

MFG224000-L

Nesting Utility Hands-On

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Learning Objectives

- Use all the functions in nesting utility at an intermediate level
- Prepare the nested parts for CAM and create the 2D Profile operation to cut out the parts
- Understand the nesting settings and workflows to use for metal, wood and composite materials
- Know how to use AutoCAD and its file formats (DWG/DXF) in combination with Nesting Utility

Description

The class will explore by doing all the major commands and options the Inventor Nesting Utility add-in has to offer:

- Nest entire assemblies or individual Inventor sheet metal parts, extrusions and sketches
- Nests on multiple rectangular sheets of same or varying dimensions or on roll material
- Optimize nest efficiency (filler parts, tweak nesting parameters)
- Read in DXFs and use layer mappings to guide the fabrication process
- Explore associativity scenarios between 3D model and the generated nests
- Export nest as DXF or 3D model
- Generate NC toolpath using HSM CAM workflows
- Explore nest reports and costing

Speaker(s)



Bob Van der Donck

Principal UX Engineer Autodesk

Bob is an electro-mechanical engineer with a keen interest in software both for industrial design and for creating CAD/CAM integrated solutions. In the past 25 years at Autodesk, he managed or led technical teams in various disciplines like quality control and product support. Bob has a proven

track record in scripting and .NET applications based on various APIs. With his solid background in both product design and UX design, he created the UI for Autodesk's first integrated CAD/CAM solutions (Inventor HSM and Fusion CAM) and Autodesk's composites and cutting solutions (TruLaser, TruPlan, TruFiber and Nesting Utility).

<http://linkedin.com/in/bobvanderdonck>



Ravi Javia
Product Manager Autodesk

Ravi Javia is a Product Manager at Autodesk. Ravi graduated from Stevens Institute of Technology with BE in Mechanical Engineering (concentration in robotics and mechatronics) and an ME in Engineering Mgmt/Systems Engineering. He pursued his interest in Advanced Manufacturing while working with Magestic Systems Inc. which was later acquired by Autodesk in July 2014. Ravi has developed his expertise in nesting, cutting, and fabrication while working with various customers.



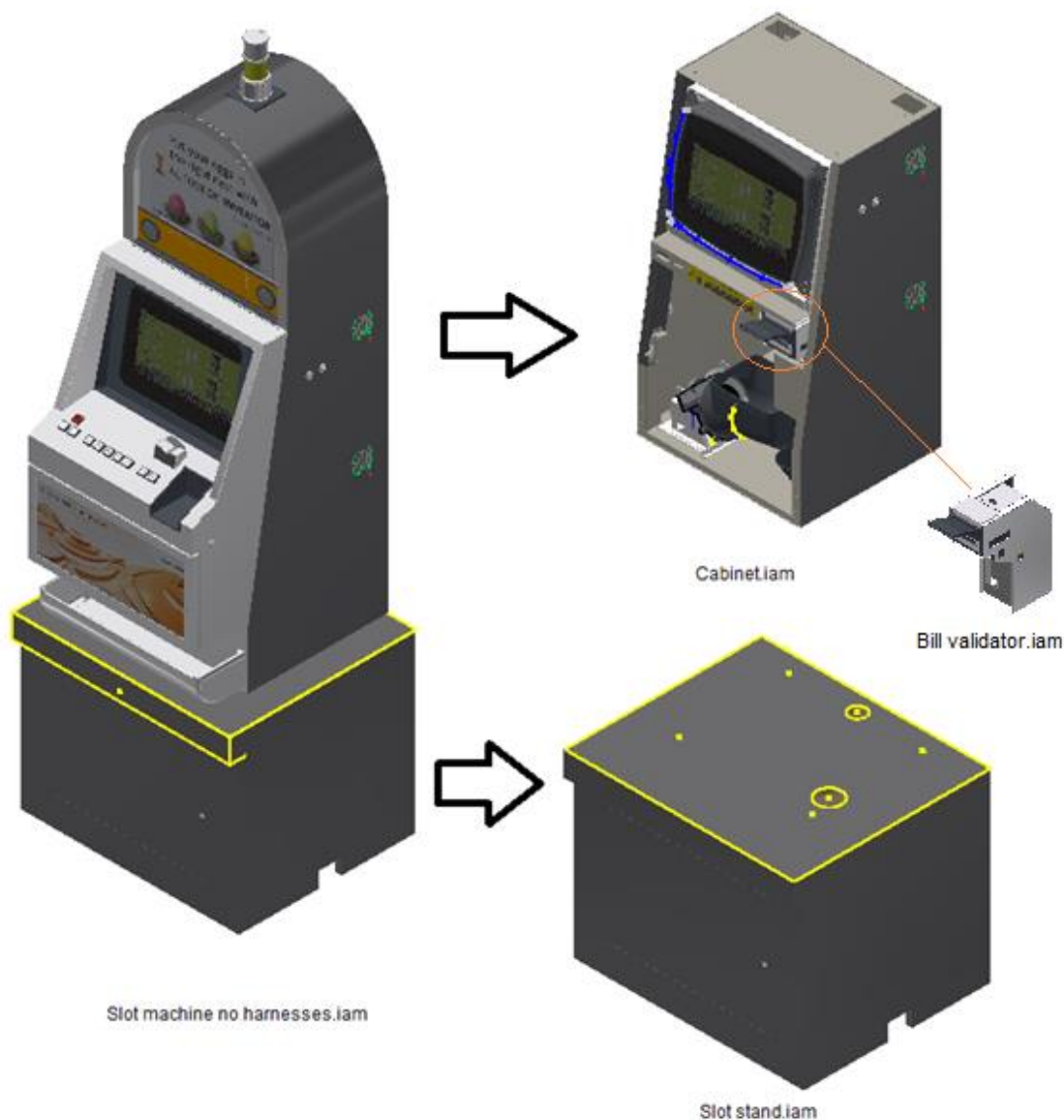
Bob Holland
Product Support Engineer Autodesk

Bob has been supporting Autodesk products for 32 years.

Introduction

For the lab we will be using components of the master assembly called Slot Machine no harnesses.iam. The entire assembly is checked into a Vault hive, conveniently called Vault. We will not work with the main assembly itself as it contains over 375 components. For the sake of time, we will concentrate on three smaller sub-assemblies:

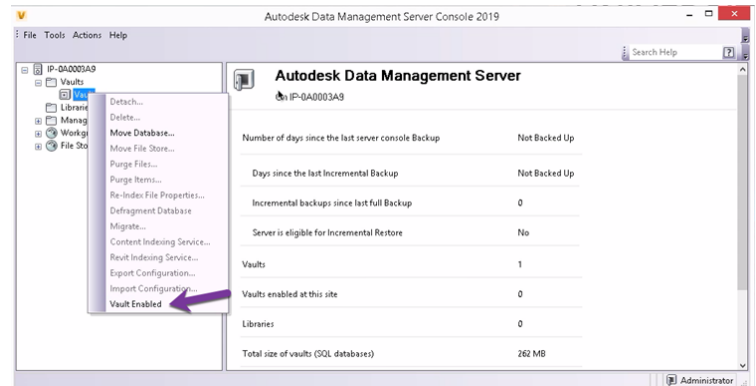
- Cabinet.iam
- Bill validator.iam
- Slot stand.iam (please open, inspect BOM and close the assembly)



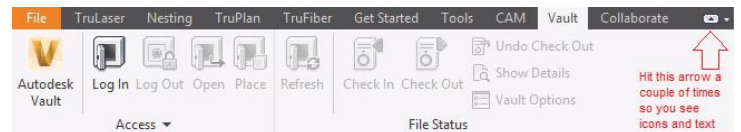
Pre-requisites:

We will first need to re-enable the Vault software on your lab machine and checkout the files.

1. Start the Vault server
2. Login to the Vault server with
3. Username = **admin**, no password
4. Enable the Vault from the File menu



5. Start Inventor 2019
6. Familiarize yourself with the Vault ribbon



7. Login to the Vault (use the default settings)

Chapter 1: Create a nest document

The creation of a nest is a two-step process: shape extraction first followed by the actual nesting

1. Shape extraction
2. Nest study creation



Figure 1: Extracted shapes

Shape extraction is the process that recognizes 2D closed loops in source files

- Only one shape is extracted per source file
- A shape can contain multiple internal or external loops but all are treated as atomic in the nesting process

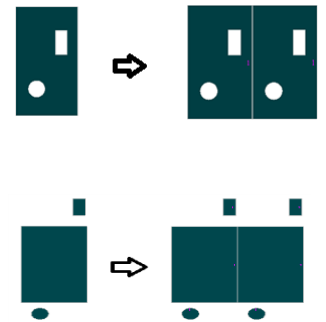


Figure 2 Internal vs. external loops

Nest results are stored in an .inest document, which is Nesting Utility's own file format. There are multiple ways to create such an inest file and we will explore each of these:

- Method 1: create a nest from the Nesting **ribbon**
- Method 2: create a nest from the **context menu** of IPT/ IAM
- Method 3: create a nest from the **New** menu + template (default or custom)

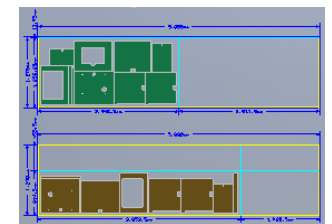


Figure 3 Nested shapes

Task 1.1: Create nests (method 1) from ribbon

Step 1: Shape extraction

- a. In case you have any documents open, close all documents
- b. Start Nesting from the Nesting ribbon. This will automatically use the default .INEST template, no questions asked

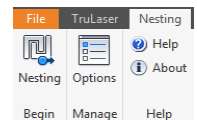


Figure 4 Nesting ribbon zero doc

- c. Make sure the Calculate panel is docked under the Browser

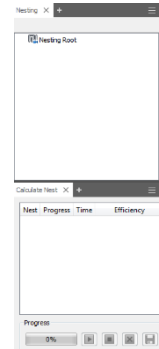


Figure 5 Calculate docking panel

- d. Start Sources dialog (extraction)
e. Use Vault Source Files dropdown

- f. Select **Slot stand.iam** from the Slot Stand folder in the Vault
This assembly ONLY contains extruded parts but with 3 different materials

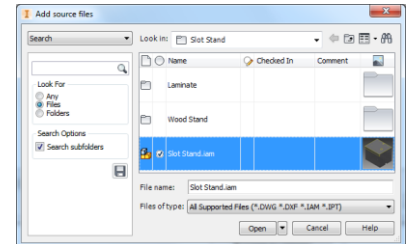


Figure 6 Add Vault source files

- g. Open (Check out all) of this assembly
h. Sources dialog shows the extracted shapes

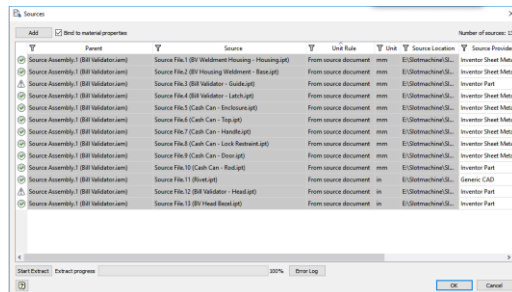


Figure 8 Sources dialog

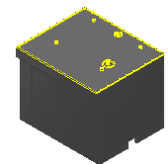


Figure 7 Slot stand

- i. Hit OK once progress bar has reached 100%
This will display the shapes in graphics and populates the shape nodes in the browser



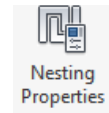
Figure 9 Extracted shapes

- j. Open the Options dialog and check the Sources arranged by material checkbox
- k. Set the Color display in the ribbon to Material



Figure 10 Sources arranged by material

- l. Use the Nesting Properties command in the ribbon to get overview of all shapes. Verify the different material and the QTY of the parts either in the Source Nesting Properties dialog of by using the Properties on an individual shape



| Source | Source QTY | Material | Material ID | Orientation | Length (X) | Width (Y) | Bind |
|--|------------|--------------|---------------|-------------|------------|-----------|-------------------------------------|
| Source File.6 (Slot Stand - Corner Joint.ipt) | 12 | Wood (Maple) | Material ID.2 | <not set> | 1in | 1.02924in | <input checked="" type="checkbox"/> |
| Source File.1 (Slot Stand - Top.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 28in | 24in | <input checked="" type="checkbox"/> |
| Source File.2 (Slot Stand - Back.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 26.5in | 22in | <input checked="" type="checkbox"/> |
| Source File.3 (Slot Stand - Side.ipt) | 2 | Wood (Maple) | Material ID.3 | <not set> | 22in | 23.25in | <input checked="" type="checkbox"/> |
| Source File.4 (Slot Stand - Front.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 2.25in | 28in | <input checked="" type="checkbox"/> |
| Source File.5 (Slot Stand - Front Bottom.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 1.25in | 26.5in | <input checked="" type="checkbox"/> |
| Source File.7 (Slot Stand - Shelf.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 26.5in | 21.25in | <input checked="" type="checkbox"/> |
| Source File.8 (Slot Stand - Face.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 19.75in | 28in | <input checked="" type="checkbox"/> |
| Source File.9 (Slot Stand - Cover.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 16.9688in | 11.7188in | <input checked="" type="checkbox"/> |
| Source File.10 (Slot Stand - Door.ipt) | 1 | Wood (Maple) | Material ID.3 | <not set> | 14.5in | 20.0625in | <input checked="" type="checkbox"/> |
| Source File.11 (Slot Stand - Top Lam (B).ipt) | 1 | Rubber | Material ID.4 | <not set> | 28in | 24in | <input checked="" type="checkbox"/> |
| Source File.12 (Slot Stand - Back Lam (B).ipt) | 1 | Rubber | Material ID.4 | <not set> | 28.0571in | 22.7812in | <input checked="" type="checkbox"/> |
| Source File.13 (Slot Stand - Side Lam (B).ipt) | 2 | Rubber | Material ID.4 | <not set> | 22.7812in | 24.0312in | <input checked="" type="checkbox"/> |
| Source File.14 (Slot Stand - Front Lam (B).ipt) | 1 | Rubber | Material ID.4 | <not set> | 3.0625in | 28.0625in | <input checked="" type="checkbox"/> |
| Source File.15 (Slot Stand - Front Bottom Lam (B).ipt) | 1 | Rubber | Material ID.4 | <not set> | 28.0625in | 2in | <input checked="" type="checkbox"/> |
| Source File.16 (Slot Stand - Face Lam (B).ipt) | 1 | Rubber | Material ID.4 | <not set> | 19.75in | 28.0312in | <input checked="" type="checkbox"/> |
| Source File.17 (Slot Stand - Door Lam (B).ipt) | 1 | Rubber | Material ID.4 | <not set> | 14.4375in | 19.9375in | <input checked="" type="checkbox"/> |

Figure 11 Source Nesting Properties

- m. Select any shape on screen with RMB to bring up the marking menu and use the Properties command to verify QTY and material on an individual shape

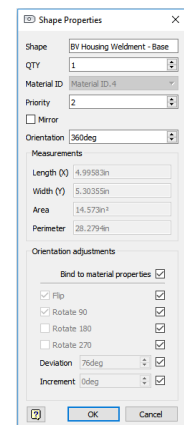
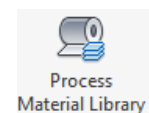


Figure 12 Shape properties

- n. Open the Process Material Library

| Material ID | Material | Thickness | Nesting Color | Density | Remote Material Name | Provider |
|---------------|--------------|-----------|---------------|-------------|----------------------|----------|
| Material ID.1 | Generic | 0.12in | | 1,000kg/m^3 | | |
| Material ID.4 | Rubber | 0.03125in | | 930kg/m^3 | Rubber | Inventor |
| Material ID.2 | Wood (Maple) | 2in | | 670kg/m^3 | Wood (Maple) | Inventor |
| Material ID.3 | Wood (Maple) | 0.75in | | 670kg/m^3 | Wood (Maple) | Inventor |

Figure 13 Process material with automatically generated materials



- o. For the newly added materials, set following Packaging parameters:
Length = 100 inch
Width = 50 inch

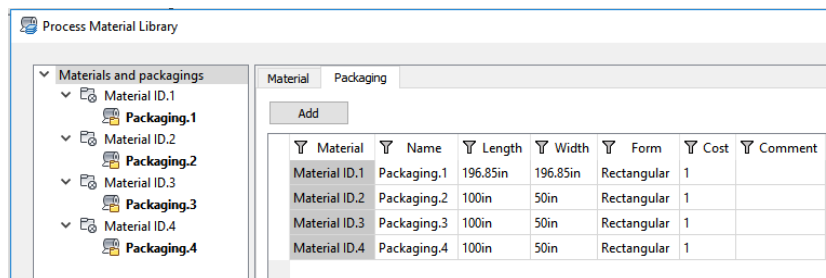


Figure 14 After changing the packaging sizes

Step 2: Nesting study

- a) Use the **Create** command to create a nest study
Note that Multiple nest studies are possible per .inest doc
- b) All shapes are automatically selected but we want to filter out the small corner joint parts. To do this **Delete** Packaging 2 (wood material with thickness of 2 in or 50.8mm) from the context menu after selecting the row in the Packaging section.
This removes the packing but also all remaining shapes that use that material from the nest.
- c) Verify that the **Automatically calculate nest** checkbox is on
- d) Leave Job QTY with a single value of 1.
The Job QTY is the multiplier that determines the total QTY
Total QTY = Source QTY X Job QTY
The Multi-value option is useful when you want to nest multiple assemblies and want each assembly to use a different Job QTY
- e) Leave **Bind all shapes to sources** checked (not to be confused with bind to material)
The Bind check ON guarantees that the nest updates when shape properties change. Turn this check off if you want to override/freeze nest properties on a per nest basis.
Unbound cells are shown with Orange background
- f) Hit OK to generate the nest
- g) Save the file as **Nesting1.inest**

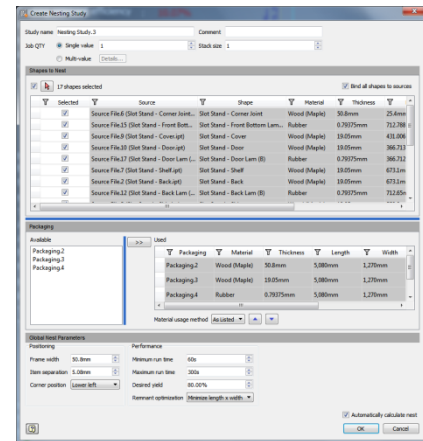


Figure 15 Creation of a Nesting Study

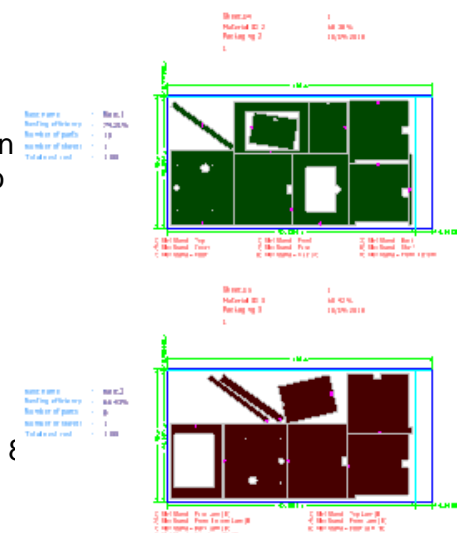


Figure 16 Nesting study with two nests

- h) From the Vault ribbon, Check-in the inest file in the Vault, close all files.



- i) Find the Nesting1.inest file in Vault and verify in the Uses pane that all file dependencies are correctly saved in Vault

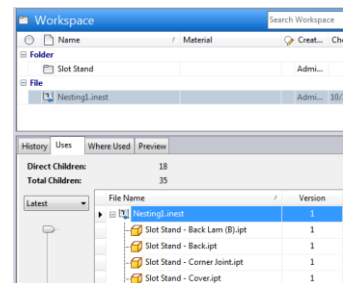
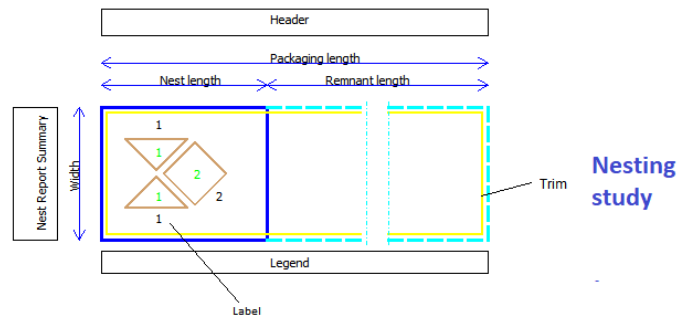


Figure 17 Dependencies check in Vault

Chapter 2: Terminology & browser & display & UI behavior



Sources



Add-in uses client graphics which means minimal selection capability.

Marking menu and cross-referencing between graphics and browser works as expected but there is no measuring capability unless you create a 3D Model from the nest (see later)

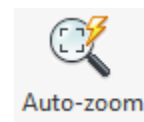
All shapes are represented as flat faces without thickness (rotate the viewcube to verify)

Dialogs are multi-threaded. This means you can start a new command while for instance a complex nest is being calculated.

Task 2.1: Explore AutoZoom

Autozoom allows you to zoom in fast to a particular node.

- Toggle off AutoZoom and select a node in the browser
- Toggle on AutoZoom and select the same node in the browser and note the difference
- Open the Sources dialog and make it as small as possible. What happens when you select a row in the Sources dialog?



Some ribbon commands (Edit, Calculate, Export, 3D Model) are only enabled for relevant browser nodes

Task2.2: Explore different command access methods

- Select any nest and then selected Edit in the ribbon
- Close the dialog, select the same nest and use the Properties context menu



- c) Close the dialog and double click on the same nest.
All three tasks should bring up the Edit Nest dialog. You decide which one you prefer.

Chapter 3: Control the nest display

Task 3.1: Control display from ribbon

- Toggle Shaded to Wireframe in the ribbon
Wireframe is useful to relate the shape label to the legend as the shape label is positioned very close to the shape boundary.
- Toggle back to Shaded
- Colors
Toggle between Material and Source and inspect the color change.
The other color options allow visualization of which shapes are mirrored or rotated on the nest.

Note that the Nesting utility material color is unrelated to the Inventor Appearance of the material used in the source part.

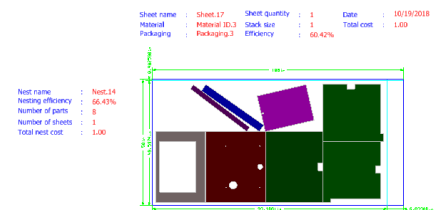
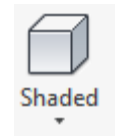


Figure 18 Using color to identify mirrored and rotated shapes

- Object visibility
Turn off the Dimensions, Header, Annotations, Fabrication info

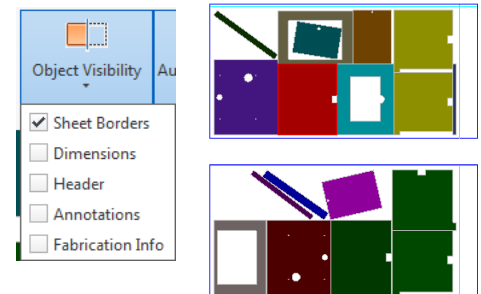


Figure 19 Nesting study without text

Task 3.2: Options dialog

- Options > Display tab > Nests
Re-enable Dimensions, Header, Annotations, Fabrication info by checking the Enable checkboxes
Note that these options work in tandem with Object visibility
- Options > Nests > header
Change number of columns from 2 to 3 and add the Thickness to the display
- Options > Nests
Change the Property name color from white to blue

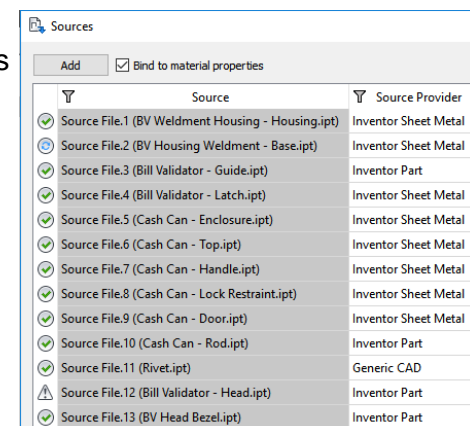
*Note that this is a necessary change if you want to work with the
Presentation color scheme*

Chapter 4: Create nests (method 2): from context menu

This is the most comfortable method to use when you have already an Inventor part or assembly open in your session. The same technique can be used for both iam and individual ipt.

When dealing with Inventor ipt and iam files you need to be aware of the following

- Sheet metal ipt requires a **flat pattern** to be present
- Automatic shape extraction rules for ipt
 - Extrusions and sketches can be extracted
 - **Last unconsumed visible sketch** then
 - **First non-suppressed extrusion** and uses the extrusion height as nest thickness
 - An ipt file containing STL meshes or “dumb” bodies with at least one flat face can also be extracted
 - No attempt is made to indirectly extract extrusions/sketches/flat from the parent of a **derived part**
- Explicit shape extraction is possible by setting the **Use for nesting** flag and **NestingThickness** parameter (see later)
- Automatic shape extraction rules for iam
 - **BOM QTY** dictates source QTY
 - BOM QTY **overrides** are honored
 - Excluding parts from nest
 - Not effective: Toggling visibility or using LOD
 - Effective methods are:
 - Setting **QTY = 0** in assembly BOM
 - **Disabling** source in Nesting Utility
 - **Deleting** source in Sources dialog/browser. This is only temporary until you refresh.
- Providers
 - Source Providers are used to apply automatic extraction rules
 - Each file type has a provider
 - Order of providers matters
- Log file and log messages
 - Non-closed shapes
 - Overlapping shapes or lines
 - Sheet metal files with missing flat pattern etc.



| Source | Source Provider |
|---|----------------------|
| Source File.1 (BV Weldment Housing - Housing.ipt) | Inventor Sheet Metal |
| Source File.2 (BV Housing Weldment - Base.ipt) | Inventor Sheet Metal |
| Source File.3 (Bill Validator - Guide.ipt) | Inventor Part |
| Source File.4 (Bill Validator - Latch.ipt) | Inventor Sheet Metal |
| Source File.5 (Cash Can - Enclosure.ipt) | Inventor Sheet Metal |
| Source File.6 (Cash Can - Top.ipt) | Inventor Sheet Metal |
| Source File.7 (Cash Can - Handle.ipt) | Inventor Sheet Metal |
| Source File.8 (Cash Can - Lock Restraint.ipt) | Inventor Sheet Metal |
| Source File.9 (Cash Can - Door.ipt) | Inventor Sheet Metal |
| Source File.10 (Cash Can - Rod.ipt) | Inventor Part |
| Source File.11 (Rivet.ipt) | Generic CAD |
| Source File.12 (Bill Validator - Head.ipt) | Inventor Part |
| Source File.13 (BV Head Bezel.ipt) | Inventor Part |

Figure 20 Various Source Providers



Task 4.1: Use Create Nest command

- Close all files and on the Vault tab Open and Check-out **Cabinet\Bill Validator\Bill Validator.iam** from Vault.
This assembly contains a mix of sheet metal and regular ipt files

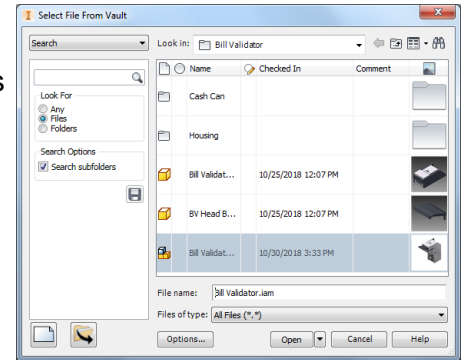


Figure 21 Open and check-out from Vault

- From the Model browser, use Create Nest command from the context menu
- Select the Default template
- Hit OK
A new .inest doc is opened and the Sources dialog automatically comes up
- Change the Source provider for part BV Housing Weldment – Base.ipt from Generic CAD to Inventor Sheet Metal
Tip: you might need to move or add the Source Provider column to see it

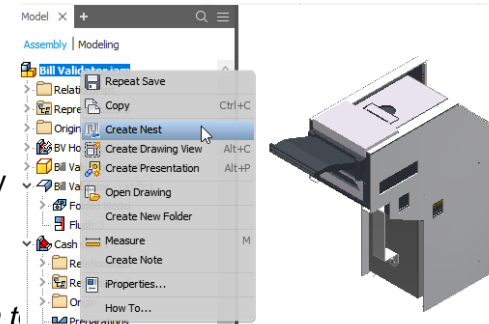
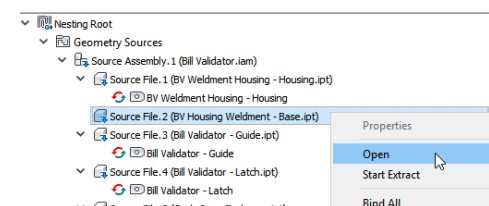


Figure 22 Create nest from Model browser

Task 4.2: Error correction

- While the Sources dialog is up and when progress is at 100%, note that there are errors.
Check the error(s) by hovering over the row or by opening the Error log and identify the name of the error part
- Hit OK to preserve the extracted shapes
- Open **BV Housing Weldment - Base.ipt** by using context menu



Page 1 Figure 23 Finding and opening the source

- d) Create the flat pattern and save the file
- e) Return to the inest document and you will see a blue refresh icon on the part
- f) Use the Start Extract context menu to extract the correct shape

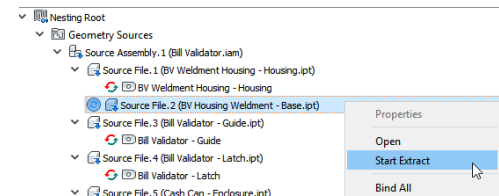


Figure 24 Re-extracting

Task 4.3: Recognize extrusions, sketches explicitly

- a) Open the **Bill validator - guide.ipt** part in a separate document. Verify that the **first extrusion** of the part was automatically extracted and the extrusion height used to define the material thickness. Let us produce this part differently by nesting it in a completely different direction.

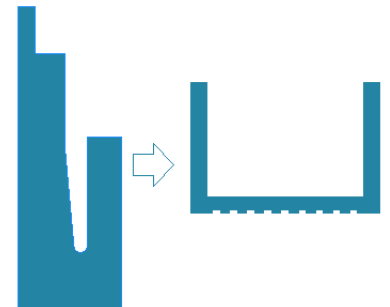


Figure 25 Identifying alternative shapes

- b) Add the yellow sketch at the end face and project the face in the sketch
- c) Flag the sketch as "Use for nesting" by using the context menu
- d) Edit Sketch1 and add the length dimension $d55 = 223.413$

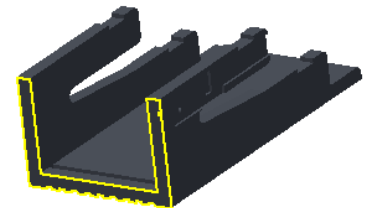


Figure 26 sing a 2D sketch as shape

- e) Use the Nesting Thickness command on the root node and paste in the measured length in the dialog.
This will create an Inventor model parameter NestingThickness = **3.048 mm (or 0.12 in)**
If you want the thickness to be associative with model changes, it is better to assign the NestingThickness as a formula.

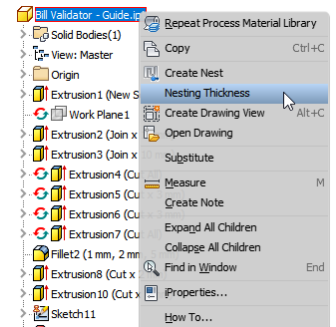


Figure 27 Nesting thickness parameter

- f) Verify that NestingThickness exists in the Parameters dialog and set NestingThickness = **d55 + 1mm** (resulting in a value of 224.413mm)
- g) Save the file and return to the inest document
- h) Use Start Extract on the modified Bill validator - guide.ipt node. Verify in the shape Properties that the material with the correct thickness and the correct shape is now extracted

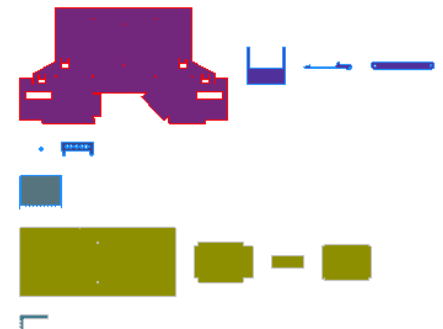


Figure 28 All the 2D shapes of the bill validator

Task 4.4: Exclude parts

- a) Identify and Open part **Bill Validator - Head.ipt**.
This is not a part suitable for nesting or it might even be a purchased part. We will eliminate it from the nesting process either by setting its BOM QTY in the assembly to 0 or better by disabling it in the nest itself.

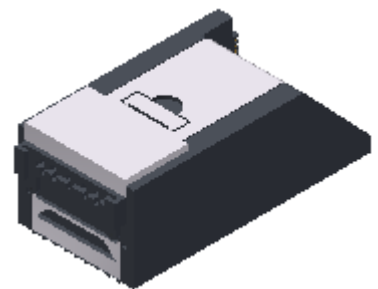


Figure 29 Bill validator head

- b) In the inest document, uncheck the Enabled flag on the node Bill Validator - Head.ipt

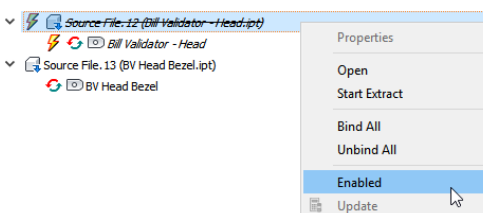


Figure 30 Disabling a source

- c) Create a new nest study with the default settings and verify that part Bill Validator - Head.ipt is not included

Tip: If you used filters previously, you might need to Clear filters in the Nesting Study to see all selected shapes

Chapter 5: Custom Templates & Materials & Packaging

Nesting parameters are set on the material but can be modified on-the-fly in the nest dialog during nest creation and nest edit.

- Material: material, thickness, orientation parameters (rotate, deviation, increment), grain, frame, separation

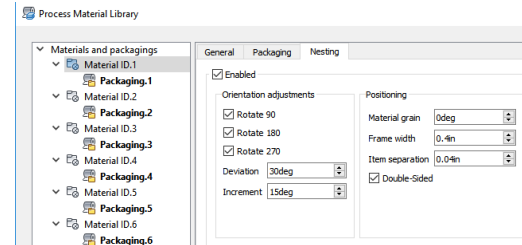


Figure 31 Most important material properties

- Packaging: length, width, form, cost, trim

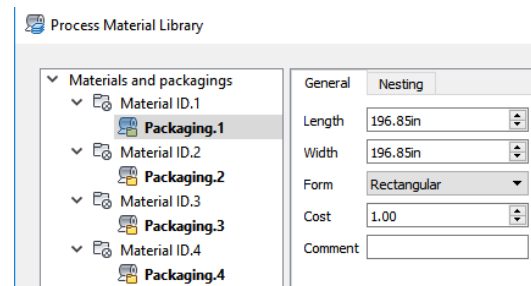


Figure 32 Most important packaging properties

- Nest dialogs: corner position, performance parameters

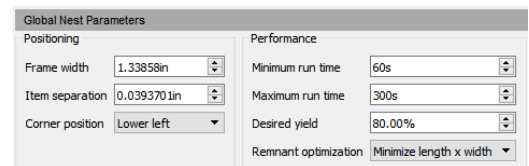


Figure 33 Global nesting parameters

Very Important: All Nesting Utility dialogs remember the last used parameter values and filter settings (blessing + curse). To increase predictability, we advise to store materials, packaging and provider choices in a custom template

Task 5.1: Move material from cache to Inventor material library

Skip this task if you have 2019.2.1 installed

- Open file **Cabinet\Brackets\Bracket Monitor Connector.ipt**. This component uses material Aluminum 3105-H12 that is in the Autodesk Material Library but not in the Inventor Material Library.
- Open the Inventor Material Library and add the cached material to the Inventor library in the Metal Category
- Close and restart Inventor so that this Inventor library change can take effect.

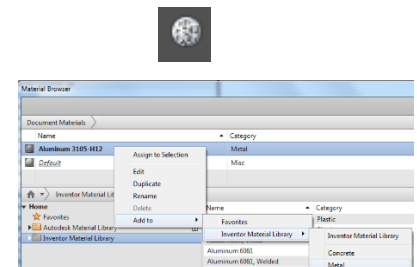


Figure 34 From cache to Inventor Material Library

Task 5.2: Synchronize to existing materials

First, we want to populate our template with existing Inventor materials that we frequently use

- New and use the Standard.inest template.
- Process Material library
Verify that one default Generic material with thickness 0.12 in (=3 mm) exists and that it contains one packaging with width x length = 196.85x196.85 in² (=5x5 m²)
- On the root node in this dialog, Add from provider and add the Aluminum 6061 and Aluminum 3105-H12 materials from Inventor. You can add even more or add all but we don't want to bloat the template.
- Add thickness of **0.0625** to both materials (Inventor has no notion of thickness) and leave the Material grain = **0**
- Uncheck all orientation related checkboxes and set
Orientation = **0 deg**
Increment = **0 deg**
Material grain = **0 deg**

These particular settings give the shapes few degrees of freedom and will increase nesting speed.

More importantly, this guarantees that the nested parts will come out with a zero degree grain.

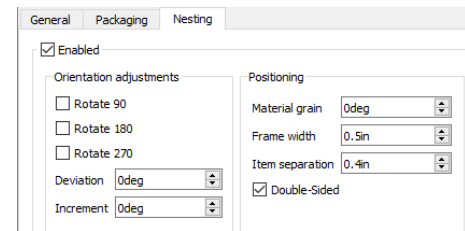


Figure 35 Reducing degrees of freedom of a nest

- Each material can have multiple packagings.
On the first packaging of the Aluminum 6061 material, set
Length = **40 in**
Width = **20 in**
Form = **Rectangular**
Cost = **1**

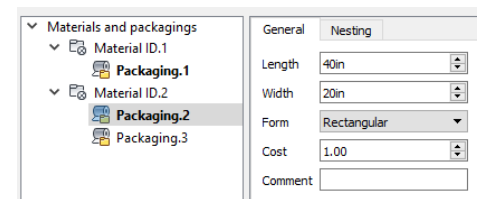


Figure 36 Smaller sized packaging

- Add a second packaging to Aluminum 6061:
Length = **200 in**
Width = **100 in**
Form = **Rectangular**
Cost = **3** (second packaging is 3 times as expensive as the first packaging 😊)

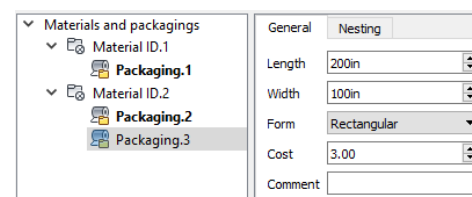


Figure 37 Larger sized packaging

- h) Important: Set the **smallest** packaging as the active packaging by double clicking. The active packaging is shown in bold and used by default for new nests.

Task 5.3: Providers

You can decide which providers to use and in which order.
Provider choices are also remembered in template

- a) Open the Providers dialog from the expanded Management panel

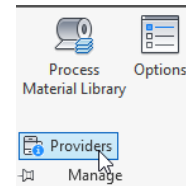


Figure 38 Accessing Providers from the expanded panel

- b) For ipt file type, leave only the Sheet Metal provider checked

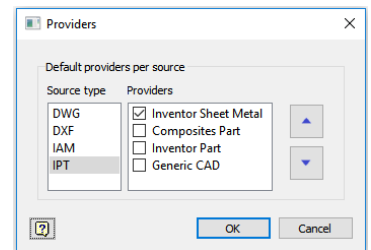


Figure 39 Sheet metal provider selected

Task 5.4: Create a custom template

- a) Save Copy as Template with name **Sheet metal only.inest**. We will use this template next.
- b) Close the document (no need to save)



Chapter 6: Create advanced nests (method 3): from New

Task 6.1: Extract sheet metal only

- Use File > New. This access often used when hand picking individual files to nest (files do not have to be part of the active Inventor project!)
- Select the custom inest template called **Sheet metal only.inest**.
- Open the **cabinet.iam** file.
You will now have two documents open in the session.
- Create nest and use the Add to open document option
Note that there is no longer a need to create Aluminum materials as they already exist in the template

Figure 40 Cabinet assembly

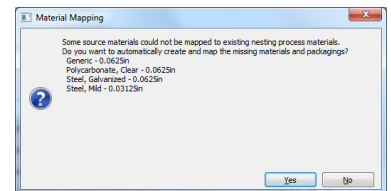


Figure 41 Aluminum material is already present in template

- Verify in the Source Provider column that only sheet metal files are extracted
- Examine error log or use tooltip by hovering over the error
- Hit OK to save the extracted shapes

Task 6.2: Modify geometry in a source part

Material or BOM QTY changes only require a **refresh** of the assembly node. However geometry changes in the source require a re-extract of the shapes. All above changes of course will affect existing nests

- Locate the shape Weldment Door Rib in the Sources.
Note that the shape is not filled.
- Use the marking menu to Open the source file **Weldment Door Rib.ipt**
- Un-suppress cut in Weldment Door Rib.ipt
- Use Start Extract from the context menu on the Weldment Door Rib
Note that the error is corrected and new geometry is taken into account (also in any existing nests)

Task 6.3: Filter out even more parts

- Start the Nesting Study dialog

- b) In the table Clear all filters (Tip: select in a random cell to refresh the display and see the result)
- c) Deselect all selected shapes
- d) Use column Filters to filter out all shapes except the shapes with Material = Aluminum 6061 and Thickness = 0.0625 in
- e) Add these shapes to the selection by checking the Selected checkboxes or by using the “Add to selection” context menu
- f) Hit OK to create the nest
Close the error that pops up. We will solve the error in the next chapter.

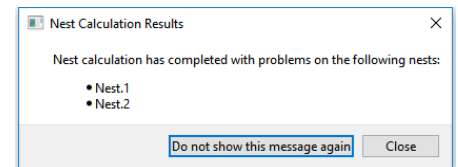


Figure 42 Problematic nests

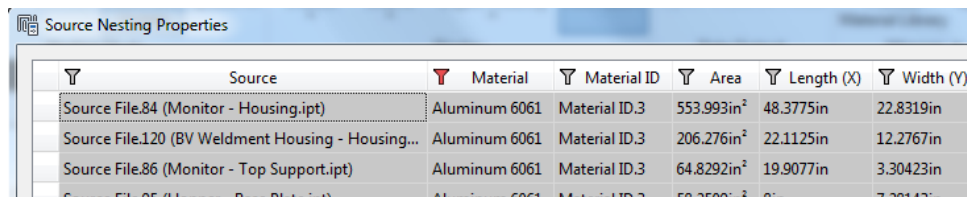
Chapter 7: Edit a nest: increase efficiency

The Nesting study itself cannot be edited but a nest can be edited to increase the nesting efficiency or simply make the nest work. A common way to increase efficiency is to change the packaging size, increase the (Job) QTY or add extra shapes to a nest.

Task 7.1: Change packaging

The most common mistake is to use shapes that are too large to fit on the sheet resulting on error dialogs as can be seen on the right. The solution is to increase the packaging size.

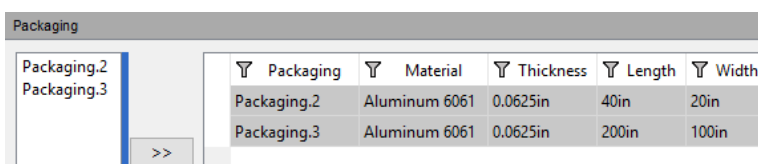
- Show the Source Properties and filter material on Aluminum 6061
 - Move the Length (X) and Width (Y) columns to the left
 - Add Area column by using Display Column context menu on column headers
 - Sort the Length (X) and/or Width(Y) columns to find the shapes with the biggest size and compare this to the packaging size being used for those shapes
- Use source nesting properties to locate X,Y dimensions and compare to packaging dimensions
In this sorted and filtered, you can clearly see that the Monitor – Housing part is the largest and might not fit on a packaging of size 50x30 in²



| Source | Material | Material ID | Area | Length (X) | Width (Y) |
|--|---------------|---------------|------------------------|------------|-----------|
| Source File.84 (Monitor - Housing.ipt) | Aluminum 6061 | Material ID.3 | 553.993in ² | 48.3775in | 22.8319in |
| Source File.120 (BV Weldment Housing - Housing...) | Aluminum 6061 | Material ID.3 | 206.276in ² | 22.1125in | 12.2767in |
| Source File.86 (Monitor - Top Support.ipt) | Aluminum 6061 | Material ID.3 | 64.8292in ² | 19.9077in | 3.30423in |
| Source File.95 (Hopper - Base Plate.ipt) | Aluminum 6061 | Material ID.3 | 58.2500in ² | 8in | 7.28143in |

Figure 43 Monitor-Housing is a large part

- From the table context menu, use Save View to store this view with name “FindArea” for later debugging use.
You can flip back and forth between the FindArea view and the Default view.
- Edit the nest.
- Add the larger packaging to the nest for the parts that use material Aluminum 6061



| Packaging | Material | Thickness | Length | Width |
|-------------|---------------|-----------|--------|-------|
| Packaging.2 | Aluminum 6061 | 0.0625in | 40in | 20in |
| Packaging.3 | Aluminum 6061 | 0.0625in | 200in | 100in |

Figure 44 Addition of a larger 200x100 in² packaging

Note that Material library and Packaging changes as well as geometry changes in the source file, force the nest to be out-of-date and this sometimes requires a **manual** recalculation of existing nests.

Use the Start all button in the Calculate panel or start individual nest calculations with Calculate context menu to update the nest in a manual fashion.

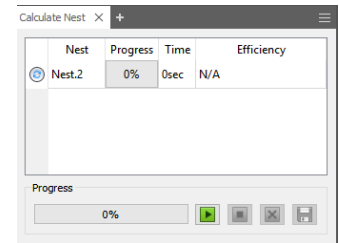


Figure 45 Calculate panel in waiting mode

Task 7.2: Change QTY

- Edit the nest and change the QTY of all shapes from 1 to **10**
- Hit OK to proceed with the nest recalculation
- Observe that the Efficiency has increased

Note: Source QTY and Job QTY are not accessible on an existing nest but Total QTY (in the QTY column) can be edited.

Task 7.3: Add a Shape to a nest

You can mix and match external ipt/dwg or ipt, unrelated to the current assembly to increase efficiency.

- Open the Sources dialog
- Add the Sample bracket.DXF file from the AutoCAD files folder
- Assign the Material ID to the material representing the 0.0625 thick Aluminum
- Change the Unit rule to Custom
This enables edits in the Unit column
- Change the unit to **cm**
Note that the original unit was in (indicated by the underscore)
This means that we effectively will scale down the DXF files with a factor 2.54

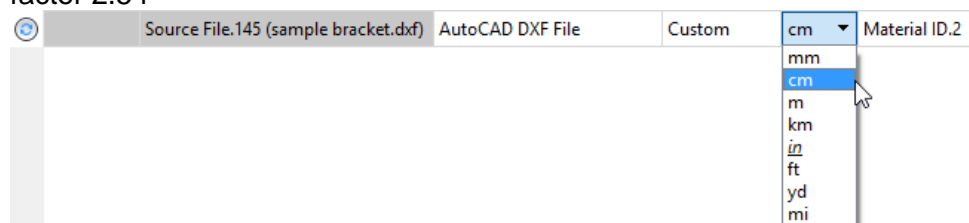


Figure 46 Customizing units for DXF or DWG

- f) Start Extract and hit OK to save the shape
- g) Edit the nest
- h) Hit the selection arrow in the Shapes to nest section of the dialog
- i) Select the sample bracket shape node in the browser.
Note that nodes with the wrong material cannot be selected, which is signaled by the STOP cursor
- j) Change the QTY of the bracket from 1 to 20
- k) Hit OK to calculate the nest and note the efficiency increase

Chapter 8: Edit a nest: Source properties

By default the Source file properties are bound to the material.
 The bound (or read-only) cells are marked in a grey background.
 If Bind is unchecked, all source nesting properties are available for edit
 (cell background is white). Once an edit is made, the overridden cell
 background is marked in orange

Task 8.1: Change the degrees of freedom of the nest

Use of filtering/sorting/multi-edit to identify and unbind multiple shapes and
 change the orientation, rotate, mirror and flip values

- Verify the efficiency in the nest summary on the graphic screen
- Use Unbind all from the context menu of a nest or a nest study
- Edit the nest
- Check Flip/mirror/Rotate 90/Rotate180/Rotate 270 on the **Hopper Handle**.
- Change the initial Orientation to **45** and allow a Deviation of **45** deg with incremental steps of **5** deg.
 This allows the shape to rotate from -90 to +90 with 5 deg increments

- Increase QTY to **500**

| Source | Shape | Bind | Priority | Source QTY | Mirror | QTY | Orientation | Deviation | Increment | Flip | Rotate 90 | Rotate 180 | Rotate 270 |
|---------------------------------------|-----------------|--------------------------|----------|------------|-------------------------------------|-----|-------------|-----------|-----------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Source File.250 (Hopper - Handle.ipt) | Hopper - Handle | <input type="checkbox"/> | 2 | 1 | <input checked="" type="checkbox"/> | 500 | 45deg | 45deg | 5deg | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |

Figure 47 Orange cells indicating values different from the material library

- Hit OK and the nest will automatically update
- Verify new efficiency in the nest summary (or during nest calculation in the Calculation panel)
- Verify that the Hopper handle shape now is used on the sheet with various orientations.

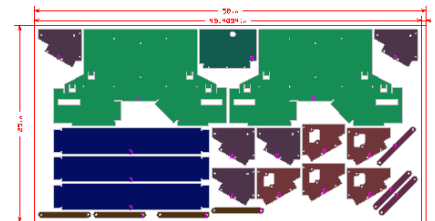


Figure 48 Oblong in various orientations

- Change the Color display in the ribbon to Nested Orientation to better distinguish the various shape orientations.



Figure 49 Two different colors indicating different orientations

Chapter 9 : Advanced nest optimization techniques

Task 9.1: Tweak global nest parameters

- Set the Positioning & Performance parameters according to this image and verify you obtain the expected results

| Global Nest Parameters | |
|------------------------|-----------------|
| Positioning | |
| Frame width | 0.5in |
| Item separation | 0.25in |
| Corner position | Upper right |
| Performance | |
| Minimum run time | 60s |
| Maximum run time | 600s |
| Desired yield | 90.00% |
| Remnant optimization | Minimize length |

Figure 50 More ambitious global nest parameters

Tip: use the tooltips on the dropdown fields to understand the behavior.

Task 9.2: Material usage method and inventory

- Edit the nest
- Set desired yield back to 80% (for time reasons)
- Make sure the smaller packaging is in pole position and both packagings have an infinite Inventory QTY
- Set the Material usage method = **As listed**

| Y Packaging | Y Material | Y Thickness | Y Length | Y Width | Y Inventory QTY |
|-------------|---------------|-------------|----------|---------|-----------------|
| Packaging.2 | Aluminum 6061 | 0.0625in | 40in | 20in | ∞ |
| Packaging.3 | Aluminum 6061 | 0.0625in | 200in | 100in | ∞ |

Figure 51 Small packaging first with infinite inventor

- Hit OK to Calculate the nest

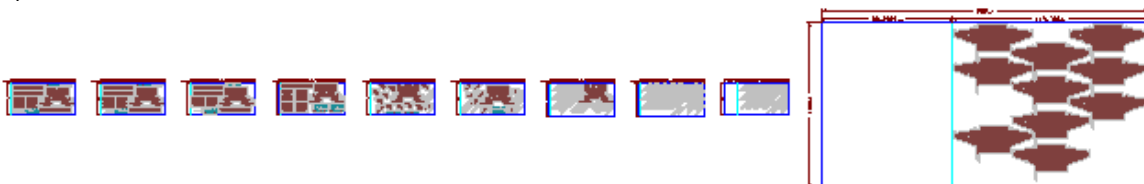


Figure 52 Multi-sheet nest favoring the smaller packaging size

- f) Edit the nest and the Inventory QTY of the small packaging to 1

| Y Packaging | Y Material | Y Thickness | Y Length | Y Width | Y Inventory QTY |
|-------------|---------------|-------------|----------|---------|-----------------|
| Packaging.2 | Aluminum 6061 | 0.0625in | 40in | 20in | 1 |
| Packaging.3 | Aluminum 6061 | 0.0625in | 200in | 100in | ∞ |

Figure 54 Reducing inventory to 1

- g) Hit Ok to generate the nest

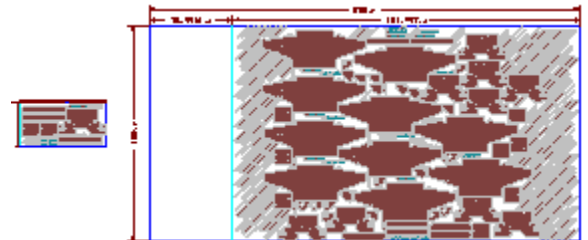


Figure 53 Favoring the larger packaging size

- h) Set the Material usage method = Best Mix (or Best size)

- i) Hit Ok to generate the nest

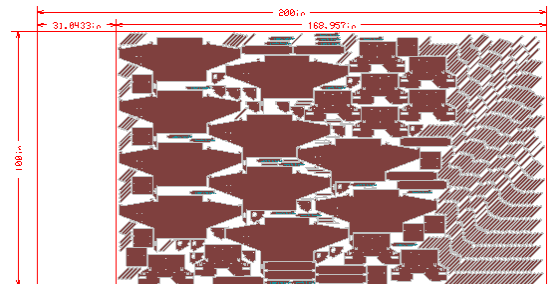


Figure 55 Using Best mix/Best size

Task 9.3: Priority

Determines which shapes will be cut first

- Edit the nest
- Set corner position to Upper right
- Set the priority of Monitor housing to 100
Note that the Monitor housing is nested first.

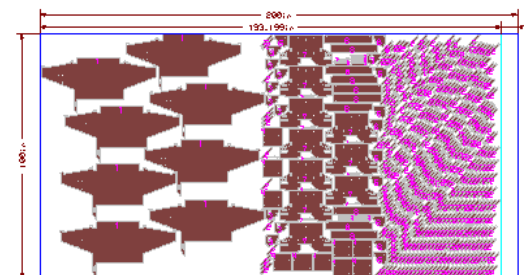


Figure 56 Prioritizing the monitor housing

Task 9.4: Sheet count

Nesting utility does not replicate the display of identical sheets but only shows one of the identical sheets and subtly changes the way the sheet

borders are displayed

- a) Edit the nest
- b) Delete the small packaging
- c) Set QTY on all rows to a high number like 300
- d) Set Stack size = 2
- e) Verify the high efficiency and the double borders around the sheet

Sheet quantity : 2
 Stack size : 2

Double borders close to each other = multiple stacks
 Double borders further apart from each other = multiple identical sheets



Figure 57 Multiple plates and stacks per sheet

Chapter 10: Export nest as Inventor file

Create 3D model command creates a multi-body ipt

Tip: use the Make components command to obtain iam

Task 10.1: Create 3D Model

- a) Create a second nest study in the same file and use the defaults

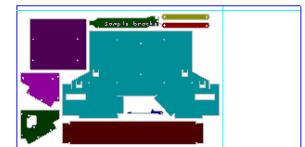


Figure 58 New study with job QTY = 1

- b) Select a sheet of this new study (NOT a nest!)
- c) Use Create 3D Model from the ribbon (or from the context menu)
- d) Verify that you obtain a single ipt file with multiple bodies with the correct thickness and the correct material and appearance, identical to the original source file.

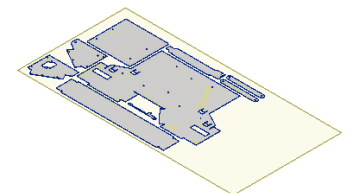
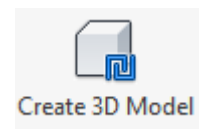


Figure 59 Inventor 3D model of a nest

- e) Save the ipt

Chapter 11: Toolpath generation

We will now generate NC toolpath using Inventor HSM add-in

Task 11.1: Produce CAM files

- a) Use the ipt you just created
- b) Setup
 - c) Use Operation type = **Cutting** and hit OK
- d) Create a 2DProfile operation
 - e) In the 2DProfile > Tool tab, set
 - a. Type = **Plasma cutting**
 - b. Make sure Kerf width < Separation value used in the nest
 - f) In the 2DProfile > Geometry tab
 - a. Check **Select same plane faces**
 - b. Loops = **Inner loops**
 - c. Side = **Start inside**
 - d. Select the FACE of one of the closed contours
 - g) Duplicate the 2DProfile via the context menu
 - a. Loops = **Outer loops**
 - b. Side = **Start outside**
 - c. Check Tabs
 - h) Select both 2D Profile operations (or the Setup node)

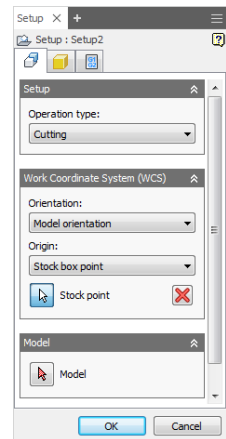


Figure 60 Cutting setup

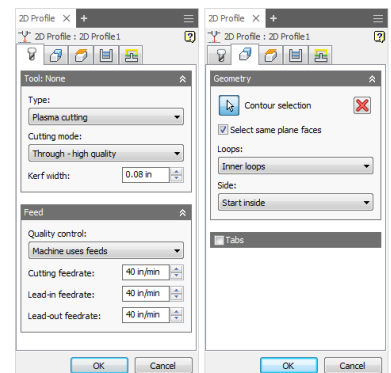
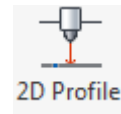
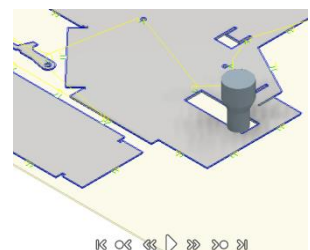


Figure 61 2DProfile operation



- i) Simulate
- j) Select Setup and Post-process
- k) Hit the Setup button in the dialog and choose “Use personal post library”
- l) Browse to the Post-processors folder
- m) Use the Torchmate processor and generate the NC code
 Make sure to check **Open NC file editor** if you want to inspect the generated code

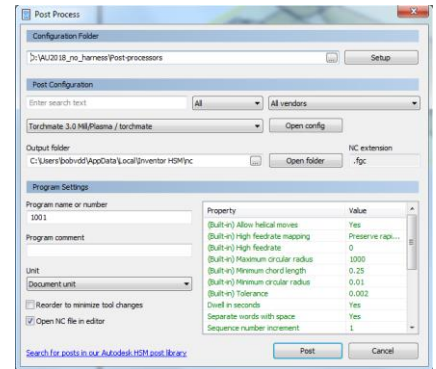


Figure 63 Post-processing with Torchmate post

Chapter 12: Nest reports

Task 12.1: Generate the default report

- a) Double click on any Report node under any nest node
This opens the default report that contains a maximum of information
- b) Explore the report contents (sorting, Show vs. Hide)
- c) Print the report as PDF and open the PDF to verify
- d) Save the report to disk as a self-contained HTML file.
This file can be sent to other machines or to colleagues without losing image information.

Task 12.2: Customize the report

- a) Options > Report
- b) Change the Report template directory to
C:\Users\Public\Documents\Autodesk\Nesting Utility
2019\Samples\Report Templates
- c) Navigate in Windows Explorer to the file
C:\Users\Public\Documents\Autodesk\Nesting Utility
2019\Samples\Report Templates\example-template-full.html
- d) Edit the file in Notepad or any other text editor
 - a. Comment out the entire report-part-cost-pie-chart <div> section (mandatory step if 2019.2.1 is not installed)

```
<!-- <div class="report-part-cost-pie-chart"
    data-source="AvgMaterialNestedCost"
    data-patterned="true"
    data-pie-tab-visible="true"
    data-pie-tab-percent-precision="4"
    data-pie-tab-border-color="#999"
    data-pie-tab-border-width="3"
    data-pie-tab-line-color="#990"
    data-pie-tab-line-width="10"
    data-pie-tab-stretch="10">
</div> -->
```

- b. Replace the report-source-parts section with

```
<div class="report-source-parts"
    data-resizable-columns ="PartName"></div>
```

This allows the Part Name column to be resizable in case you use long part names.

- c. In the report-nesting-properties section
 - i. Change the data-column-count from 3 to **1**
 - ii. Make the section visible by default by setting data-start-visible = "**true**"
 - iii. Hide some properties by adding a data-hidden-properties line

```
<div class="report-nesting-properties"
  data-collapsible="true"
  data-start-visible="true"
  data-column-count="1"
  data-shown-categories=
    "Miscellaneous,Material,Optimization,Positioning"
  data-shown-properties="Thickness,Material,Density"
  data-hidden-properties=
    "TimeVsEffStr,TimeVsEffNum">
</div>
```

- e) Re-Open the report by double clicking in the browser
- f) Change the Report Template in the dropdown to example-template-full to see the resulting report

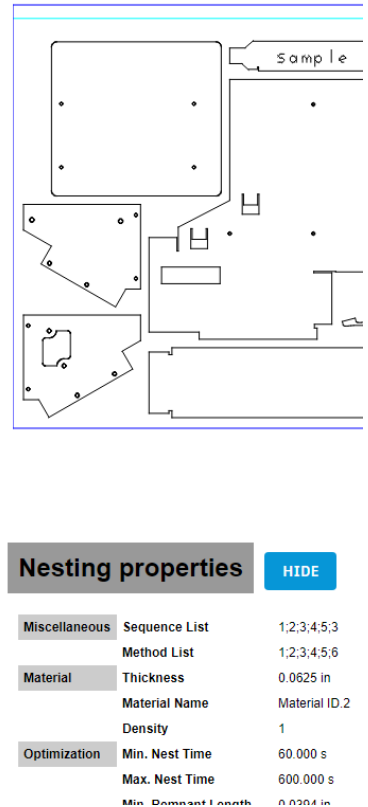


Figure 64 report with a single column Nesting properties section

Chapter 13: Nest AutoCAD files

Nesting utility can also extract shapes from DWG and DXF files. The difference with IPT files is that DXG/DXF files have no notion of material or thickness and the unit can be chosen freely. So it is the operator's diligence to provide these.

Task 13.1: Configure and nest DXF files

- Start a new nest file
- Start the Sources dialog
- Add the two DXF files from the AutoCAD files folder (sample.dxf and samplebracket.dxf)
- Start the Process Material Library and add a new material unrelated to any Inventor material

Material = **Kevlar**

Thickness = **0.1 in**

Category = **Composites**

If no Sync to provider is used, such material and material category remains independent from the Inventor material library. This gives you more flexibility but the downside is that the end result will not use the correct appearance. Here is an example where Cork and Kevlar are defined.

| Material ID | Material | Category | Thickness | Nesting Color | Density | Remote Material Name | Provider |
|---------------|----------|-----------|-----------|---------------|------------------------|----------------------|----------|
| Material ID.1 | Cork | Exotic | 1in | | 7,850kg/m ³ | | |
| Material ID.2 | Kevlar | Composite | 0.1in | | 7,850kg/m ³ | | |

Figure 65 Creating nesting materials unrelated to Inventor materials

- Start the Nesting properties dialog and assign the Kevlar material to the DXF files by selecting the material in the Material Name column
Note that the Material name is editable for DXF and DWG
- Set the Source QTY for samplebracket.dxf to **20** (as it is a small part)
- Return to the Sources dialog and set the Configuration for both files to DefaultImportConfiguration.cfg
- Assign both parts a custom unit = **cm**
- Hit Start Extract followed by OK to extract the shapes

j) Create Nest Study

Note that the small bracket is nested outside the larger part

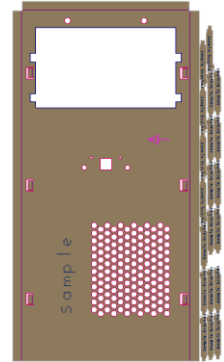


Figure 66 Smaller parts nested outside larger part

k) Open Options > Extract

- l) Hit “...” to edit the active configuration file in the Configuration Editor. We offer Configuration files for both **extract** and **export**. They allow to pre-set the layer maps for nestable and non-nestable entities, etch data, grain markers, junk and other parameters.

- m) Hit the + sign to make a copy of the default configuration file
Call the new file **CustomConfiguration1.cfg**

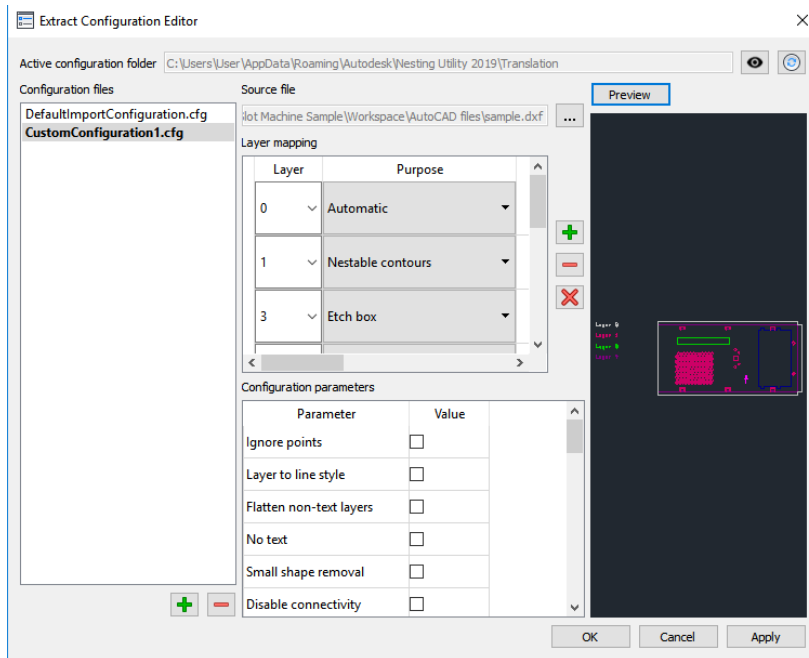


Figure 67 Creation a custom configuration for shape extraction

- n) Set the new configuration as the active configuration via the context menu or simply double click on the name.
- o) Hit the Source file “...” button and load the sample.dxf file
- p) Hit preview
- q) Change the map for layer 5 from Non-nestable entities to **Nestable contours**
- r) Hit Ok to save the configuration
- s) Sources and the Configuration for both files to **CustomConfiguration1.cfg**
- t) Re-extract and hit OK
- u) Re-calculate the nest
Note that the small bracket is now nested inside the holes of the larger part

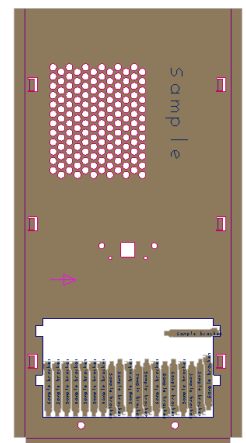


Figure 68 Smaller parts nested inside larger part

Chapter 14: Export nest as AutoCAD file

Individual or a series of sheets can be exported to DXF files.
The export settings can also be pre-defined in configuration files.

Task 14.1: Export sheets as DXF

- a) Open Options > Export to verify location and name of the configurations and then you can exit the Options dialog.
- b) Select one or more nested sheets in the browser
- c) Use the Export command from the ribbon
- d) Enter any DXF file name
- e) This brings up the Export Configuration Editor dialog
- f) Add a new configuration and make it active
- g) Map Automatic to layer 25
- h) Hit the Preview button
Note that the shape/file labels are ALWAYS preserved in the DXF output
- i) Hit OK to proceed with the DXF file creation
- j) Open the DXF in AutoCAD
Note that the outside contours sit on layer 25

Chapter 15: Nest AnyCAD files

Closed shapes can be extracted from bodies inside STEP, ProE , Solidworks files etc. if there is at least one **flat face** in the file that allows us to construct a **2D silhouette**. However the AnyCAD file must first be imported and saved in Inventor IPT format. The same holds true for STL meshes that need to be placed first inside ipt files.

Silhouette recognition from AnyCAD bodies is triggered by the **Generic CAD** provider.

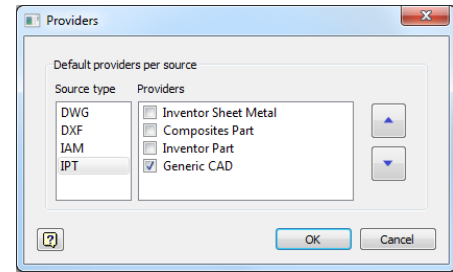


Figure 69 Using Generic CAD provider only

Task 15.1: Extract shapes from STEP file

- Open and checkout file **Cabinet\Monitor Shelf\Backplane \Backplane – PCB.ipt**
- Suppress the Emboss1 feature (irrelevant for nesting)
- Save Copy as STEP
- Close the file
- Open the STEP file as **Reference Model**
- Measure the thickness of the PCB (0.063 in)
- Set the Nesting Thickness on the root node to **0.063 in** (skip this step if you have 2019.2.1 installed)
- Save the IPT (important)
- Create Nest from a template that has the Generic CAD provider enabled.

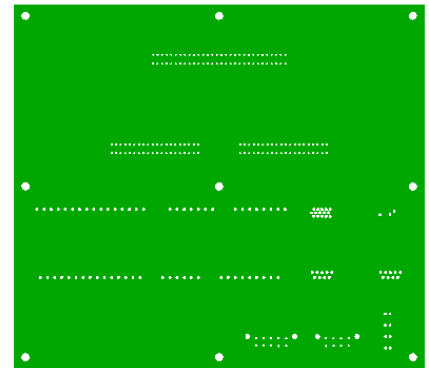
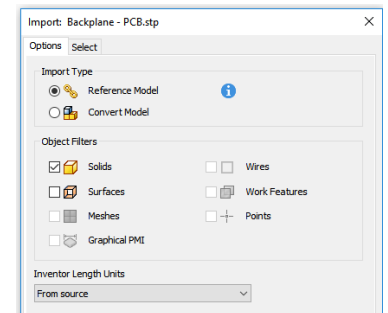


Figure 71 Shape extracted from a STEP file

Table of contents

| | |
|--|----|
| Learning Objectives..... | 1 |
| Description..... | 1 |
| Speaker(s) | 1 |
| Introduction | 3 |
| Chapter 1: Create a nest document..... | 5 |
| Task 1.1: Create nests (method 1) from ribbon | 5 |
| Chapter 2: Terminology & browser & display & UI behavior | 10 |
| Task 2.1: Explore AutoZoom..... | 10 |
| Task 2.2: Explore different command access methods | 10 |
| Chapter 3: Control the nest display | 12 |
| Task 3.1: Control display from ribbon..... | 12 |
| Task 3.2: Options dialog | 12 |
| Chapter 4: Create nests (method 2): from context menu | 14 |
| Task 4.1: Use Create Nest command | 15 |
| Task 4.2: Error correction..... | 15 |
| Task 4.3: Recognize extrusions, sketches explicitly | 16 |
| Task 4.4: Exclude parts..... | 17 |
| Chapter 5: Custom Templates & Materials & Packaging | 19 |
| Task 5.1: Move material from cache to Inventor material library..... | 19 |
| Task 5.2: Synchronize to existing materials | 20 |
| Task 5.3: Providers | 21 |
| Task 5.4: Create a custom template..... | 21 |
| Chapter 6: Create advanced nests (method 3): from New | 22 |
| Task 6.1: Extract sheet metal only | 22 |
| Task 6.2: Modify geometry in a source part..... | 22 |
| Task 6.3: Filter out even more parts..... | 22 |
| Chapter 7: Edit a nest: increase efficiency..... | 24 |
| Task 7.1: Change packaging..... | 24 |
| Task 7.2: Change QTY | 25 |
| Task 7.3: Add a Shape to a nest..... | 25 |
| Chapter 8: Edit a nest: Source properties..... | 27 |

| | |
|--|----|
| Task 8.1: Change the degrees of freedom of the nest..... | 27 |
| Chapter 9 : Advanced nest optimization techniques..... | 28 |
| Task 9.1: Tweak global nest parameters..... | 28 |
| Task 9.2: Material usage method and inventory | 28 |
| Task 9.3: Priority | 29 |
| Task 9.4: Sheet count | 29 |
| Chapter 10: Export nest as Inventor file | 30 |
| Task 10.1: Create 3D Model | 30 |
| Chapter 11: Toolpath generation..... | 31 |
| Task 11.1: Produce CAM files..... | 31 |
| Chapter 12: Nest reports | 33 |
| Task 12.1: Generate the default report..... | 33 |
| Task 12.2: Customize the report | 33 |
| Chapter 13: Nest AutoCAD files | 35 |
| Task 13.1: Configure and nest DXF files..... | 35 |
| Chapter 14: Export nest as AutoCAD file | 38 |
| Task 14.1: Export sheets as DXF..... | 38 |
| Chapter 15: Nest AnyCAD files..... | 39 |
| Task 15.1: Extract shapes from STEP file..... | 39 |
| Table of contents | 40 |