UNIGRAPHICS

ADVANCED MILL APPLICATIONS

WORKBOOK

January 2004

MT11045 – Unigraphics NX 2

EDS Inc.

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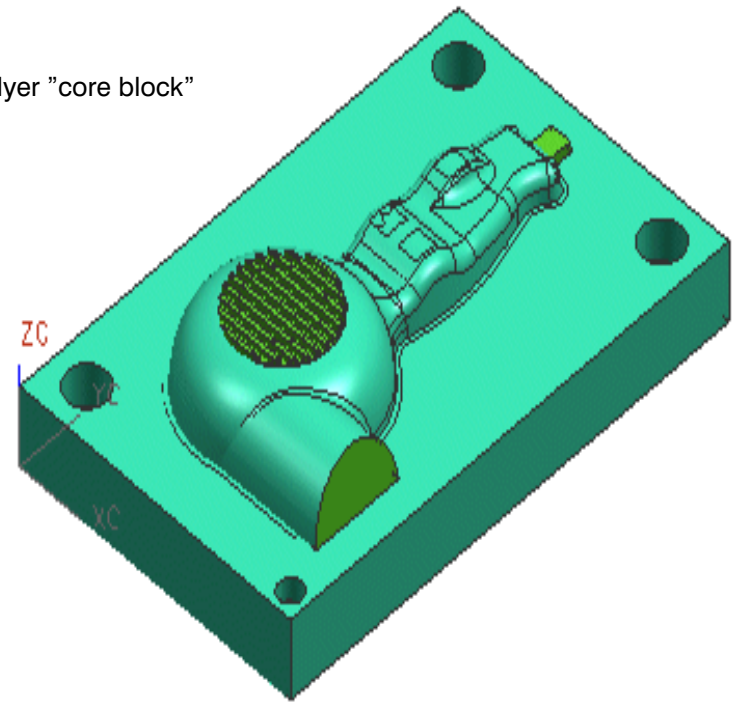
Project Description

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”



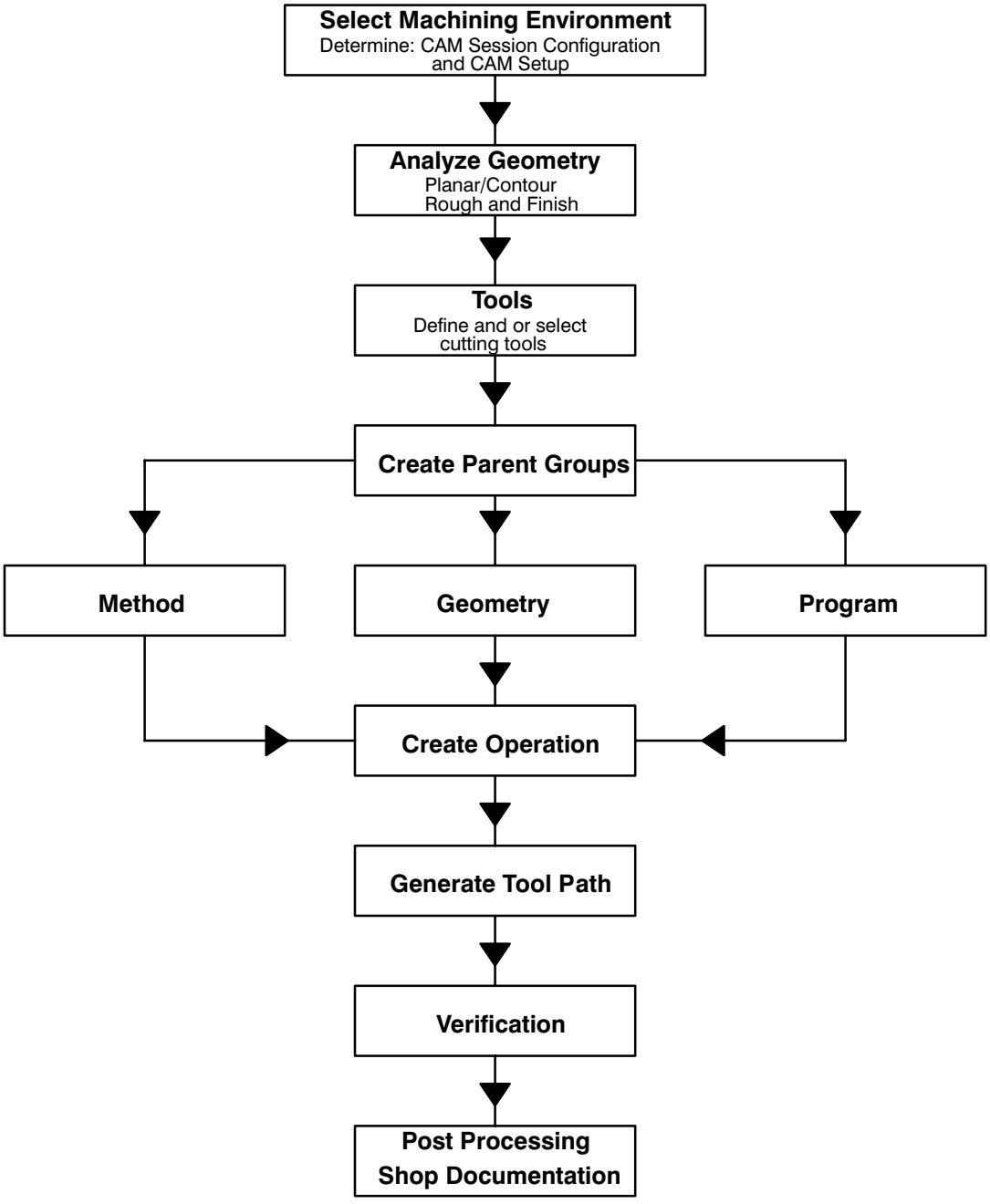
You will begin this project by using the provided Process Plan which will guide you through the various steps required to machine the core block.

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

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, 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 sheet 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 those 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 **NOTE: this operation has been completed**	cav_mill_core	50mm dia. end mill, 6mm corner radius
400.02		Semi-finish core block	cav_mill_semi_finish	20mm end mill
400.03		Finish parting line	fm_finish	20mm 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
400.10		center drill, drill and counterbore, 4 places as shown		
500	**Inspection**	**Inspect all features machined in operation numbers 400.01 thru 400.09**		
600	**Deburr-Clean**	**deburr and clean part per specifications**		

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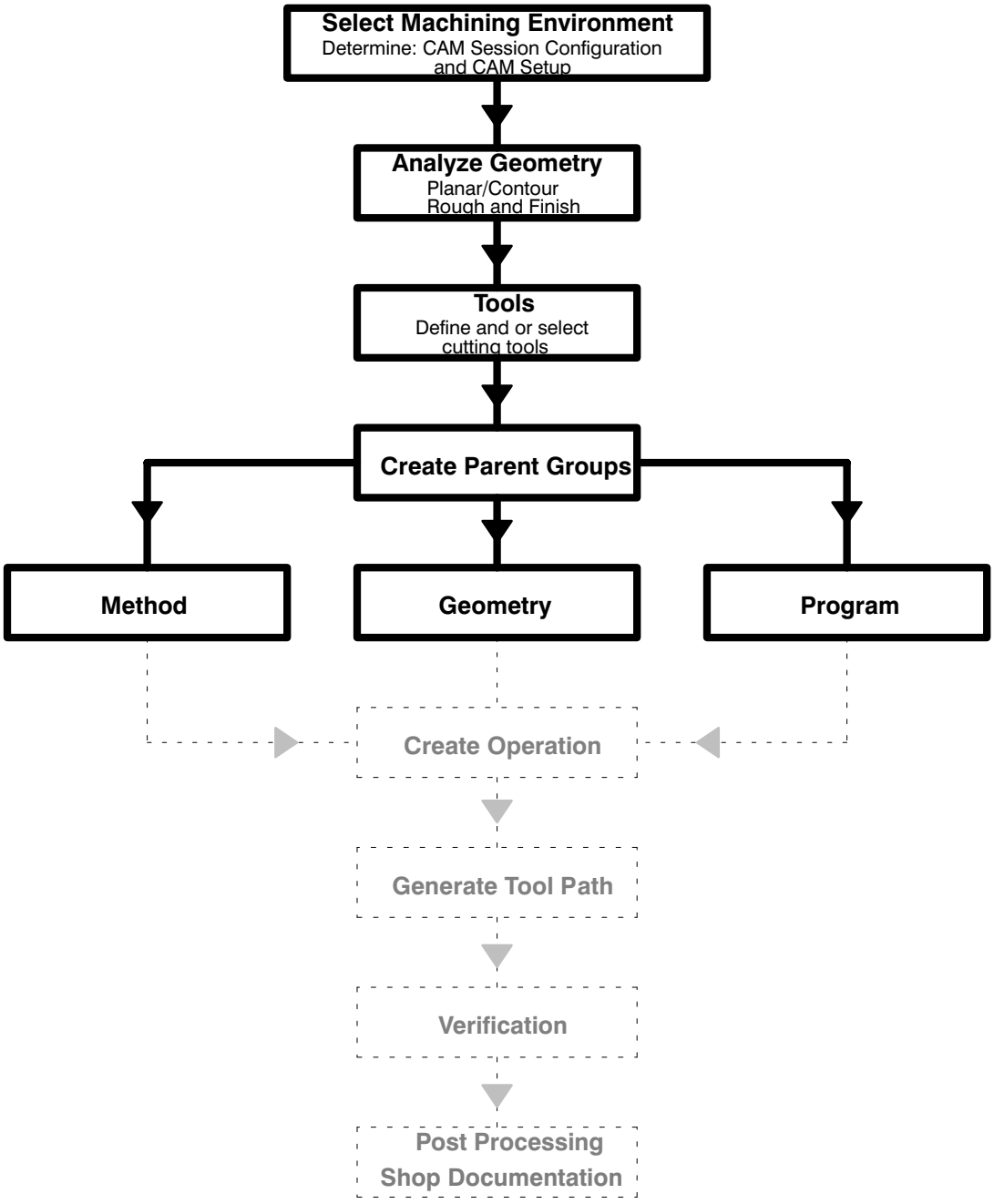
Manufacturing Operation Preparation

Section 2

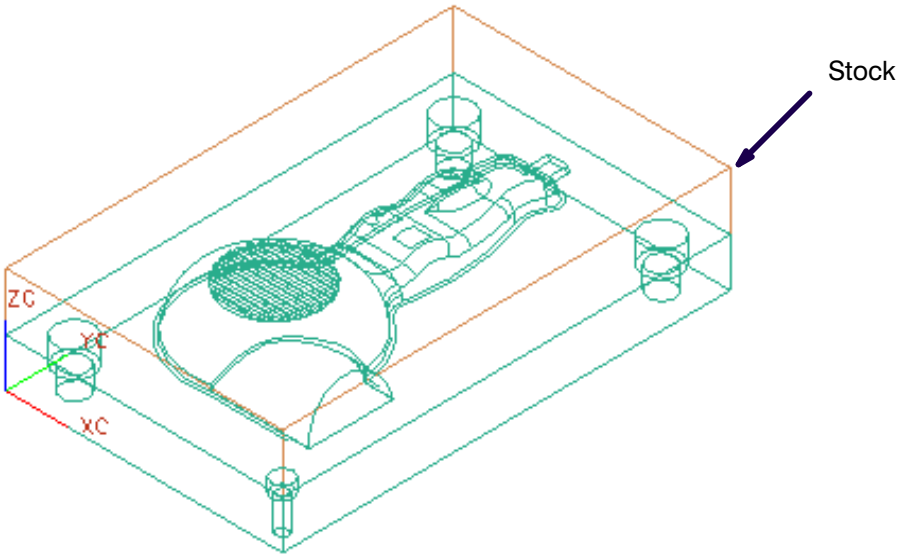
Unigraphics Manufacturing Process

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.

Hair Dryer Core 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_mfg_asmb.prt.** Rename the part to *****_dryer_mfg_asmb.prt** where *** represents your initials. This part is a manufacturing assembly.

Step 2 Identify tools per the **Process Planning Sheet** required to machine the part. The following list of tools, were derived from the **Process Planning Sheet** and have already been created for you.

- **Milling tools:**

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

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

  20mm 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**.

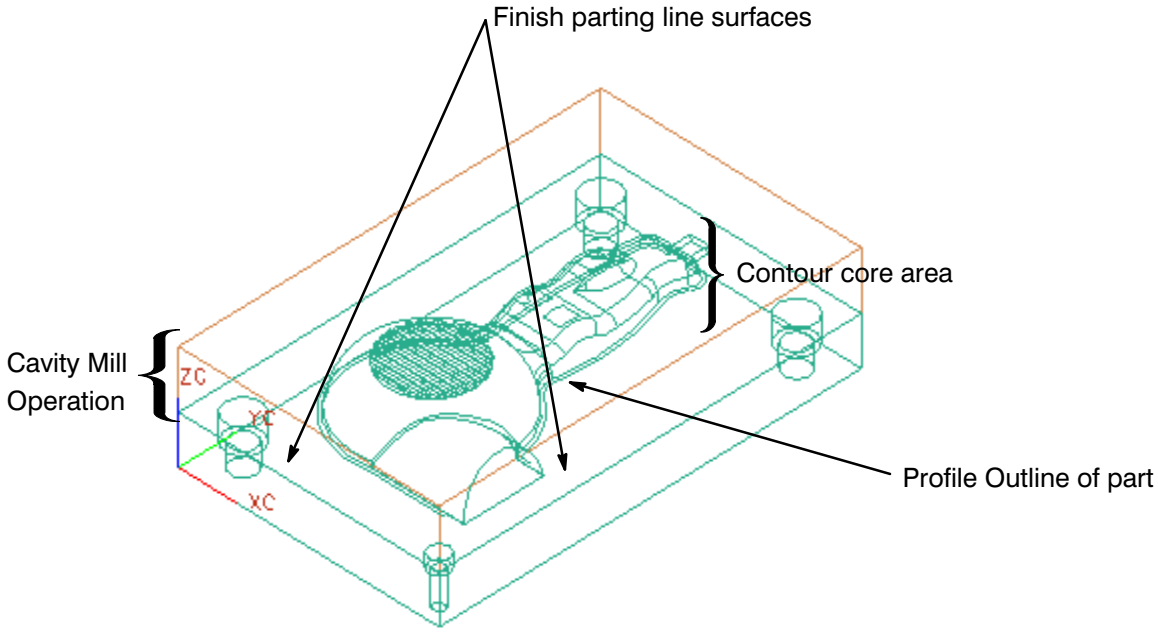
  6mm dia. ball mill, tool library entry **UGT0203_001**.

  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 3 Familiarize yourself with the various geometry groups that have already been established. Geometry parent groups can be identified for cavity milling and contouring operations.



Step 4 Examine the various **Method** parent groups. Methods are based 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 5 Observe that the **PROGRAM** parent group object contains the group object, **SIDE-1-ROUGHING**, that performs the first roughing operation. You will be adding additional group objects throughout the workbook project. The use of meaningful names aids in the structuring of the program and the creation of shop documentation.

Creating and or assigning parent group objects eases the burden of programming by allowing the collection of “objects” and the assignment of parameters and or options that are common to those objects (referred to as inheritance).

Step 6 Add an additional program group object, named **SIDE-1-FINISHING** that will hold all of the finishing operations.

Step 7 Save the assembly**.**

The assembly part file that you have created is located in a different directory than the components (part and stock) that were used. You will need to set your load options for proper loading of the components the next time that you retrieve the assembly.

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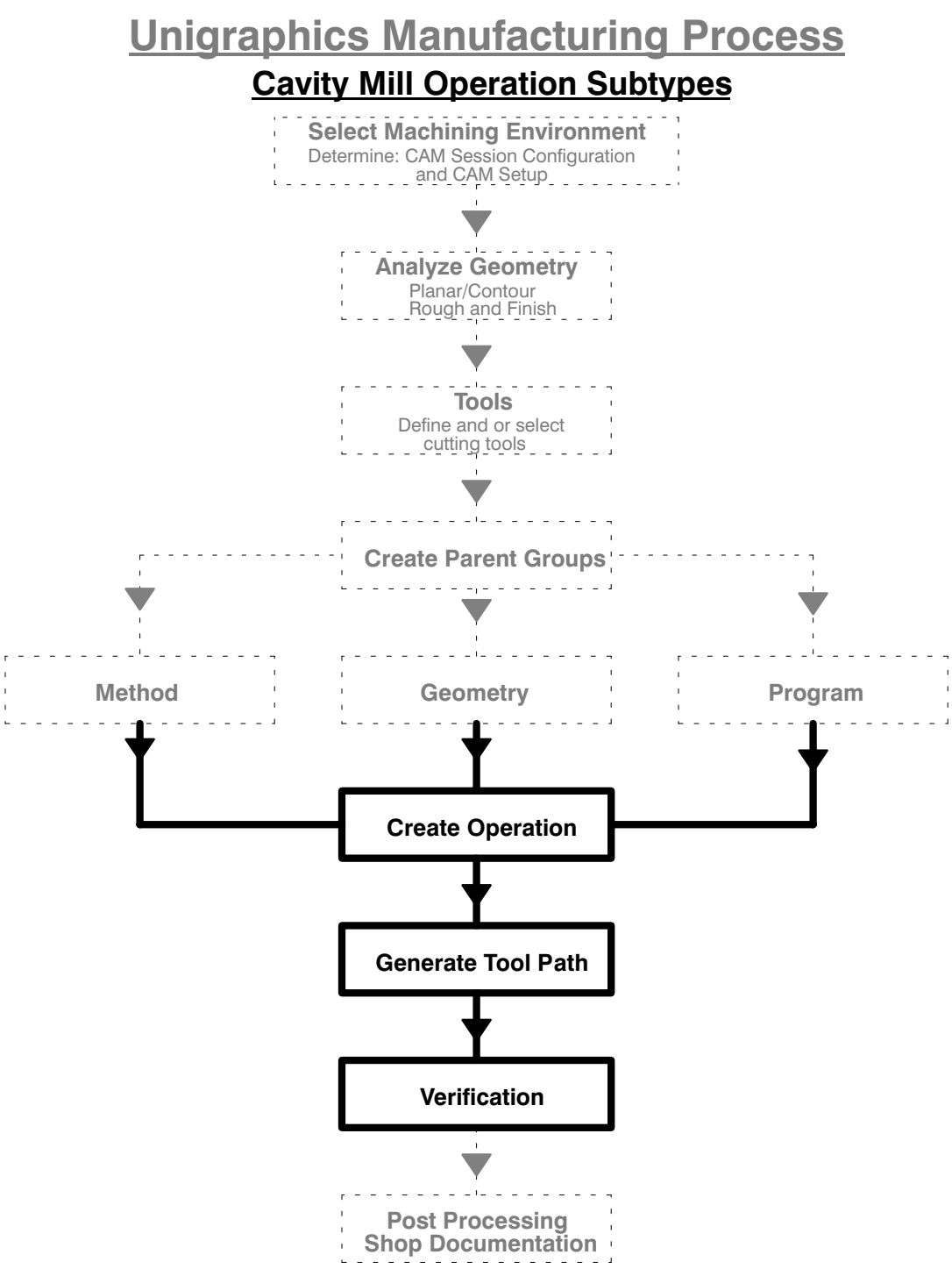
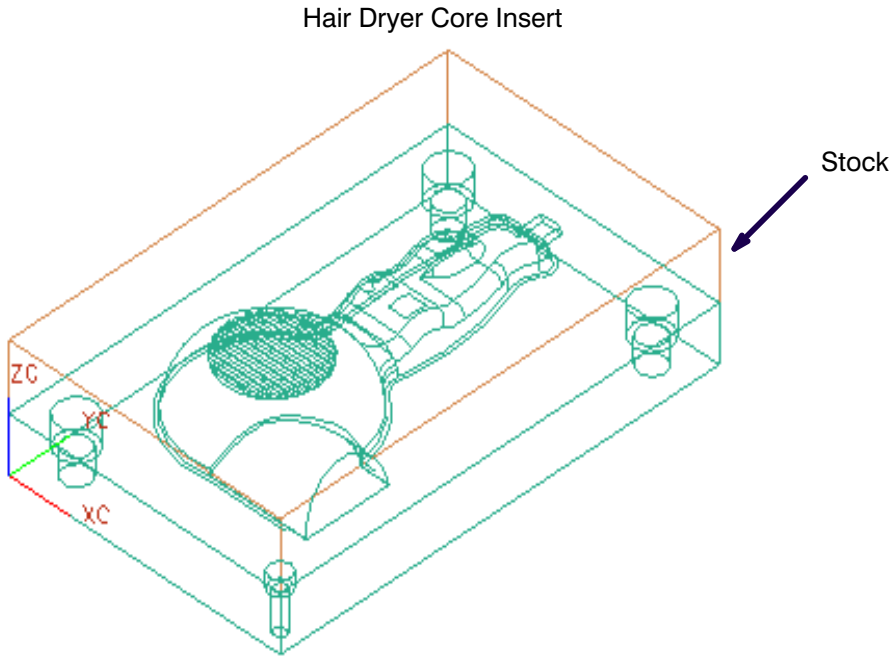
Cavity Milling

Section 3



3

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 and Fixed Contour types and operation subtypes that you have learned in the Advanced Mill Applications class.



There is one Cavity Milling, six Z-Level and eleven 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 semi-finish the stock for the hair dryer core insert utilizing the IPW (In-Process Work Piece) from the first operation (**CM_INITIAL-ROUGH**) that has already been done for you.

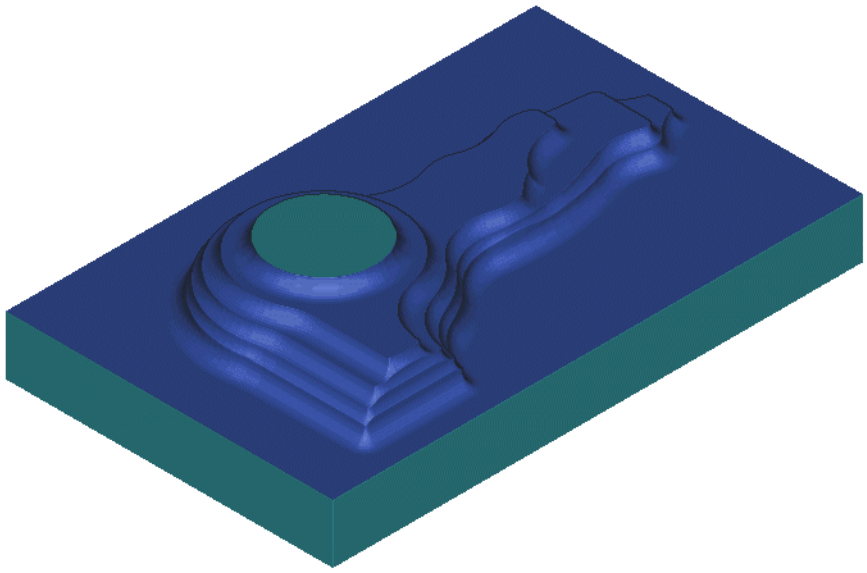
In subsequent sections you will use various Fixed Contour operation subtypes to finish the various contour shapes of the hair dryer core insert.

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_mfg_asmb.prt.**

Step 2 The roughing operation (**CM-INITIAL-ROUGH**), used a 50mm x 6mm corner radius diameter mill and the Cavity Mill operation subtype to rough the blank stock, Leaving 3mm stock overall (from the process planning sheet, this is operation #400.01).

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



Step 4 Semi-Finish the core block using the IPW from the first operation, using the 20mm end mill tool. Use a cut depth of 3mm and set the bottom of the range to prevent the tool from dropping into any of the counterbored holes. Remember to activate the IPW in the cutting dialog of the Cavity Mill operation.

Step 5 Verify the results.

Step 6 Save your part file.

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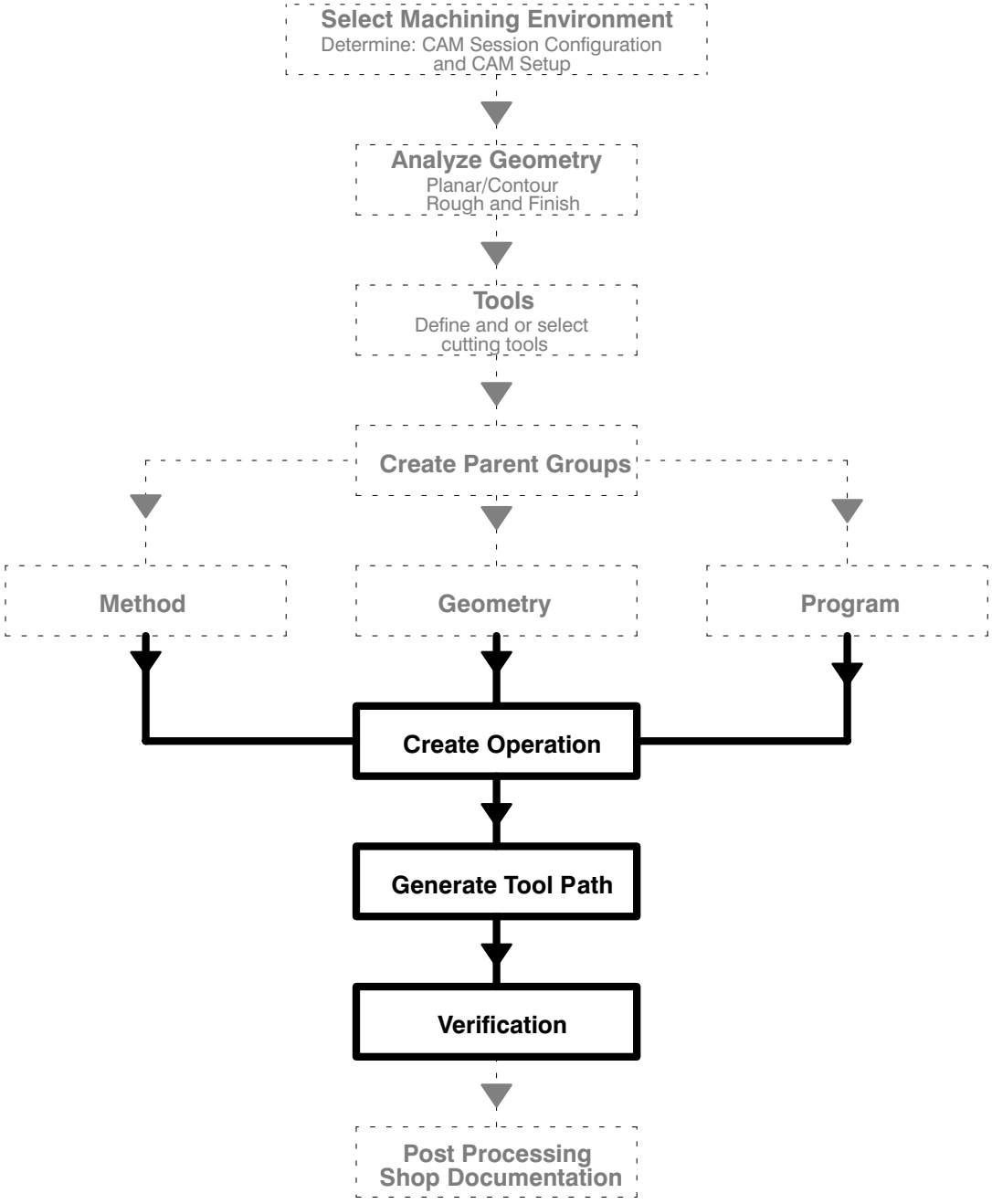
Fixed Contour

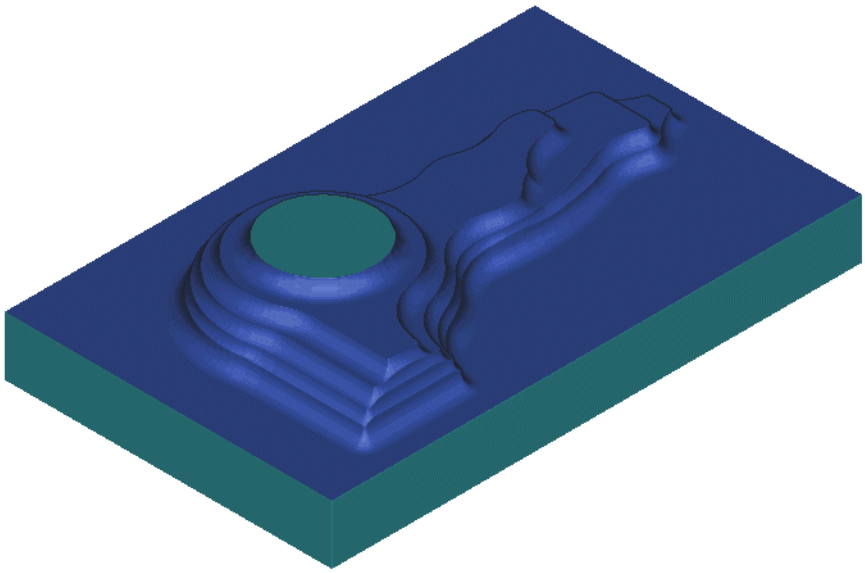
Section 4

Unigraphics Manufacturing Process

Fixed Contour Operation Subtypes



In Process Model from previous Cavity Mill Operation

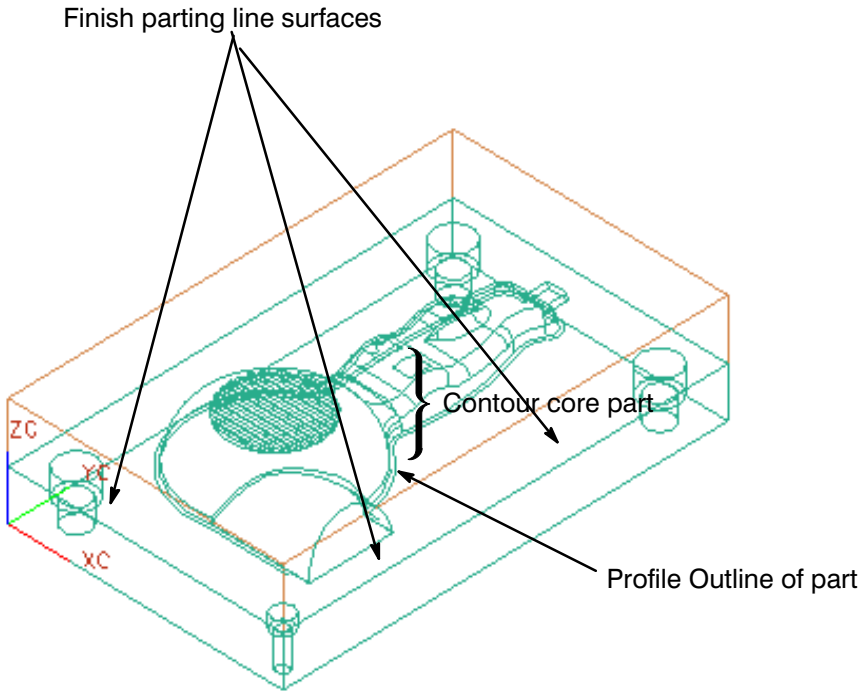


In the previous section of this workbook, you used the **Cavity Mill** operation subtype to rough machine the block.

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_mfg_asmb**.

Review the various settings of the clearance plane and the location of the MCS.

Step 2 Create a tool path to finish the parting line of the hair dryer core insert. Use a 20mm diameter flat end mill and Face Milling operation subtype to finish machine the parting line of the hair dryer insert (Operation #400.03).

If necessary, set feeds and speeds, and engage and retract parameters.

Step 3 Create a tool path to finish the entire core shape of the hair dryer core insert. Use a 20mm ball mill and Mill Contour operation type to finish machine the contoured area of the hair dryer insert (Operation #400.04).

Use the Contour_Area subtype and use follow periphery with scallop height stepover set to **On Part**.

Turn on the clearance plane in the **Non-Cutting Moves** dialog for both the **Approach** and **Departure** moves.

Hint: Create a Mill_Area of just the contoured faces and omit the faces located in the grill area of the part.

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

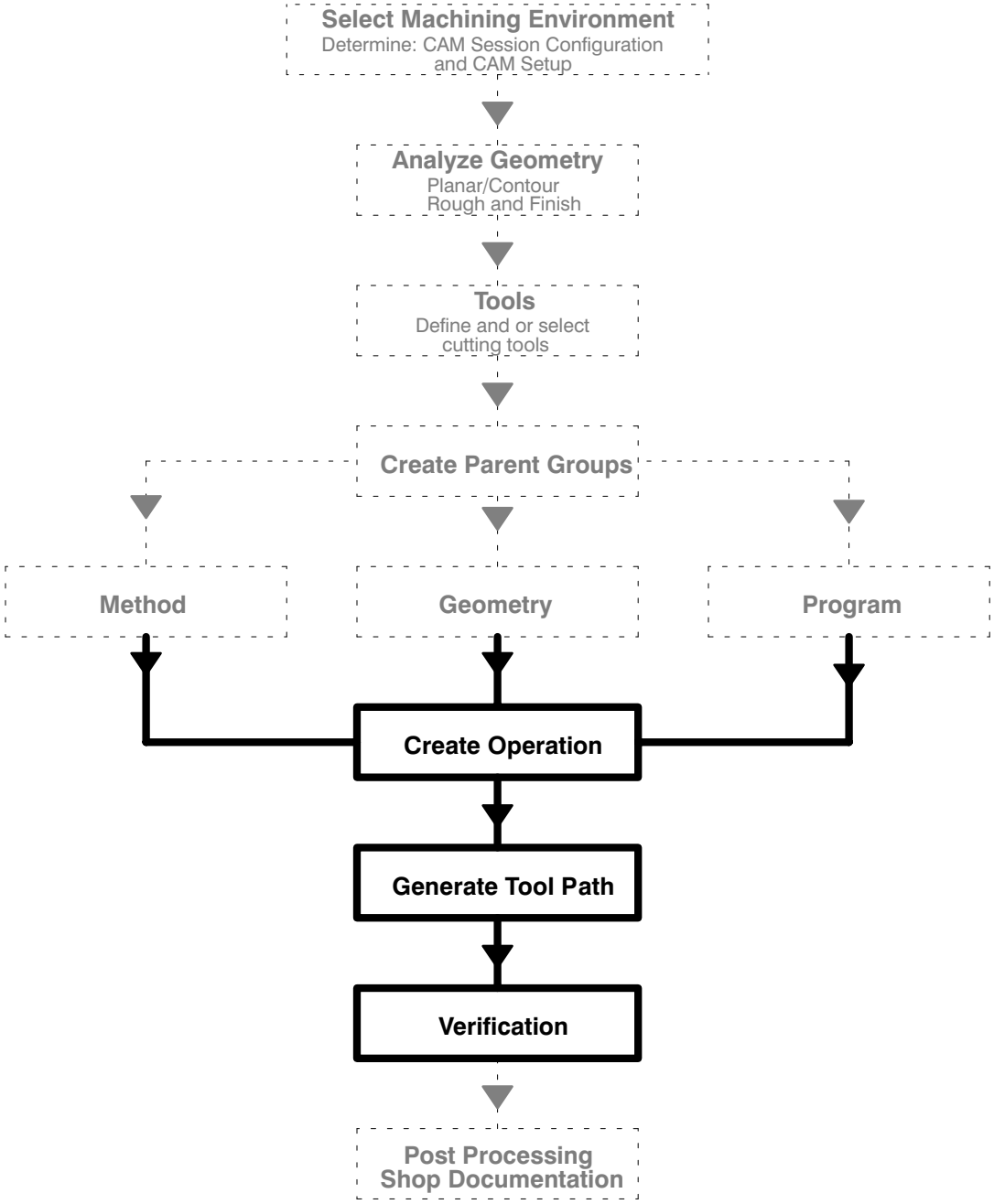
Step 5 Save your part file**.**

Flowcut

Section 5

Unigraphics Manufacturing Process

Fixed Contour Operation Subtypes (Flowcut)

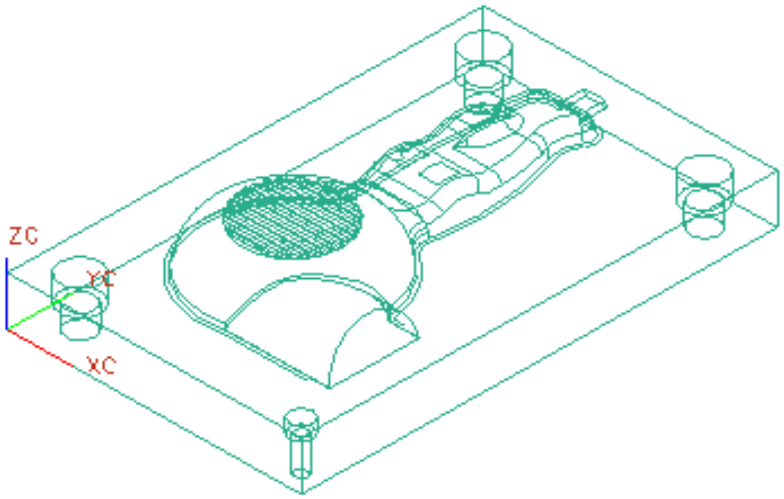


In the previous section of this workbook, you used the **mill_planar** type and chose the **FACE_MILL** operation subtype to finish the parting line face. Changing the type to **mill_contour**, allowed the use of the **Contour_Area** subtype to finish the contoured areas of the dryer with ball nose tools.

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



Step 1 If necessary, open the part *****_ama_dryer_mfg_asmb.prt.**

Step 2 Create a tool path to remove stock material left by previous operations. Use an 8mm diameter ball tool and Flowcut Reference Tool 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 Flowcut Reference Tool 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 Flowcut Reference Tool 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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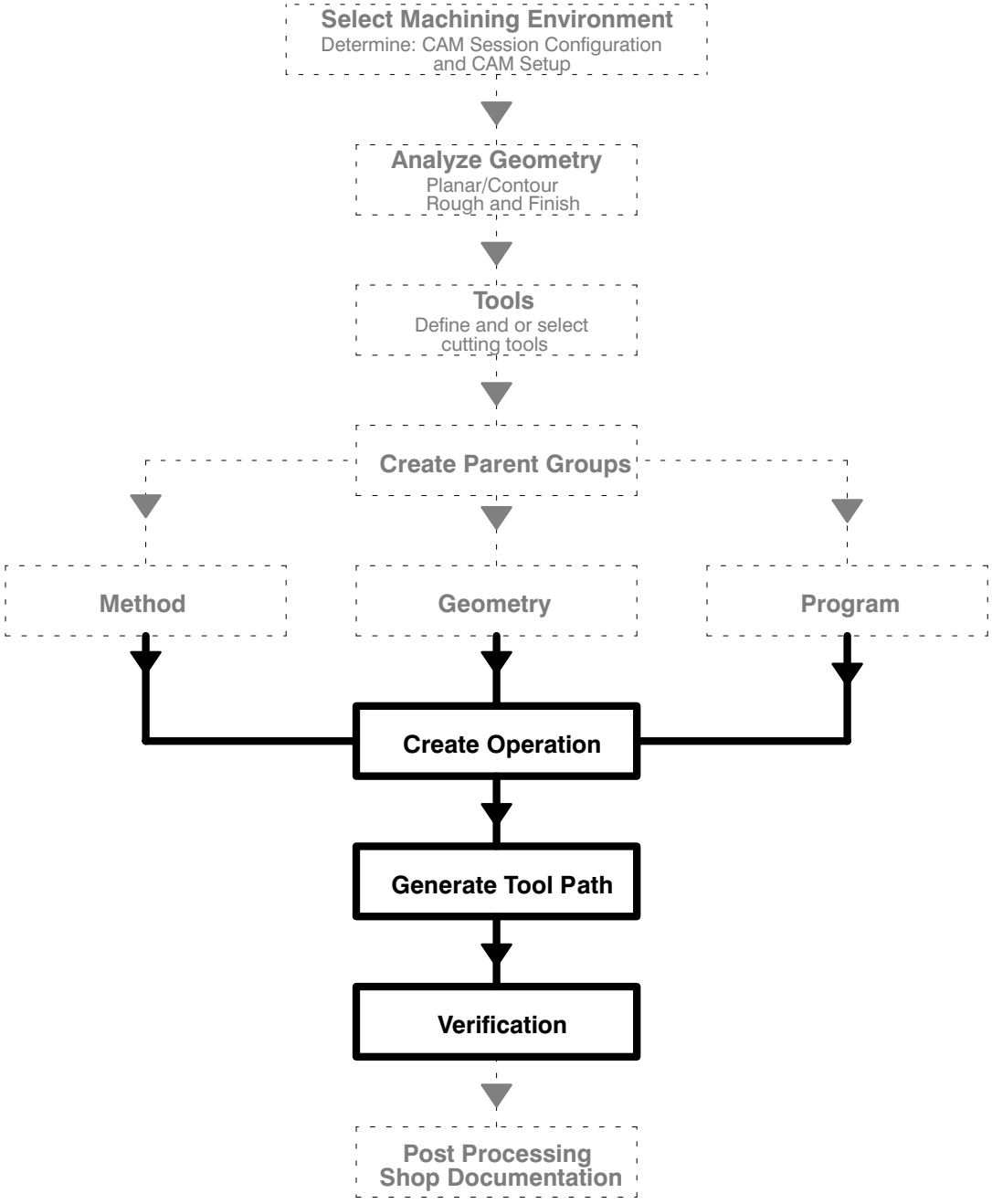
Fixed Contour Finishing

Section 6

6

Unigraphics Manufacturing Process

Fixed Contour Operation Types (Finishing)

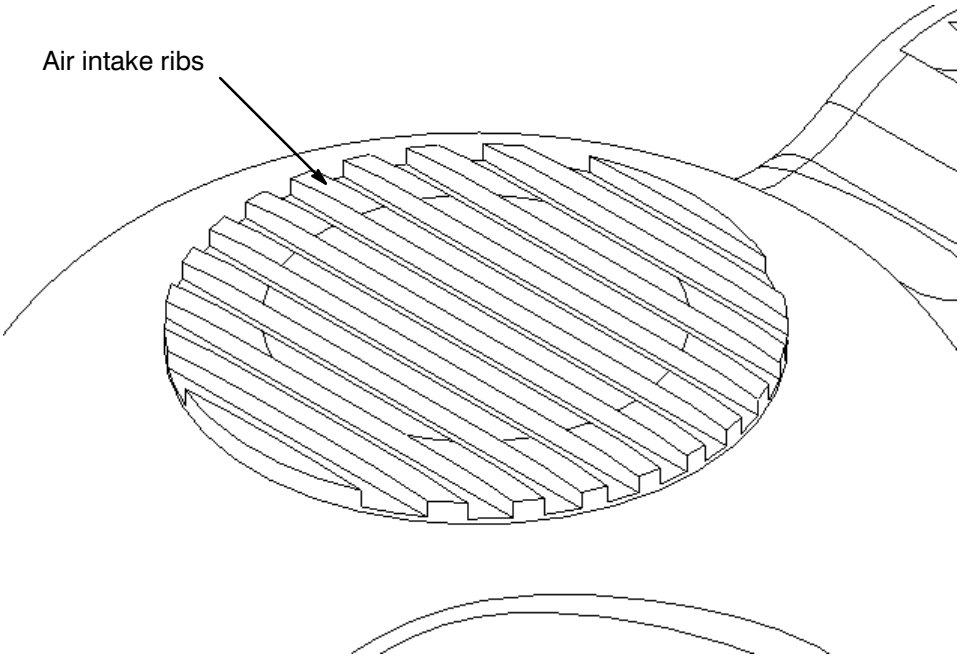


6

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 **CONTOUR_AREA** operation subtypes to semi-finish and finish the tops of the air intake ribs (operation # 400.08 thru 400.09 on the Process Planning sheet). The **FACE_MILL** subtype may be used for the valley between the ribs.

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_mfg_asmb.**

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 feeds and speeds, and engage and retract parameters.

Step 4 Create a tool path to finish the area between the air intake ribs. Use a 2mm end mill using the **FACE_MILL** operation type to finish.

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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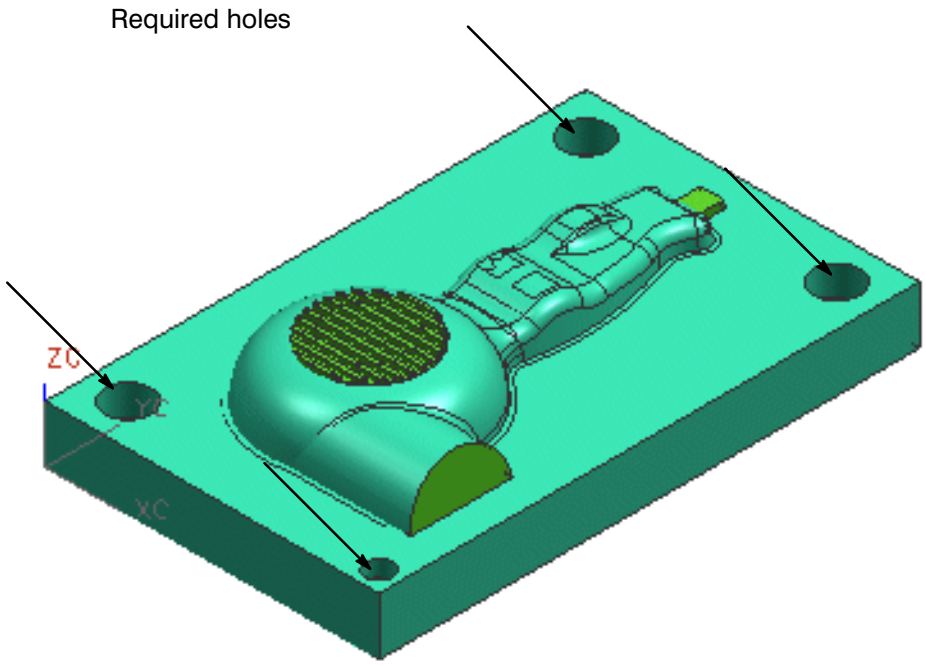
Hole Making

Section 7

In this section of the workbook, you will use the **HOLE_MAKING** subtype to generate operations necessary for the machining of the four counterbored holes.



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

Step 2 Change to the Geometry View in the Operation Navigator, edit the Workpiece group object and change the material to UNOBTAINIUM.

Step 3 Create the geometry information required to place the four counterbored holes in the core of the hair dryer. Tools are selected automatically by the Hole Making subtype.

Step 4 Select the Program view of the Operation Navigator and move the newly generated Hole Making operations into the program parent group below the **CM-INITIAL-ROUGH** and **SIDE-1-FINISHING** programs.

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.

This finishes the workbook project.