UNIGRAPHICS

ADVANCED MILL APPLICATIONS

WORKBOOK

September 2002

MT11045 – Unigraphics NX

EDS Inc.

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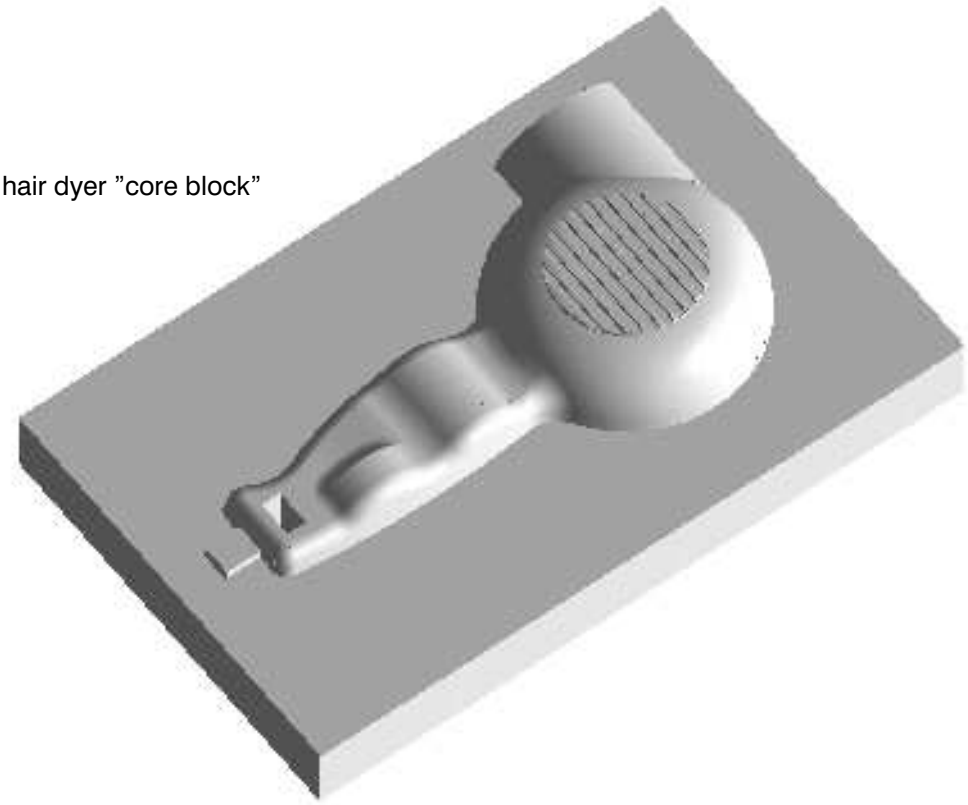
Project Description

Advanced Mill Application Project Overview

The Advanced Mill Application project is an additional activity that incorporates the skills learned to perform advanced machining processes. During the course of working through this workbook exercise, you will be asked to perform tasks which will be used to machine the core block of a plastic hair dryer.

Plastic hair dyer ”core block”



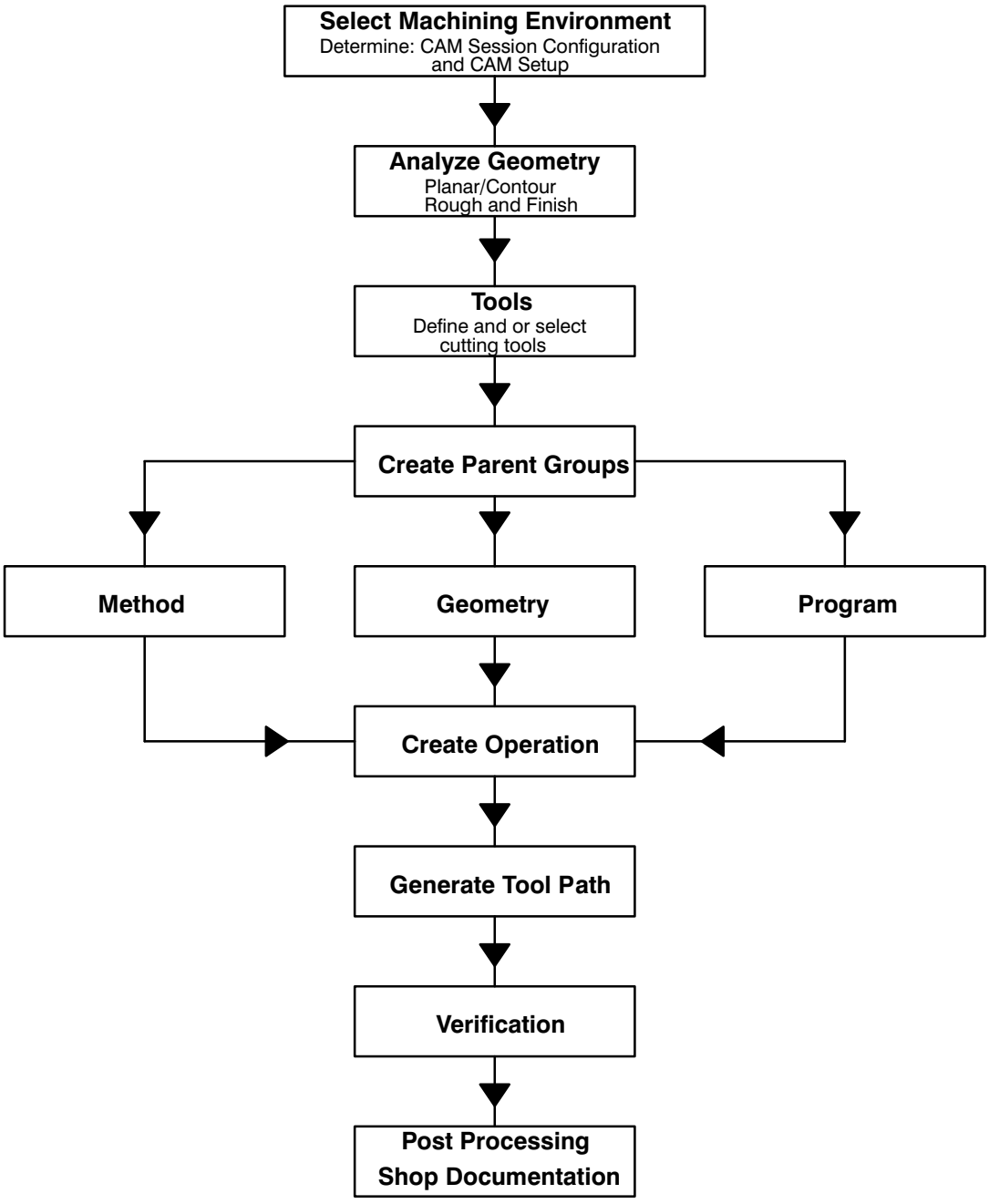
You will begin this project by using the provided Process Plan which will guide you through the various steps required to machine the core block.

The manufacturing processes or methods that you will use in this workbook may or may not be the same approach, in order or content, that you would use at your company. This mimics the situation where the same mold is manufactured by various companies, but the methods of manufacture differ, giving each individual company what they feel is a competitive edge in the marketplace. The end result, the final mold, is the same. What is more important in this class, is gaining an understanding of the methodology and applications of using the various advanced manufacturing options of Unigraphics. This allows you to customize tool path creation to methods or processes that you are familiar with.

It is the intent of this project to allow you to apply the skills taught in this course. However, the time constraint of this course is a factor, at any point when progress is not being made, ask for the help of your instructor.

The following flowchart indicates the manufacturing process steps that you will perform in creating and processing tool paths in Unigraphics. You will use this flowchart as a guide throughout this project.

Unigraphics Manufacturing Process



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Process Planning

Section 1

A manufacturing process plan typically describes the step by step procedure of manufacturing a part. Items in such a plan often include area of manufacturing (department), type of machining (milling, turning, wire EDM, grinding, etc.), description of operations to perform, fixturing of the part, tooling required, and any other information which is necessary for successful manufacturing.

The following process planning sheets represent the manufacturing of the hair dryer core insert. Included are the operation number, work center designation, operation description, operation name and tool description. A definition of these items follows:

- **Operation Number** is the sequential order in which a process is performed.
- **Work Center** is the particular work area in which the operation is performed.
- **Description** is the detailed description of the operation that is to be performed.
- **Operation Name** is the actual name of the operation used to machine the specific feature or task.
- **Tool** is the description of the tool used to machine the specific feature.

Operation Number	Work Center	Description	Operation Name	Tool
100	**Inspection**	**X-ray stock for defects**		
200	**Manual Machining**	**Mill stock to 235mm x 145mm 55mm**		
300	**Manual Machining**	**Drill Press** **Drill 8 clamping holes**		
400	**CNC Machining**	**3-axis vertical** **Setup as shown, core side of part is up.**		
400.01		Rough mill core block, leave 3mm stock	cav_mill_core	50mm dia. end mill, 6mm corner radius
400.02		Outline core shape	core_outline	25mm ball mill
400.03		Finish parting line	pl_finish	20mm flat end mill
400.04		Finish core shape	core_finish	20mm ball mill
400.05		finish all uncut areas with 8mm ball mill	flowcut_8mm	8mm ball mill
400.06		finish all uncut areas with 6mm ball mill	flowcut_6mm	6mm ball mill

Operation Number	Work Center	Description	Operation Name	Tool
400.07		finish all uncut areas with 3mm ball mill	flowcut_3mm	3mm ball mill
400.08		semi-finish ribs	semi_finish_ribs	2mm ball mill
400.09		finish ribs	finish_ribs	2mm end mill
500	**Inspection**	**Inspect all features machined in operation numbers 400.01 thru 400.09**		
600	**Manual Deburr Clean**	**deburr and clean part per specifications**		
700	**Wire EDM**	**Wire EDM for core insert on core block. Insert used for "branding" purposes.**	wire_core_insert	.2 mm diameter wire

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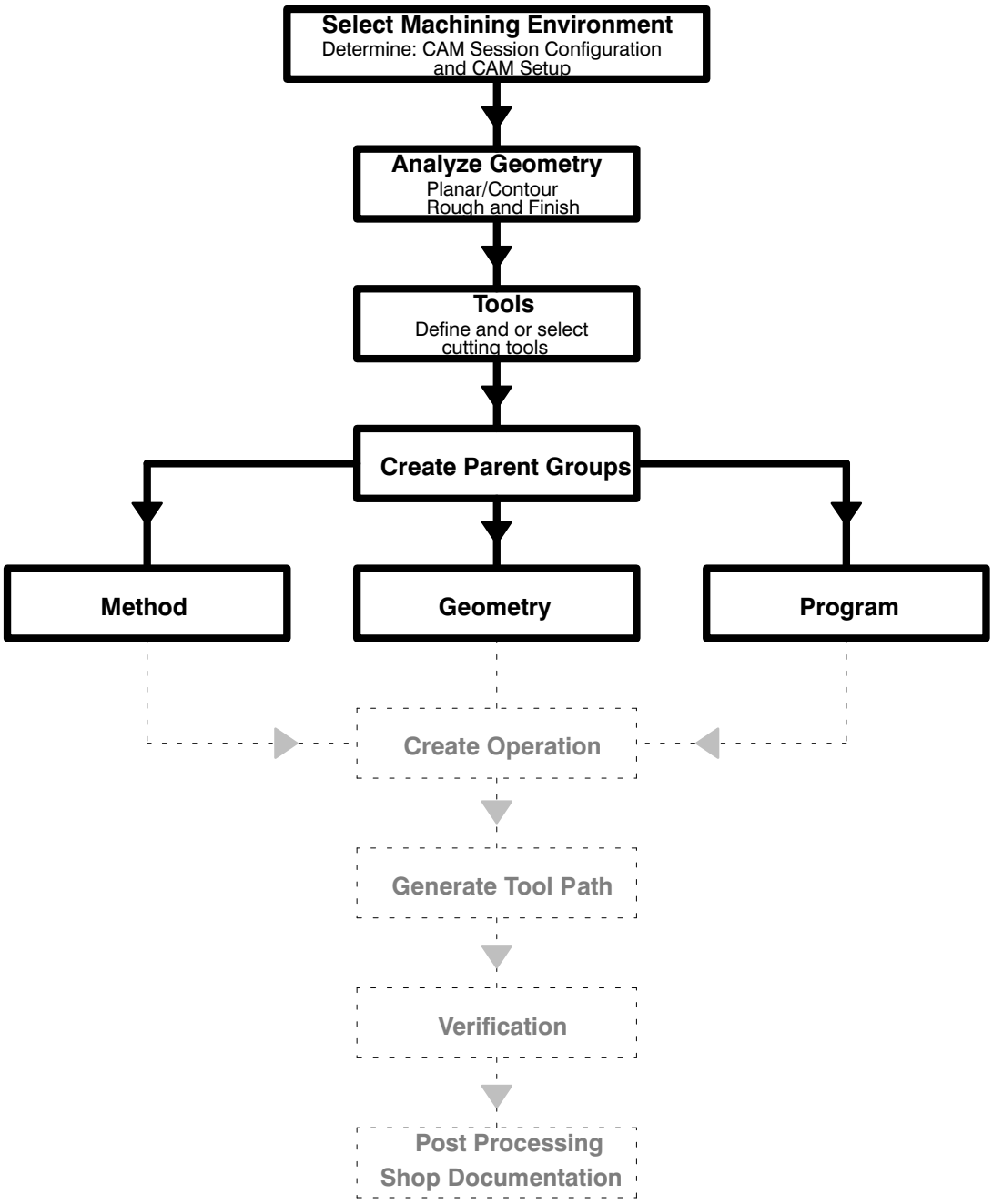
Manufacturing Operation Preparation

Section 2

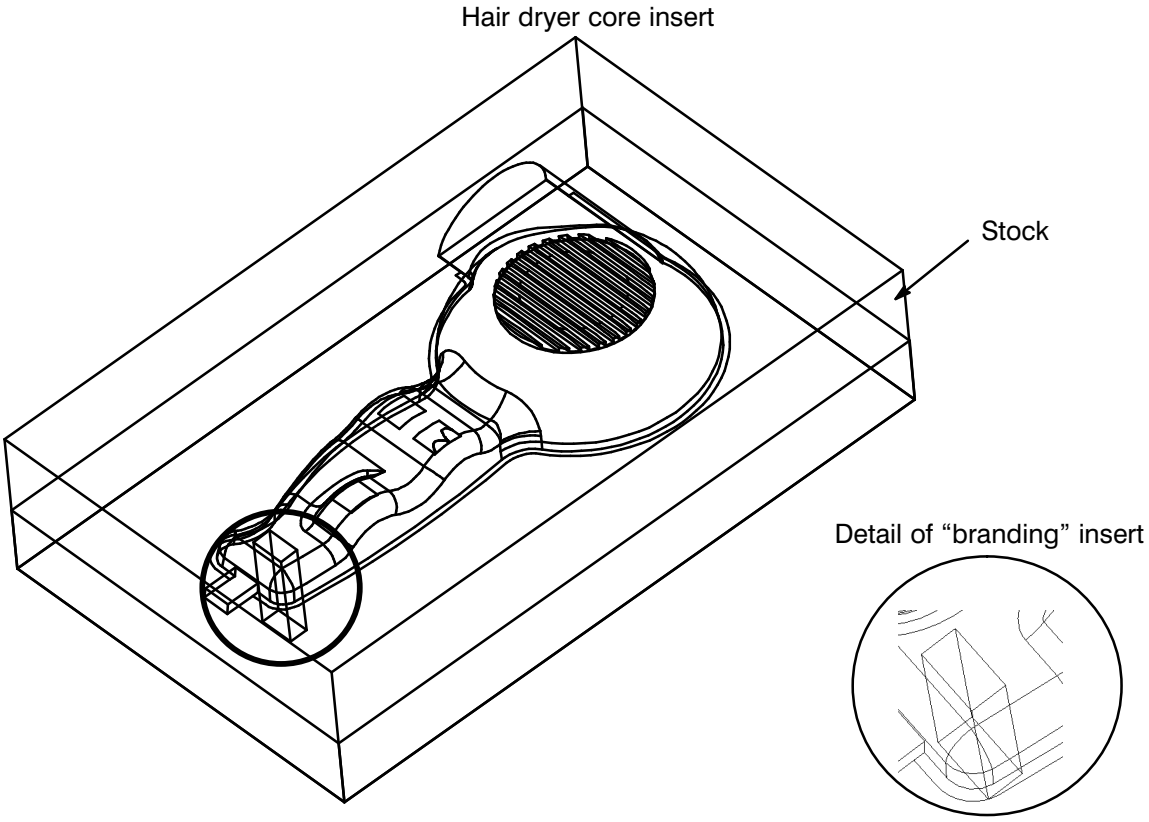
Unigraphics Manufacturing Process

Manufacturing Operation Preparation



Before you create any tool paths, numerous items must be taken into consideration for achieving the desired output. Items, such as cutting tool types and sizes, must be defined or retrieved from libraries. Feeds and speeds, based on part material and cutter material, must be determined. Geometry must be analyzed as to planar or contoured type and the Machining Environment must be selected and created. Planning the use of geometry in the various operations will aid in the creation and use of Geometry Parent Groups. This will save you numerous steps in the selection of geometry.

Notice the detail of the “branding” insert in the illustration below. The “branding” insert is used to change the brand name of the hair dryer for various customers. The “branding” insert slot will be created by a wire EDM operation that has already been modeled into the part. In order for the various tools, used in milling the core insert, to cut smoothly and not “drop” into the “branding” slot, the Wave Geometry Linker will be used to create a copy of the hair dryer core insert geometry. This copy will have an extruded plug added that will cover the slot of the modeled insert.



The following steps will allow you to create the items that are needed to successfully create and generate tool paths for the hair dryer core insert.

Step 1 Open the part, located in the workbook directory, **ama_dryer_core.prt.** Rename the part to *****_ama_dryer_core.prt** where *** represents your initials (this is a manufacturing assembly).

Step 2 Create an empty component part called *****_wave_core_no_insert_slot**. This component part will be used for your Wave linked body of the core insert.

Step 3 Create the Wave linked body of the core insert. Mask the opening of the “branding” insert slot (Hint: try creating a plug or use “time stamp”). The physical “branding” insert slot will be created using a wire EDM operation in a later section. You are going to mask the slot in order for the tools used in milling the core insert to cut without dropping into the previously modeled “branding” insert slot.

Step 4 Determine the Machining Environment. Select the CAM Session Configuration. Base the Configuration on operation types, for example planar and or contour milling.

Selecting the correct Configuration will avoid problems as you get further into selecting operation types. If you choose a configuration that does not allow for contour milling and determine as the job is nearing completion, that contour milling is required, the original Configuration can remain the same, but you must ***browse*** for a new operation **type** such as **mill_contour**.

Step 5 Determine the geometry types. Determine Planar and Contour geometry used in the various operation types.

Analyze the geometry which you will need to rough and finish the part. Can you use the same geometry to rough and finish?

The “Why” Before selecting the operation type, you must identify which geometry can be machined using Planar or Contouring techniques.

Step 6 Define the tools necessary for machining. Identify tools per the Process Planning Sheet required to machine the part. Create tools as required. The following list of tools, were derived from the Process Planning Sheet.

- **Milling tools:**

  50mm dia. end mill, tool library entry **UGT0201_021.**

  25mm dia. ball mill, tool library entry **UGT0203_064**.

  20mm dia. flat end mill, tool library entry **UGT0201_017**.

  20mm dia. ball mill, tool library entry **UGT0203_012.**

  8mm dia. ball mill, tool library entry **UGT0203_003**.

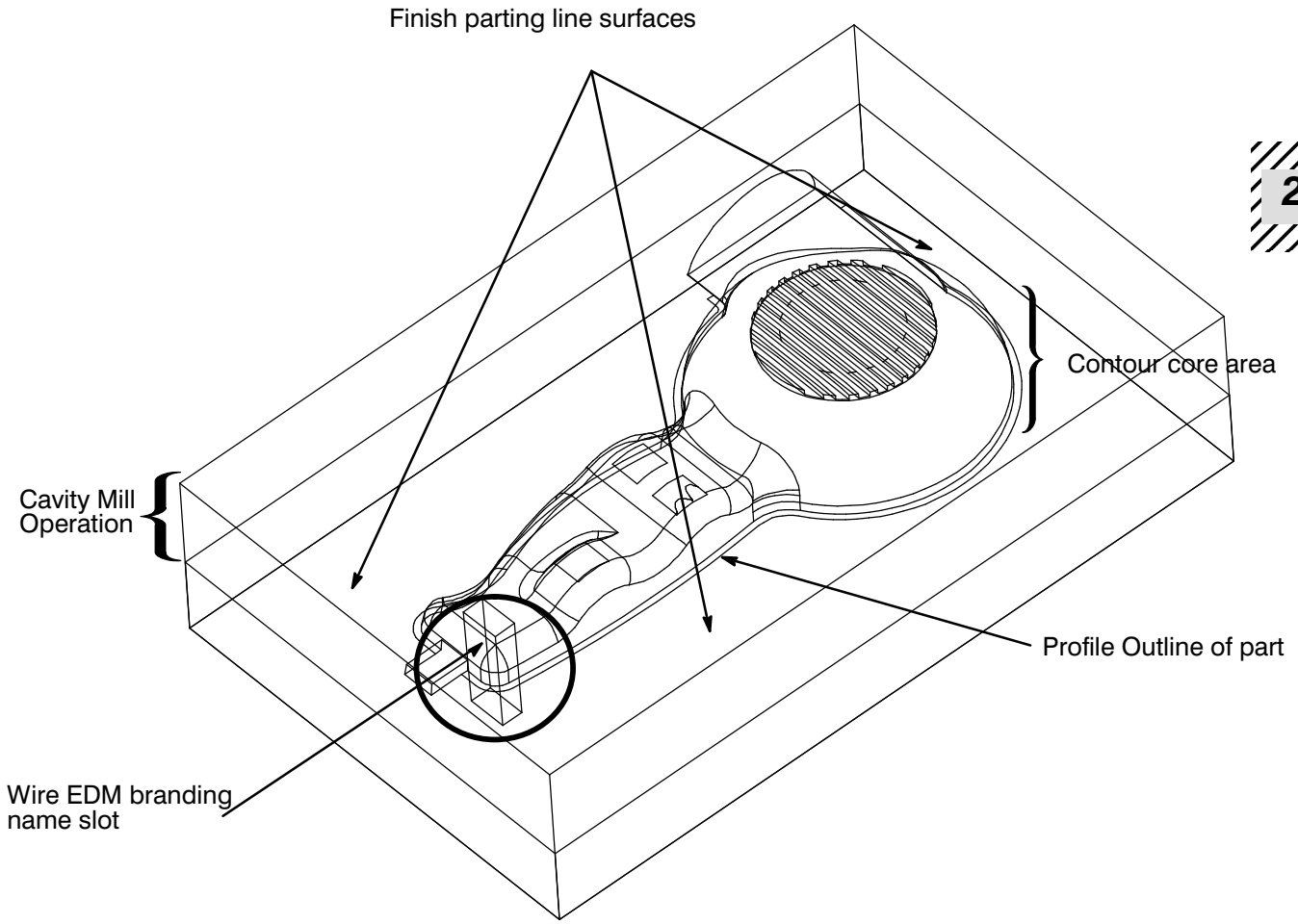
  6mm dia. ball mill, tool library entry **UGT0203_001**.

  3mm dia. ball mill, tool library entry **UGT0203_021**.

  2mm dia. ball mill, tool library entry **UGT0203_007**.

  2mm dia. end mill, tool library entry **UGT0201_001**.

Step 7 Create/Assign the **Geometry Parent Groups.** Select and/or create Geometry Parent Groups for the type of operation required that will be used in subsequent operations. Geometry Parent Groups can be identified for cavity milling, contouring and wire EDM operations.



Step 8 Create/Assign the **Method Parent Groups**. Select and/or create Method Parent Groups for the type of operation required. Base Methods on machining practices such as rough or finish. Assign options as required.

Option settings, such as Intol, Outtol, Part Stock, Feeds and Speeds and tool display characteristics can be assigned through the use of Method Parent Groups.

Step 9 Create/Assign the **Program Parent Groups**. Select and/or name the Program Parent Groups to help organize your sequence of operations. Use a meaningful name, such as **Prog_core_rough**, that would be easily identifiable if you had numerous Program Parent Groups.

Creating and or assigning Parent Groups eases the burden of programming by allowing the collection of “objects” and the assignment of options that are common to those objects (inheritance).

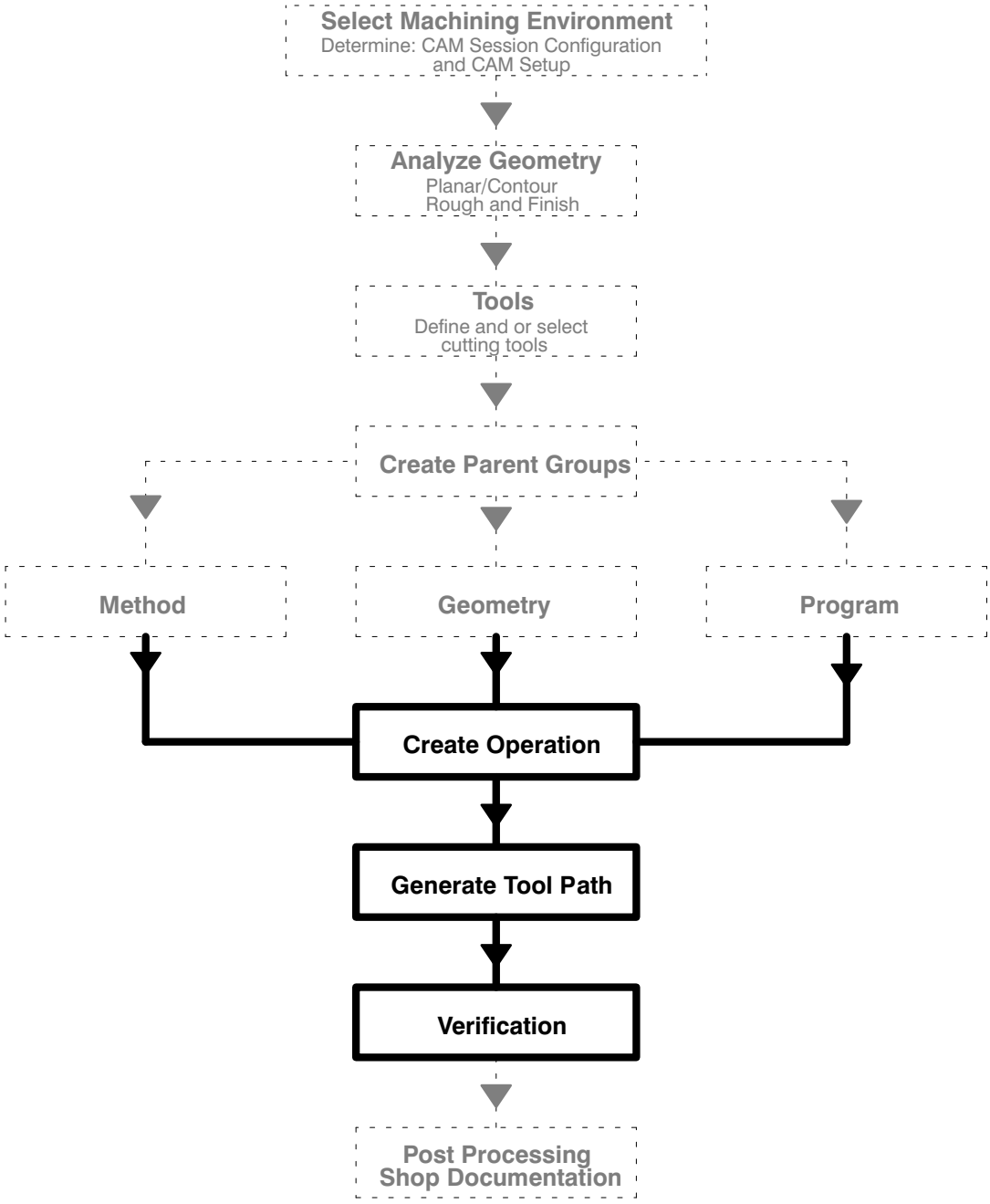
Step 10 Save the assembly and all component parts**.**

The part which you have created is located in a different directory than the components that were used. You will need to set your load options for proper loading of the components into the assembly. This will allow proper retrieval of your file.

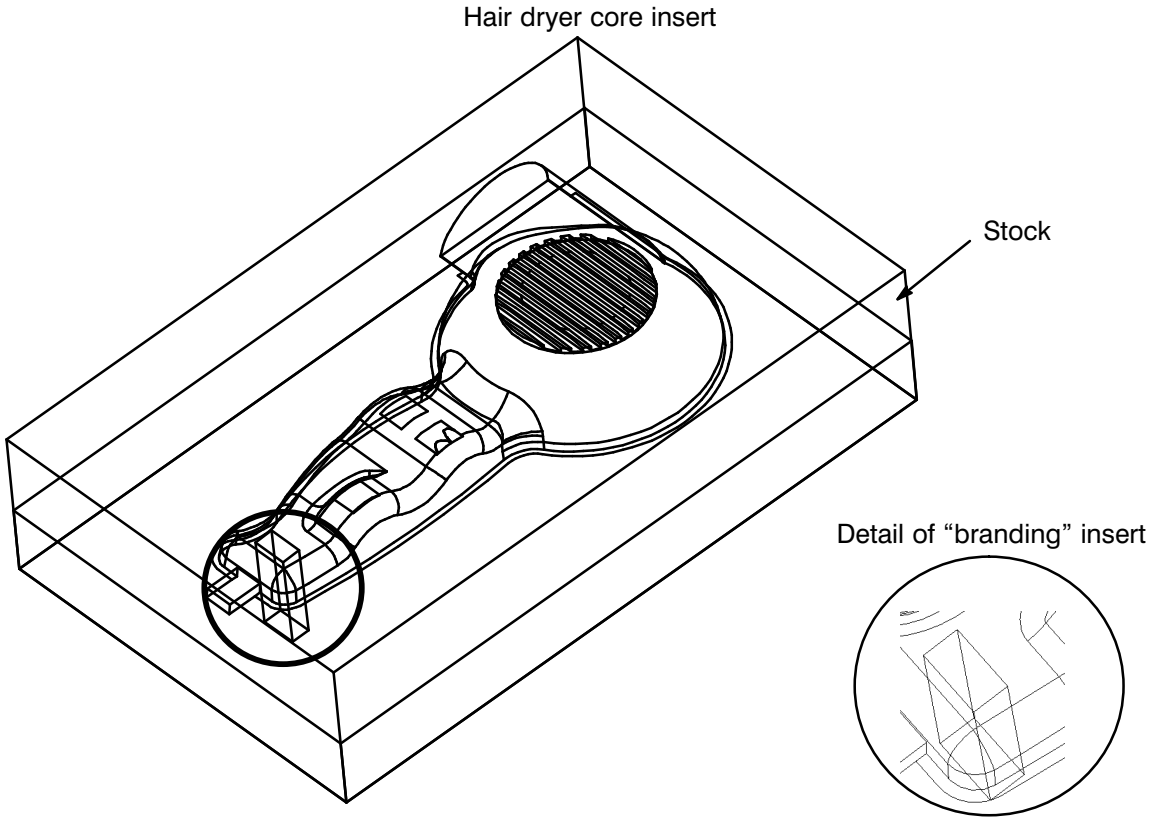
Cavity Milling
Section 3

Unigraphics Manufacturing Process

Cavity Mill Operation Subtypes



The hair dryer core insert can be rough and finish machined by a number of different approaches using various operation subtypes needed to achieve the desired results. The methods that you will use in this workbook project, may or may not be the methods that you would employ at your company, however, they represent the use of Cavity Milling, Fixed Contour and wire EDM operation subtypes that you have learned in the Advanced Mill Applications class.



There is one Cavity Milling and sixteen different Fixed Contour operation subtypes under the Mill Contour Set-up. Each operation subtype represents a different method of material removal. Selection of the operation subtype is normally based on cutting tool availability, machine rigidity, type of material being cut, geometry or feature configuration, speeds and feeds and desired finish.

In this section of the workbook, you will use the Cavity Milling operation subtype to rough the stock material for the hair dryer core insert.

In subsequent sections you will then use various Fixed Contour operation subtypes to finish the various contour shapes of the hair dryer core insert.

Remember that when you are creating these operations, common options, such as engage and retract parameters, and feeds and speeds must be specified.

Step 1 If necessary, open the part, *****_ama_dryer_core.**

Step 2 Use the Cavity Mill operation subtype to rough the stock material for the hair dryer core insert. Use a 50mm x 6mm corner radius diameter mill and the Cavity Mill operation subtype to rough the blank stock. Leave 3mm stock overall (from the process planning sheet, this is operation #400.01).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 3 Verify the tool path. Use the verify option to validate the tool path which you just created. Your In-Process model should be similar to the model displayed below.

In-Process model created from the Cavity Mill Operation using the **Toolpath Verify** option

Step 4 Save your part file.

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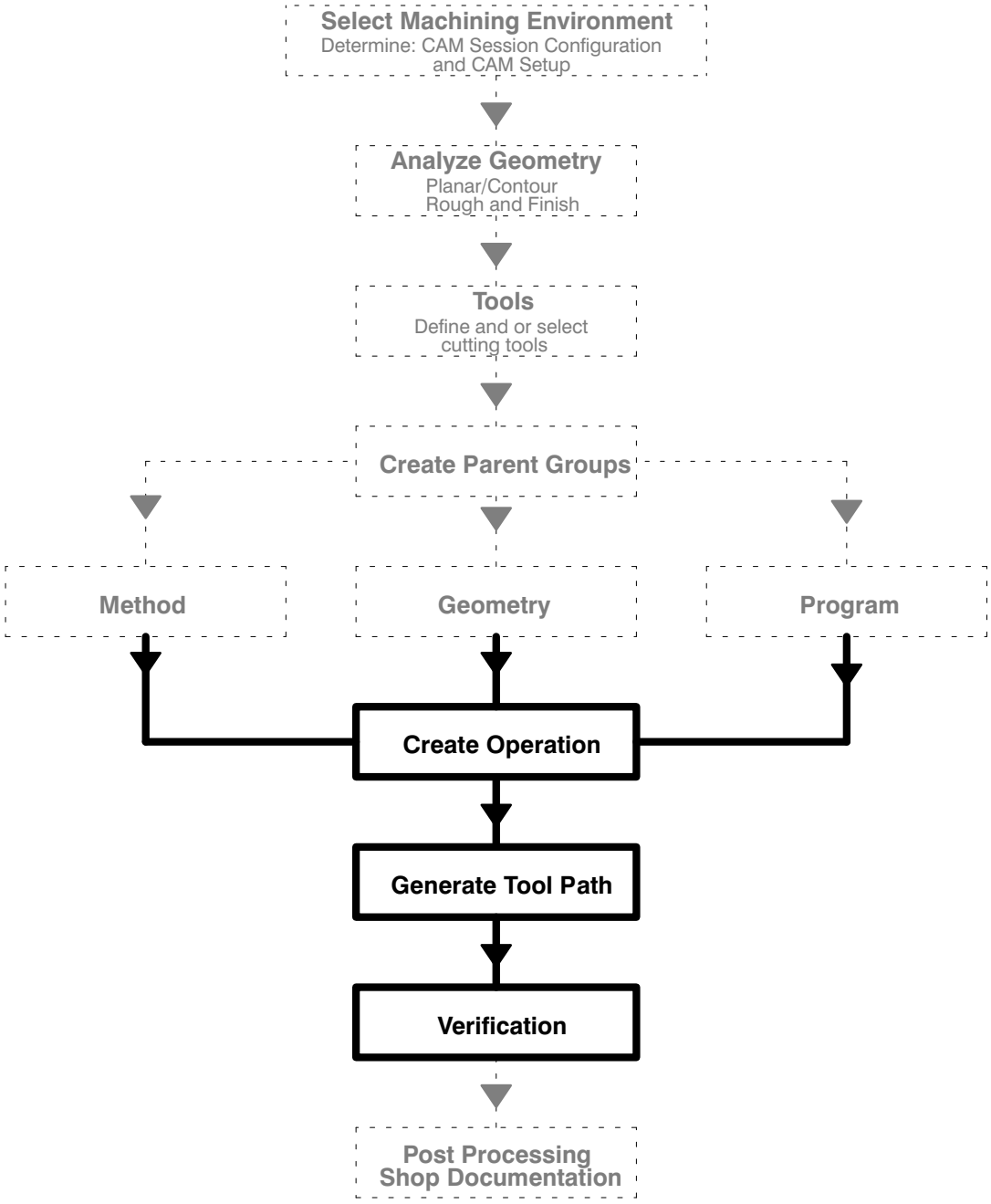
Fixed Contour

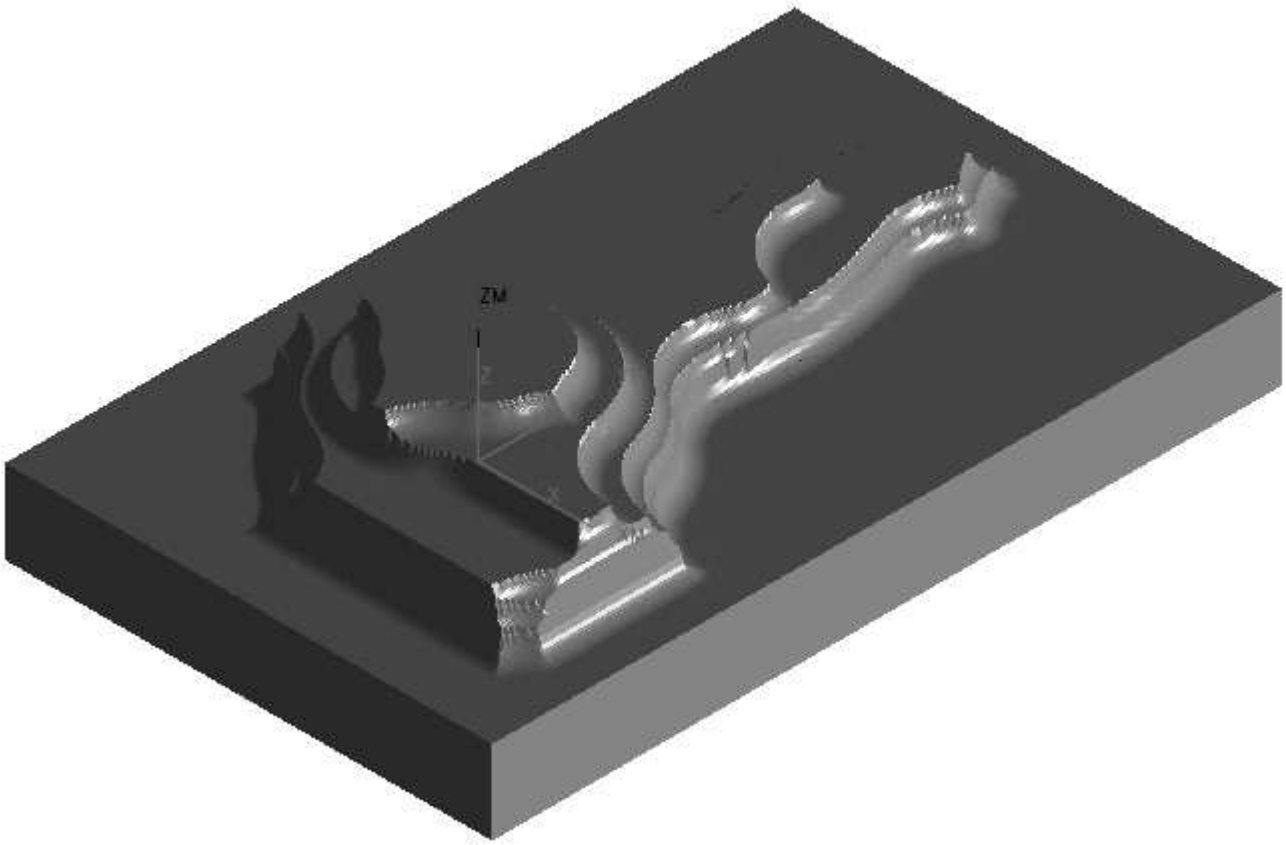
Section 4

Unigraphics Manufacturing Process

Fixed Contour Operation Subtypes



In Process Model from previous Cavity Mill Operation



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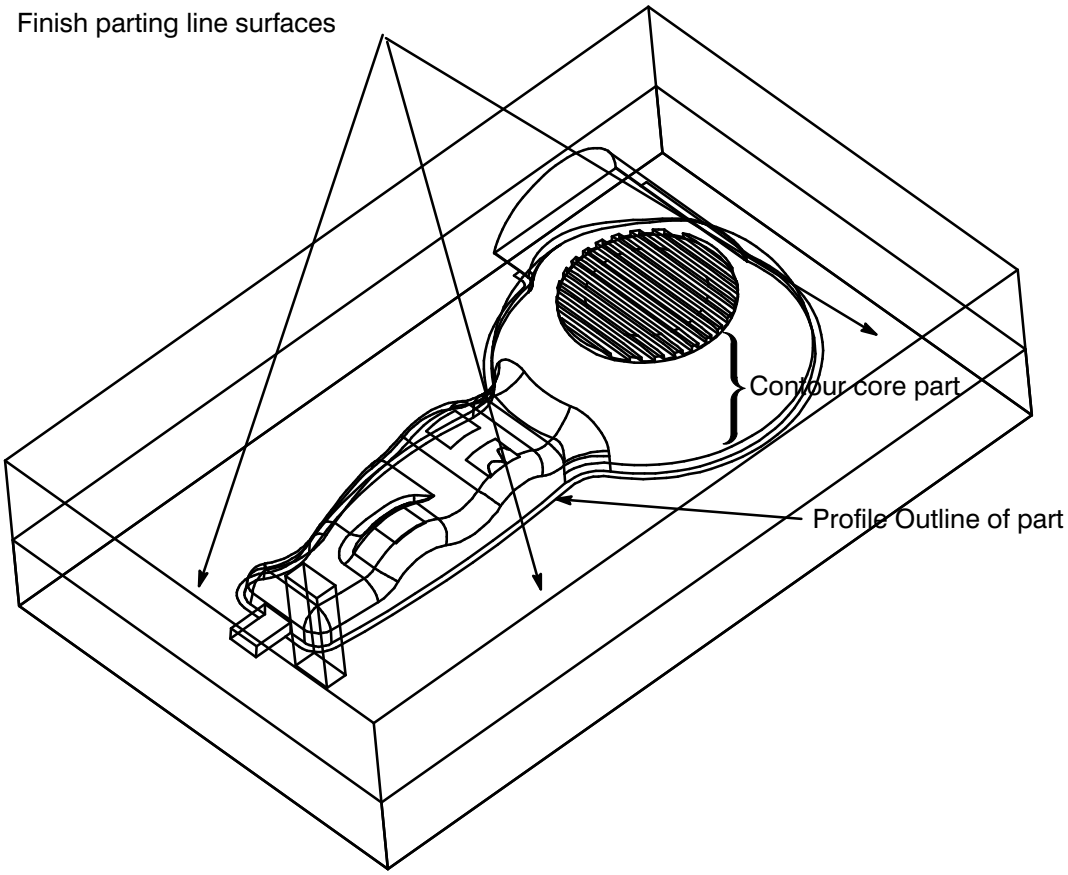
In the previous section of this workbook, you used the Cavity Mill operation subtype to rough machine the block.

In this section of the workbook, you will use the Fixed Contour operation subtype to outline the core shape (Operation #400.02 from the Process Plan), finish the parting line area (Operation #400.03), finish the core shape (Operation #400.04), and finish all uncut areas with various sizes of ball mills (Operation #400.05 thru 400.07).

In subsequent sections you will then use different Fixed Contour operation subtypes to finish the rib area of the hair dryer core insert.

Remember that when you are creating these operations, common options, such as engage and retract parameters, and feeds and speeds must be specified.



Step 1 If necessary, open the part, *****_ama_dryer_core.** Make sure that **wave_core_no_insert** is the Work part.

Step 2 Create a tool path to outline the general shape of the hair dryer core insert. Use a 25mm diameter ball tool and Fixed Contour operation subtype to outline the “core” shape of the hair dryer insert (Operation #400.02 from the processing planning sheet).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 3 Create a tool path to finish the parting line of the hair dryer core insert. Use a 20mm diameter flat end mill and Fixed Contour operation subtype to finish machine the parting line of the hair dryer insert (Operation #400.03).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 4 Create a tool path to finish the entire core shape of the hair dryer core insert. Use a 20mm ball mill and Fixed Contour operation subtype to finish machine the parting line of the hair dryer insert (Operation #400.03). Use the radial cut drive method (experiment with different drive methods).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 5 Verify the tool path**.** Use the verify option to validate the tool paths which you just created.

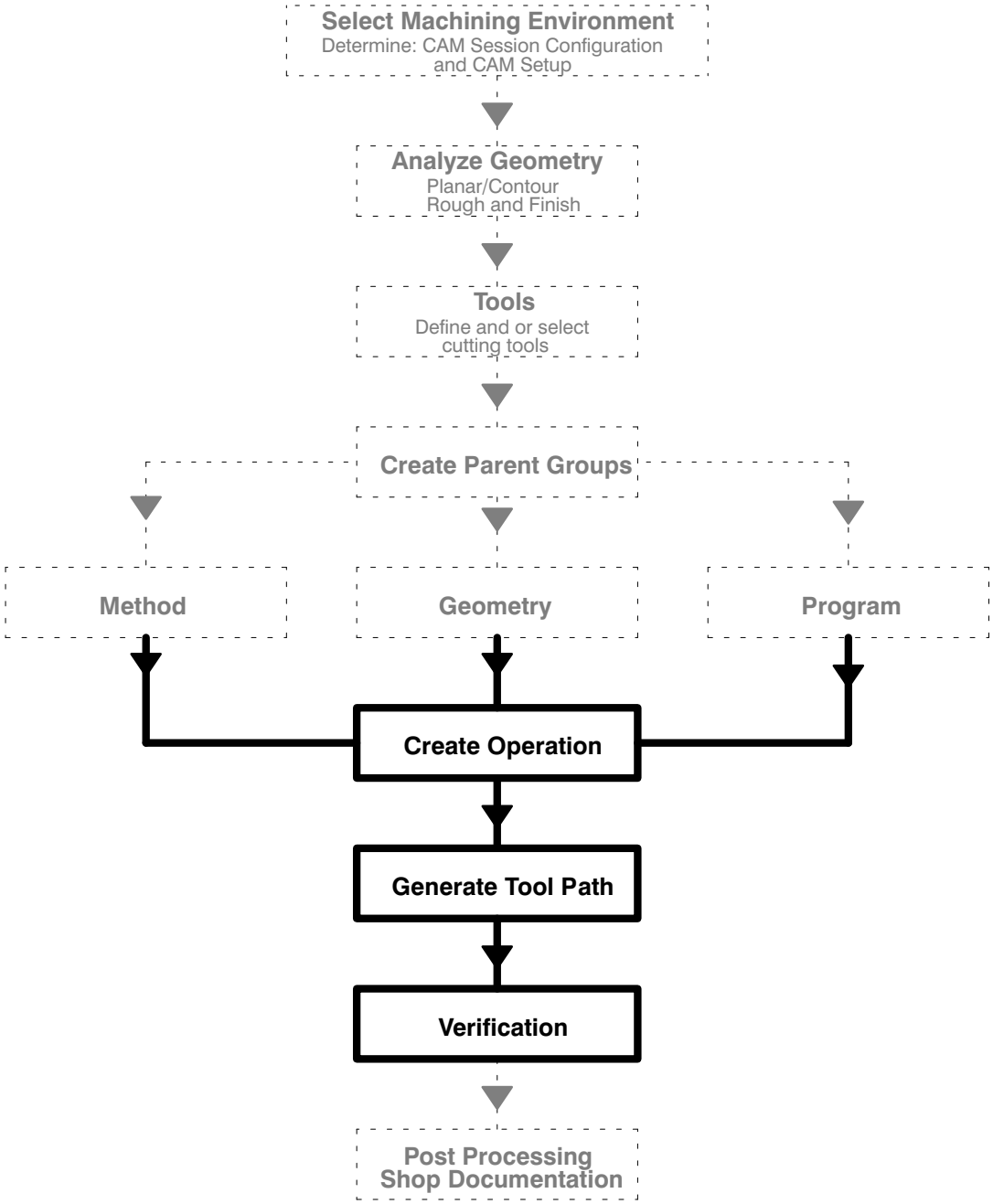
Step 6 Save your part file**.**

Flowcut

Section 5

Unigraphics Manufacturing Process

Fixed Contour Operation Subtypes (Flowcut)

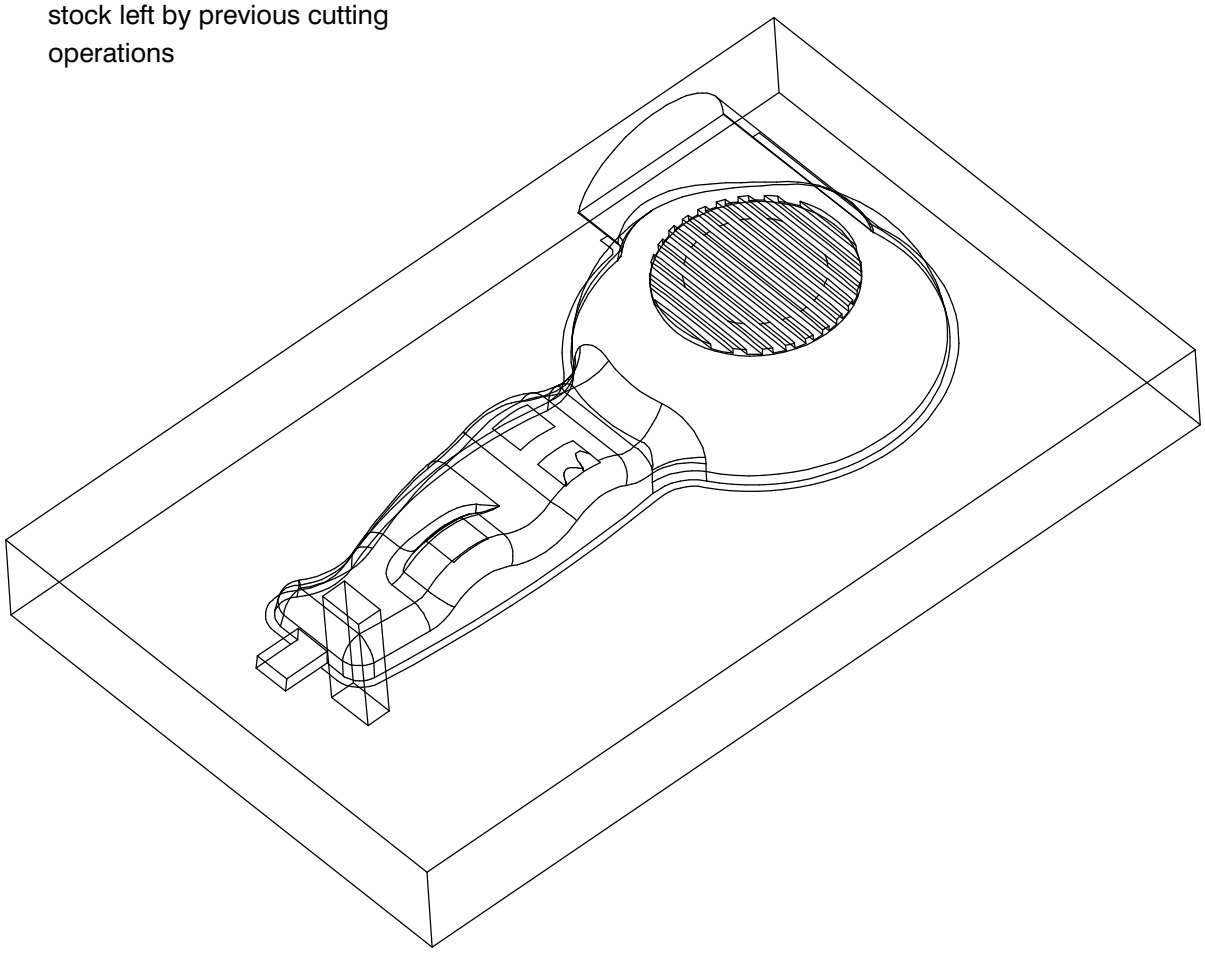


In the previous section of this workbook, you used Fixed Contour operation subtypes to outline the part, finish the parting line surfaces and finish the contour shapes of the hair dryer core insert.

In this section of the workbook, you will use the Fixed Contour operation Flowcut subtypes to remove the material that was left by previous operations (operation # 400.05 thru 400.07 on the Process Planning sheet).

Remember that when you are creating these operations, common options, such as engage and retract parameters, and feeds and speeds must be specified.

Flowcut operations will remove stock left by previous cutting operations



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Step 1 If necessary, open the part, *****_ama_dryer_core.** Make sure that **wave_core_no_insert** is the Work part.

Step 2 Create a tool path to remove stock material left by previous operations. Use an 8mm diameter ball tool and Fixed Contour Flowcut operation subtype to remove additional material left from previous machining operations of the hair dryer insert (operation #400.05 from the Processing Planning sheet).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 3 Create a tool path to remove stock left by previous machining operations. Use a 6mm diameter ball tool and Fixed Contour Flowcut operation subtype to remove additional stock which was left by the 8mm diameter ball tool to finish machine the hair dryer insert (operation #400.06).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 4 Create a tool path to remove stock left by previous operations. Use a 3mm diameter ball tool and Fixed Contour Flowcut operation subtype to remove additional stock which was left by the 8mm and 6mm diameter ball tools to finish the hair dryer insert (operation #400.07).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 5 Verify the tool path. Use the verify option to validate the tool paths which you have just created.

Step 6 Save your part file.

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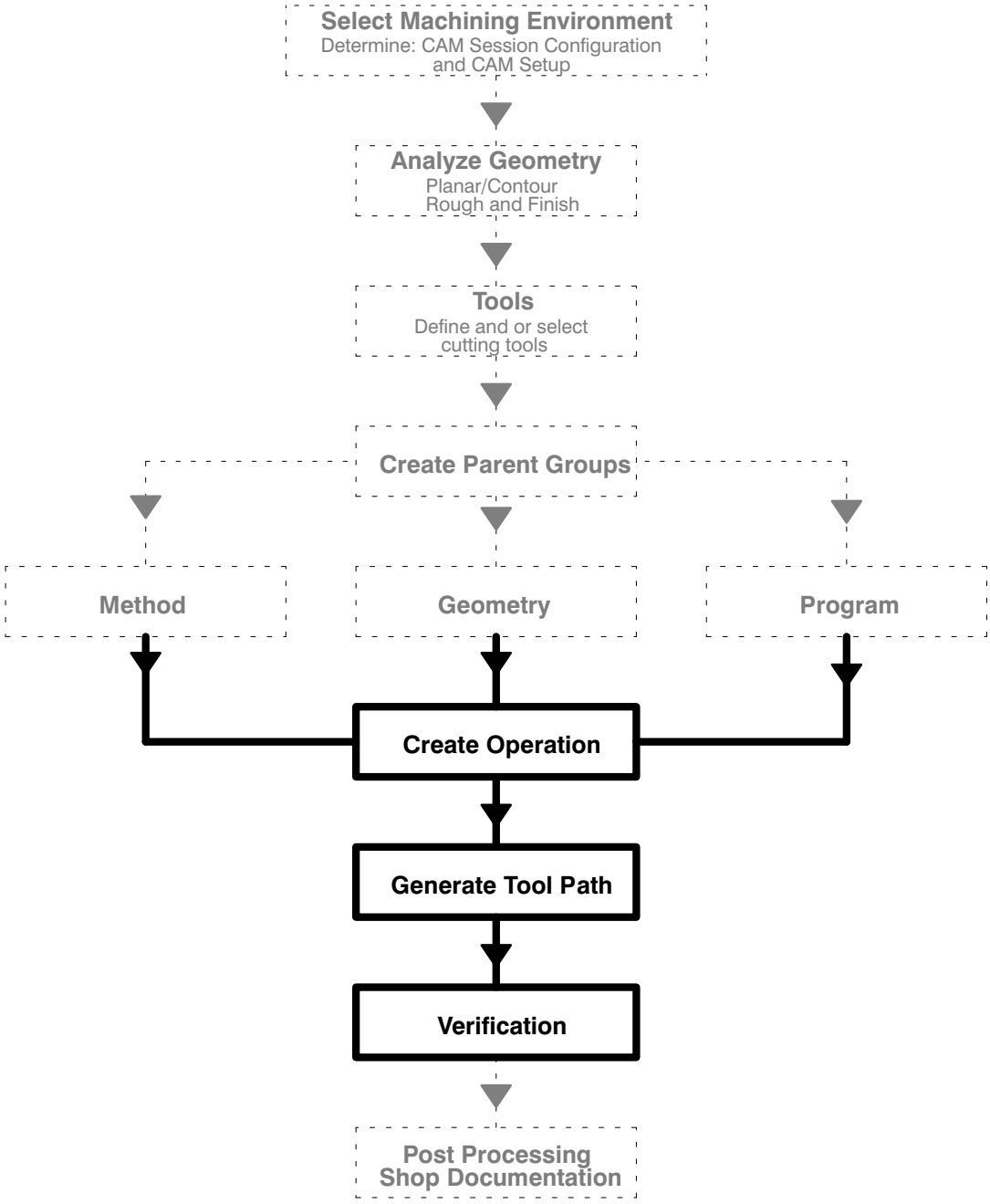
Wire EDM

Section 6

Unigraphics Manufacturing Process

Wire EDM Operation Types



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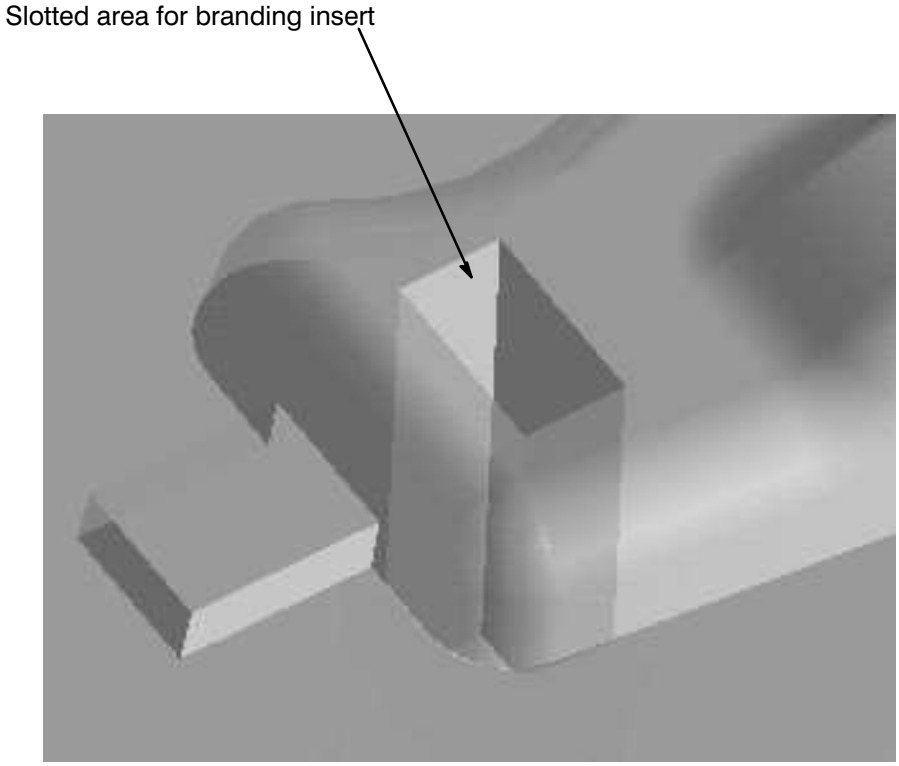
The hair dryer core insert contains a small slotted area on the handle that will contain a machined insert which is used for name branding purposes. This slotted or cored area will be removed by using the wire EDM function within the manufacturing application. Since we do not want a slug formed, which could damage the part or the machine, it is suggested that you use the No Core operation to remove the material (operation #700 on the Process Planning sheet).



Step 1 If necessary, open the part, *****_ama_dryer_core.** Make sure *****_ama_dryer_core** is your Work part.

Step 2 Create a wire EDM operation to remove the material as shown in the diagram above. Use a .2 mm diameter wire and No Core operation subtype (operation #700 from the Processing Planning sheet).

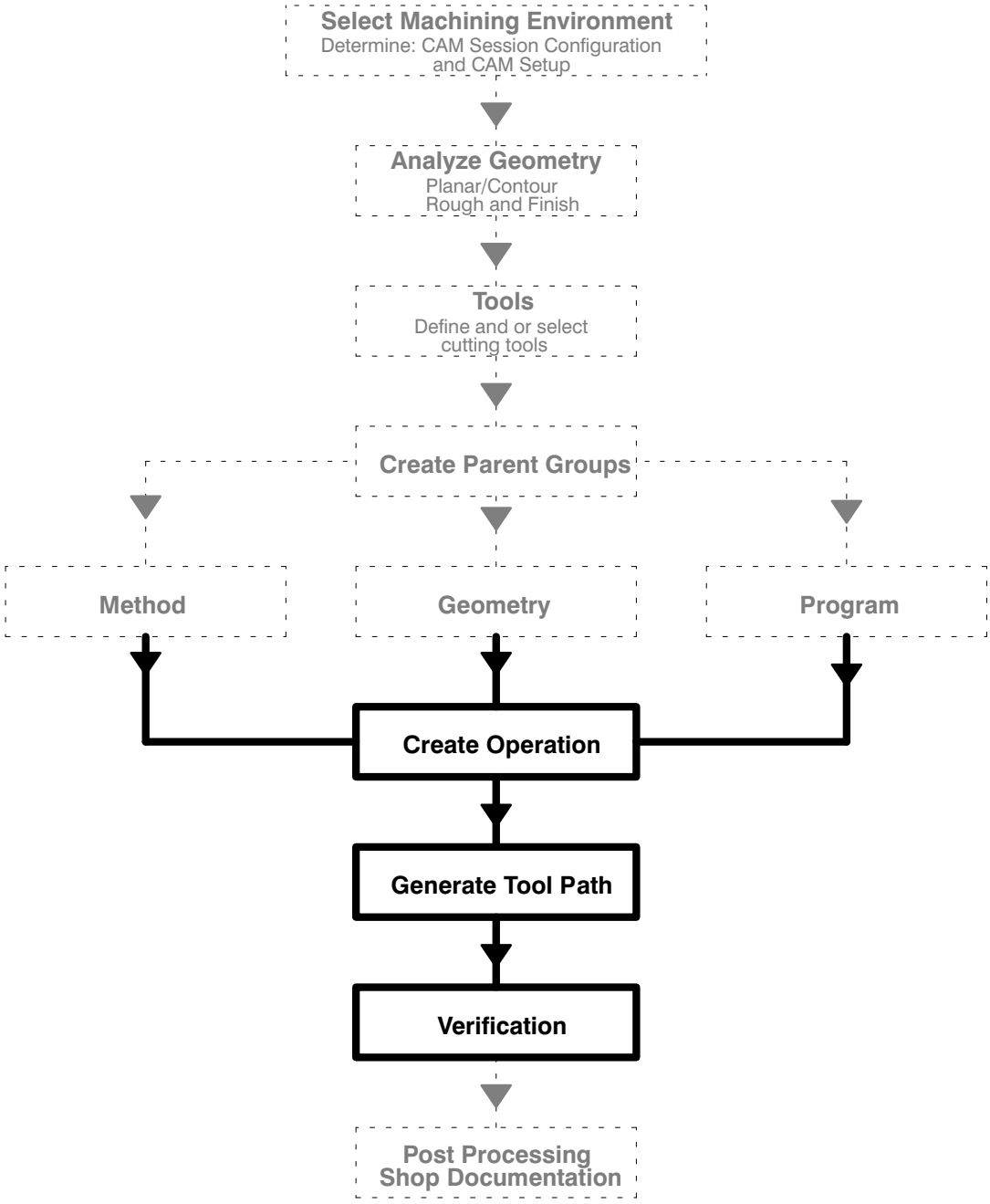
Step 3 Save your part file.

Fixed Contour Finishing

Section 7

Unigraphics Manufacturing Process

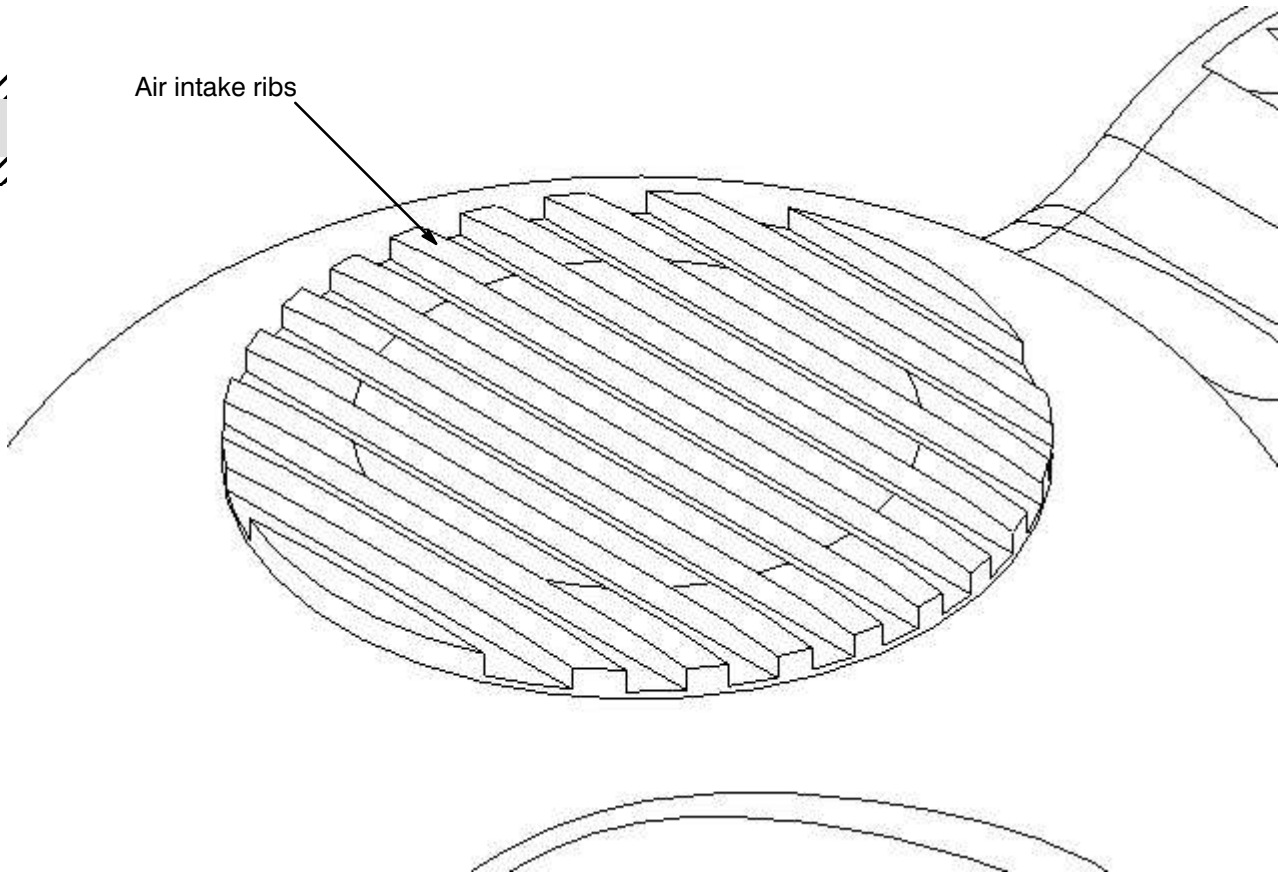
Fixed Contour Operation Types (Finishing)



In the previous sections of this workbook, you machined the hair dryer core insert completely except for the small ribs in the air intake area.

In this section of the workbook, you will use the Fixed Contour operation subtypes to semi-finish and finish the air intake ribs (operation # 400.08 thru 400.09 on the Process Planning sheet).

Remember that when you are creating these operations, common options, such as engage and retract parameters, and feeds and speeds must be specified.



Step 1 If necessary, open the part, *****_ama_dryer_core.**

Step 2 Create a tool path to semi-finish the air intake area. Use a 2mm diameter ball tool and Fixed Contour operation subtype to semi-finish the air intake area (operation #400.08 from the Processing Planning sheet).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 3 Create a tool path to finish the air intake area. Use a 2mm end mill and Fixed Contour operation subtype to finish the air intake area (operation #400.09).

If necessary, set the clearance plane, feeds and speeds, and engage and retract parameters.

Step 4 Verify the tool path. Use the verify option to validate the tool paths which you have just created.

Step 5 Save your part file.

This finishes the workbook project.

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