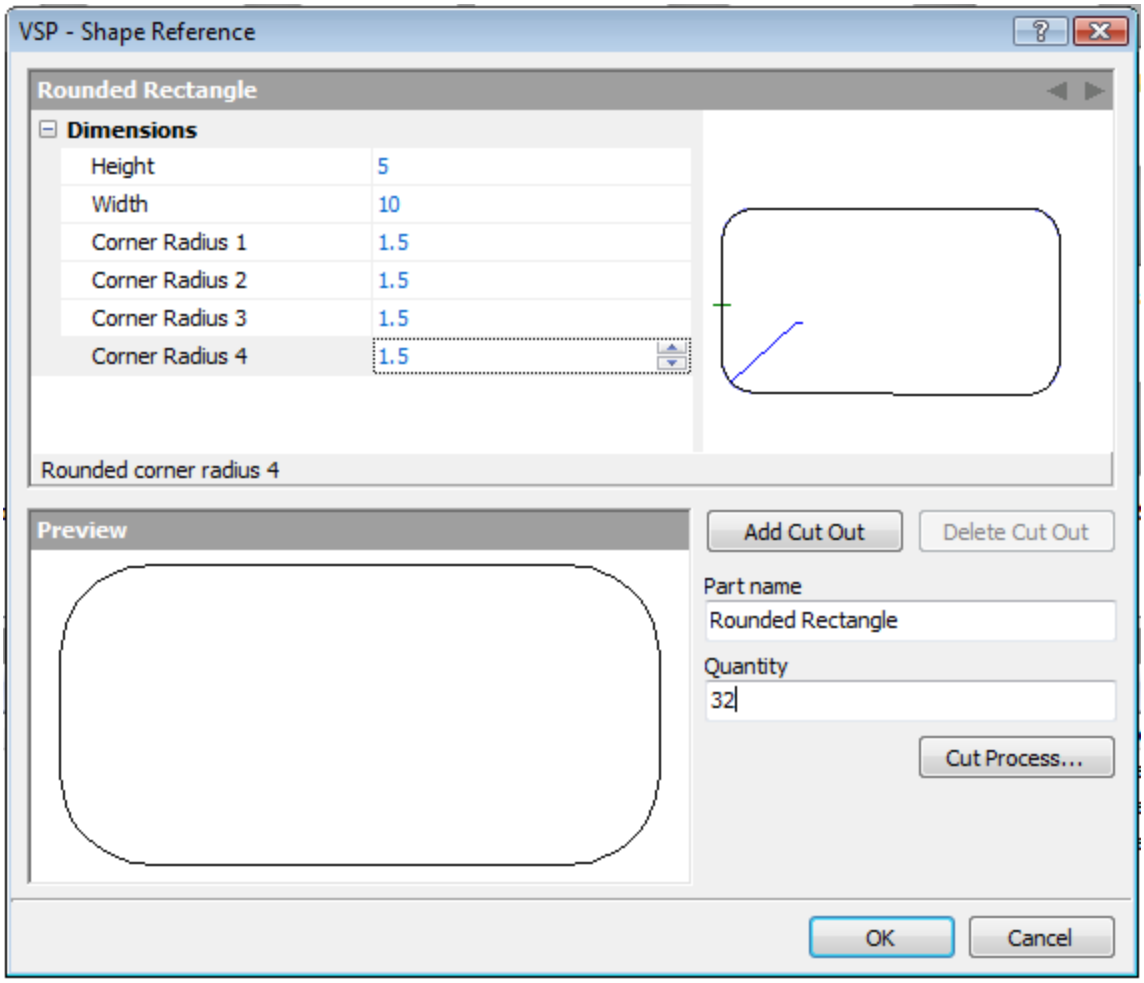
Why is the above cut length different?

- The lead length has increased

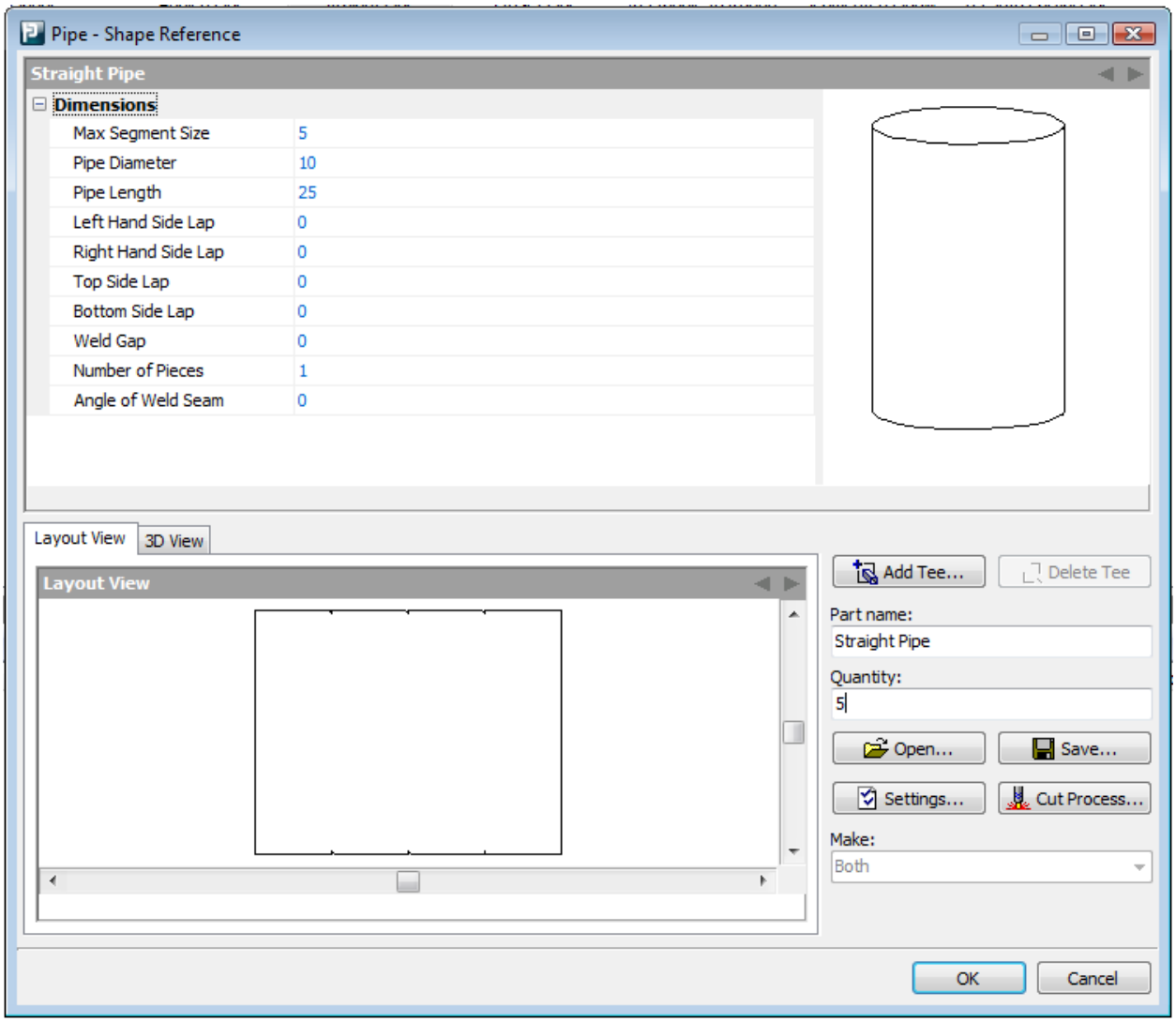
TASK - Parts: Begin a new cutting project by opening a new job. Ensure the machine is set to the provided Hypertherm Plasma. Import the following *.dxf files from the examples folder:

Part	Quantity
Brace.dxf	24
Hook.dwg	48
Blade.dxf	18

TASK – Virtual Shapes: Create the following part in VSP with Quantity 32 and add to the part list:



TASK – 2D Pipe: From Pipe, create the flat pattern from the data given below and add to the part list with a quantity of 7:



TASK - Parameters: Ensure all parts are assigned to MS, 0.25 in., 130 Amp 0_2/Air (True Hole), and return to Nesting.

TASK - Report: Run the Job Summary report on the nest.

What is the True Utilization of the nest?

Name one or more variables that will normally affect True Utilization of a nest:

- Lead length
- Separation values
- Nesting strategy

Next, clear the nest and re-nest using 2 torches (see Help manual – F1 for more information). Re-output the *Job Summary* report and note the corresponding results below:

Number of Torches:	1	2
Production Time Totals:	1:00:24	0:45:01

Write a statement that explains why single or multiple torches might be selected for various jobs:

- Choose multiple torches if it allows you to increase overall linear distance cut, however the nest configuration will dictate the overall time savings from using multiple torches. If the nest contains parts of varying geometry this may require manual torch parking and spacing throughout the nest resulting in inefficiencies.

TASK – Job Overview: Open and explore the file – File -> Open-> Automatic Nesting (strategy 4) that accompanies ProNest.

How many different parts are to be cut?

- 7

What is the total quantity of all parts to be cut?

- 298

Where in PN can you go to find the current nest properties?

- Right click on the selected net tab -> select Nest Properties
- In the task bar (ribbon) select View -> Check the Properties box

What is the true utilization of this nest?

- 64.10%

TASK - Separations: Delete the current nest, go to the Separations window and increase each of the separation values to 0.75 in.

Re-nest the current part list (again using strategy 4) and describe what affect the above changes have on True Utilization:

- True Utilization is decreased to 19.21%