A. Machine Type and Stock Setup.

Step 1. If necessary, open your file from Chapter 3.

Step 2. If necessary, display Toolpaths Manager. On the View tab, click (Alt-O).

Step 3. If Machine Group is not displayed in the Toolpaths Manager, Fig. 1 on the Machine tab, click Mill > Default from the menu.

Step 4. Expand Properties (click +) in Toolpaths Manager and click Stock setup in Toolpaths Manager, Fig. 1.

Step 5. Confirm Stock Plane is Bottom Cut, Fig. 2.

Step 6. Confirm Display check box is checked.

Step 7. Click top left corner of the red stock to move the Origin. After you click corner the arrow will point to corner.

Step 8. Key-in X, Y and Z stock dimension:

- X 305
- Y 42
- Z 70

Step 9. Key-in Stock Origin coordinates:

- X 0
- Y -21
- Z 0

Step 10. Click OK in the Machine Group Properties.
B. Confirm WCS BOTTOM CUT.
Step 1. The Stock is displayed as red wireframe, Fig. 3.

Step 2. In Status bar at bottom of display, confirm CPLANE:BOTTOM CUT, Fig. 3.

Step 3. Confirm **Bottom Cut Origin**. Use F9 to toggle axes.

C. REAR SHELL Rough Area Roughing Toolpath.
Step 1. On the Toolpaths tab in the 3D group click **expand gallery** button and click **Area Roughing**, Fig. 4.
Step 2. Select Model Geometry from the tree control and set:

Under Machining Geometry click Select entities button Fig. 5.

Step 3. Triple click the solid car body to select as machine geometry and click End Selection (ENTER), Fig. 6.

Step 4. Back in Model Geometry page set:

Wall Stock  1
Floor Stock  1
To set, double click and key-in. Fig. 7.
Step 5. Select Toolpath Control from the tree control and set:

Click Containment Boundaries button Fig. 8.

Step 6. Select Solids in the Chaining dialog box, Fig. 9.

Step 7. Under Selection Method in the Chaining dialog box, click Loop and unselect all others.

Step 8. Click edge of rear wheel shell, Fig. 10. If you select the wrong edge, click Unselect.

Step 9. Click OK in Pick Reference Face dialog box. If the wrong face is selected, click Other face in Pick Reference Face dialog box, Fig. 11.

Step 10. Click the OK in the Chaining dialog box.
Step 11. Back in Toolpath Control page:

1. Confirm 1 Boundary chain
2. Compensate to Inside
3. Uncheck Include tool radius

![Fig. 12](image)

Step 12. Select Tool from the tree control and:

1. Click Select library tool button

![Fig. 13](image)
Step 13. Click the Filter button (Fig. 14).

Step 14. Click None button under Tool Types (Fig. 15).

Step 15. Click Endmill2 Sphere button (second button top row) and click OK (Fig. 15).

Step 16. Select BALL-NOSE ENDMILL 6.0 mm Diameter and click OK (Fig. 16).
Step 17. Back in Tool page set:

**Feed rate 300**

**Plunge rate 200**

Fig. 17.

Step 18. Select **Cut Parameters** from tree control and set:

**Cutting method Climb**

**Stepdown 12.5**

**Keep tool down within % of tool diameter 500**

**XY stepover 50%**

**Minimum 2**

**Maximum 3**

Fig. 18.
Step 19. Select **Trochoidal motion** from tree control and set:

- **Minimize burial**  
  Fig. 19.

Step 20. Select **Transitions** from tree control and set:

- **Entry helix**  
  Radius 3  
  Fig. 20.
Step 21. Select Steep/Shallow from tree control and set:

- Check Minimum depth -9
- Check Maximum depth -35

Click Apply

Fig. 21.

Step 22. Select Linking Parameters from tree control and set:

- Clearance plane 0
- Select Minimum Vertical Retract
- Part clearance 0
- All Leads 0

Fig. 22.

Step 23. Click OK in Area Roughing dialog box.


Step 25. Save (Ctrl-S).
**D. Verify REAR SHELL Rough Area Roughing.**

Step 1. Use Alt-T to toggle on toolpath display, Fig. 23.

Step 2. Click Verify in the Toolpaths Manager, Fig. 24.

Step 3. We like to uncheck Wireframe in the Visibility group on the Home tab, Fig. 25.

Step 4. Click Play (R) in playback bar along bottom of the window, Fig. 26.

Step 5. Note Total Time to run program under Toolpath Info in Move List panel (8min 48.90s), Fig. 28.

Step 6. Switch back to Mastercam (Alt-Tab).
E. FRONT SHELL Area Roughing Surface Toolpath.

Step 1. Use Alt-T to toggle off toolpath display.

Step 2. Copy Roughing toolpath in the Toolpaths Manager. To copy, click to select toolpath, Fig. 29. Then, use Ctrl-C and Ctrl-V, Fig. 30.

Step 3. Expand copied 2-Surface High Speed toolpath and click Parameters, Fig. 30.

Step 4. Select Toolpath Control from tree control and set:

Click Remove selected containment boundaries button

Click Containment Boundaries button Fig. 31.
Step 5. Select **Solids** in the Chaining dialog box, Fig. 32.

Step 6. Under Selection Method in the Chaining dialog box, click **Loop** and unselect all others.

Step 7. Click **edge of front wheel shell**, Fig. 33.

Step 8. Click OK in Pick Reference Face dialog box. If the wrong face is selected, click **Other face** in Pick Reference Face dialog box, Fig. 34.

Step 9. Click the OK in the Chaining dialog box.

Step 10. Click OK in Area Roughing dialog box.

Step 11. In the Toolpaths Manager, click **Regenerate all selected operations**, Fig. 35.

Step 12. Click the **Toolpath Group-1** in the Toolpaths Manager to select both toolpaths, Fig. 36.

Step 13. Use **Alt-T** to toggle toolpath display.

Step 14. Save (Ctrl-S).
F. BOTH SHELLS Finish Raster Toolpath.

Step 1. Use Alt-T to toggle off toolpath display.

Step 2. Copy the 2nd Area Roughing toolpath in the Toolpaths Manager. To copy, click to select 2nd toolpath, Fig. 38. Then, use Ctrl-C and Ctrl-V, Fig. 39.

Step 3. Expand the pasted 3-Surface High Speed and click Parameters, Fig. 39.

Step 4. Select Toolpath Type from the tree control and select:

- Finishing
- Raster

Fig. 40
Step 5. Select **Model Geometry** from the tree control and set:

- **Wall Stock**: 0
- **Floor Stock**: 0

Fig. 41

Step 6. Select **Toolpath Control** from tree control and set:

Under **Contain** select **Tool contact point**

Click **Containment Boundaries** button

Fig. 42
Step 7. **Right click** in the Chain manager dialog box and click **Add** from menu, **Fig. 43**.

Step 8. Select **Solids** in the Chaining dialog box and under Selection Method click **Loop** and unselect all others, **Fig. 44**.

Step 9. Click **edge of rear wheel shell**, **Fig. 45**.

Step 10. Click **OK** in Pick Reference Face dialog box, **Fig. 46**.

Step 11. Click **OK** in the Chaining dialog box.

Step 12. Click **OK** in Chain Manager dialog box, **Fig. 47**.
Step 13. Select **Cut Parameters** from tree control and set:

**Cutting method Zigzag**

**Stepover .5**

Fig. 48.

Step 14. Select **Steep/ Shallow** from tree control and set:

Uncheck **Minimum**

Uncheck **Maximum**

Click **Apply**

Fig. 49.

Step 15. Click **OK** in Raster dialog box.

Step 16. Save (Ctrl-S).
G. **Verify Wheel Shells.**

Step 1. In the Toolpaths Manager, click **Regenerate all selected operations** Fig. 50.

Step 2. Click Toolpath Group-1 to select **all three** shell toolpaths, Fig. 51.

Step 3. Click **Verify** in the Toolpaths Manager.

Step 4. Click **Play** (R) in playback bar along bottom of the window.

Step 5. Note **Total Time** to run program (31min 13.32s), Fig. 53.

Step 6. Switch back to Mastercam (Alt-Tab).
H. Rename Toolpath Group WHEEL SHELLS.

Step 1. Rename Toolpath Group-1 to WHEEL SHELLS in the Ops Manager. To rename, click and hover over Toolpath Group-1 then key-in WHEEL SHELLS, Fig. 54.

I. Insert LEFT CUT Toolpath Group.

Step 1. Insert new Toolpath group. To insert group, right click Machine Group 1 at the very top of Ops Manager and click Groups > New Toolpath group, Fig. 55.

Step 2. Rename new Toolpath Group to LEFT CUT. To rename, click and hover over Toolpath Group-1 and key-in LEFT CUT, Fig. 56.

J. Switch to LEFT CUT WCS.

Step 1. Display the Planes Manager. To display, click Planes tab at the bottom of Ops Manager.

Step 2. In the Planes Manager set:
- under Name, Fig. 57
  - Click LEFT CUT
  - Click Set All

Step 3. Change to the Isometric View. Right click in the graphics window and click Isometric (WCS) (Alt-7).

Step 4. Confirm Left Cut Origin, Fig. 58. Use F9 to toggle axes.
K. Left Cut Finish Equal Scallop Toolpath.

Step 1. On the Toolpaths tab in the 3D group click expand gallery button and click Equal Scallop, Fig. 59.

Step 2. Select Model Geometry from the tree control and set:
- Under Machining Geometry click Select entities button, Fig. 60.

Step 3. Triple click the solid car body to select as machine geometry and click End Selection (ENTER), Fig 61.
Step 4. Back in Model Geometry page set:

Wall Stock 0
Floor Stock 0
To set, double click and key-in.

Under Avoidance Geometry click Select entities button, Fig. 62.

Step 5. Triple click the check body to select as avoidance geometry, Fig 63.

Step 6. Rotate view to view bottom and rear surfaces, hold down middle mouse button (wheel) and drag to rotate view, Fig. 64.

Step 7. Click bottom and rear surfaces to select as avoidance geometry and click End Selection (ENTER), Fig 64.
Step 8. Back in **Model Geometry** page set:

Confirm **8 Avoidance entities**

Fig. 65.

Step 9. Select **Tool** from tree control and set:

**Feed rate 300**

**Plunge rate 200**

Fig. 66.
Step 10. Select **Cut Parameters** from tree control and set:

- **Cut style**
  - Both to Other Way
- **Check Optimize cut order**
- **Stepover 1**
- **Keep tool down within 100%**

Fig. 67.

Step 11. Select **Steep/Shallow** from tree control and set:

- **Check Minimum depth 0**
- **Check Maximum depth -37**

Click **Apply**

Fig. 68.
Step 12. Select **Linking Parameters** from tree control and set:

- **Clearance plane 1**
- **Select Minimum Vertical Retract**
- **Part clearance 1**
- **All Leads 0**

Fig. 69.

Step 13. Select **Arc Filter/Tolerance** from tree control and set:

- **Total tolerance** 0.0625
- **Check Line/Arc Filtering Settings**
- **Uncheck Create arcs in XY**
- **Check One way filtering**
- **Set Minimum arc radius** 0.0625

Cut tolerance 10%

Fig. 70.

Step 14. Click OK in Equal Scallop dialog box. Allow Mastercam to calculate toolpath, then Save (Ctrl-S).

*Mastercam 2020 CO₂ Shell Body Toolpaths*  Page 4-23

*Metric - Area Roughing/Raster and Finish Equal Scallop*
**Verify Left Cut.**

Step 1. Confirm toolpath avoids bottom and rear surfaces, Fig. 71. Use Alt-T to toggle on toolpath display. (I changed color of toolpath for clarity.)

Step 2. Change to the Isometric View. Right click in the graphics window and click Isometric (WCS) (Alt-7).

Step 3. In the Toolpaths Manager click the LEFT CUT Toolpath group to select toolpath and click Verify, Fig. 72.

Step 4. Click Play (R) in playback bar.

Step 5. Note Total Time to run program (51min 40.33s), Fig. 74.

Step 6. Switch back to Mastercam (Alt-Tab).
M. Insert RIGHT CUT Toolpath Group.

Step 1. Insert another Toolpath group. To insert group, right click Machine Group 1 at the very top of Ops Manager and click Groups > New Toolpath group, Fig. 75.

Step 2. Rename new Toolpath Group RIGHT CUT, Fig. 76.
N. Mirror LEFT CUT to RIGHT CUT Toolpath.

Step 1. On the Toolpaths tab, click Toolpath Transform.

Step 2. In the Transform Operation Parameters dialog box:
   - under Type, Fig. 77 select Mirror
   - under Source select NCI
   - under Source operations in LEFT CUT toolpath group select Surface High Speed (Equal Scallop).

Step 3. Click the Mirror tab at top of dialog box, Fig. 78.
   - under Method select Mirror about X axis
   - Click OK

Step 4. Allow Mastercam to calculate toolpath.

Step 5. Save (Ctrl-S).
**Verify Right Cut.**

Step 1. In Toolpaths Manager, click the **Transform/Mirror** tool-path, Fig. 80.

Step 2. Click **Verify** in Toolpaths Manager.

Step 3. Click **Play** (R) in playback bar.

Step 4. Click **Close** to close Mastercam Simulation.