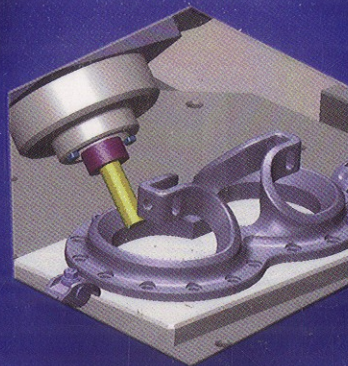


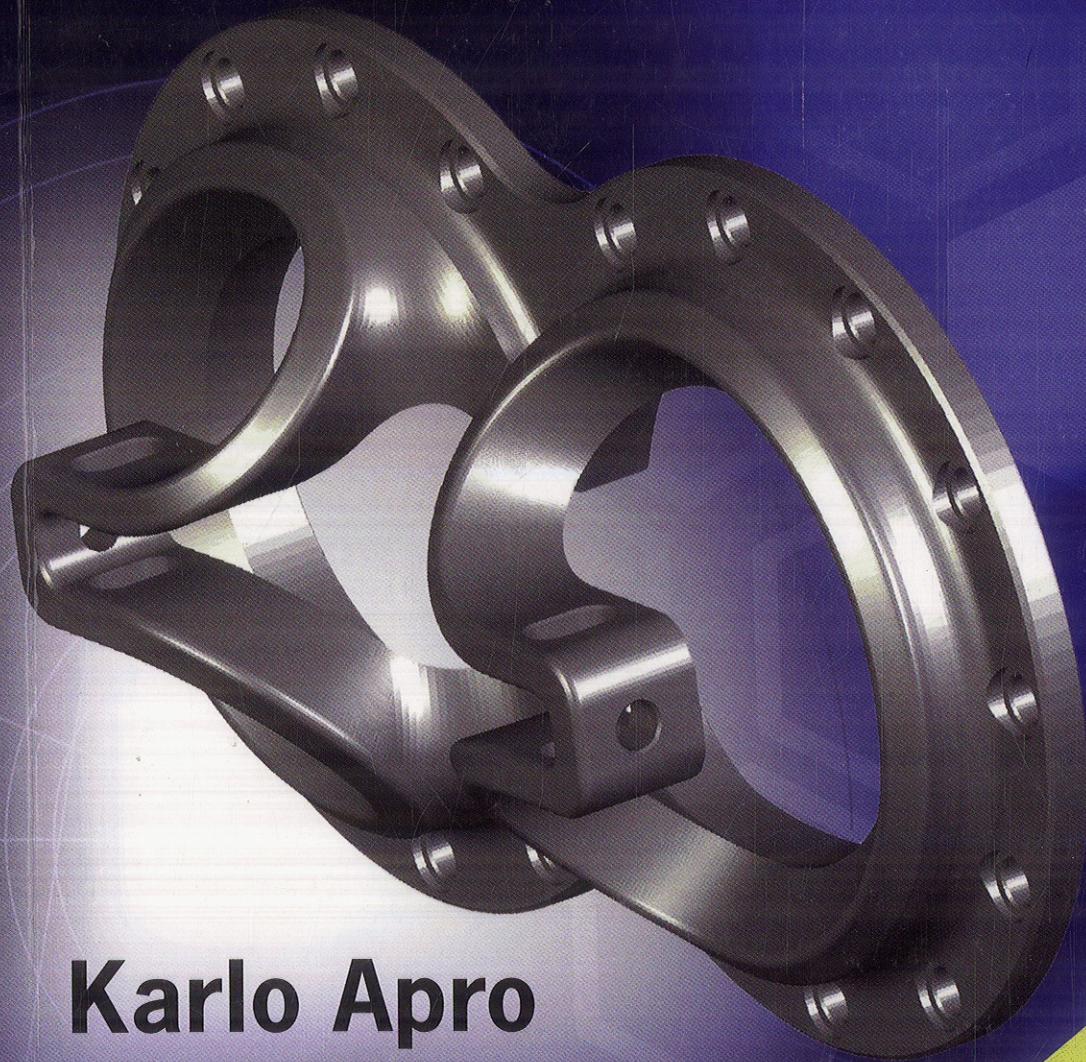


Bonus CD Included



Secrets of 5-Axis Machining

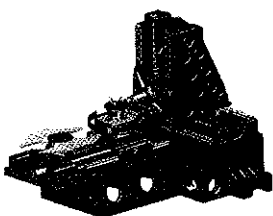
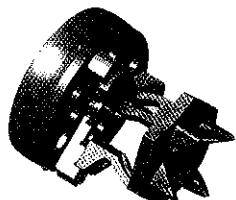
0160.945 C316
r-1.9983 55000 M03
0542 P1 G43.4 H1 Z2
Q260 G94 X-.6761 Y-1.9562 Z2.1613
Q270 G01 X-.7403 Y-1.8922 Z2.4449 F30.
Q280 X-.7429 Y-1.8834 Z2.4465 B160.95 C311.244 F
Q290 X-.7635 Y-1.8652 Z2.4369 B160.012 C311.145
N300 X-.7858 Y-1.8474 Z2.4279 B159.04 C311.189
N310 X-.8097 Y-1.8299 Z2.4198 B158.047 C311.37
N320 X-.8355 Y-1.8131 Z2.4129 B157.037 C311.698
N330 X-.8675 Y-1.7946 Z2.407 B155.872 C312.245
N340 X-.9087 Y-1.7729 Z2.4017 B154.446 C313.03
N350 X-.9508 Y-1.7527 Z2.3989 B153.071 C313.883
Q360 X-.9917 Y-1.7338 Z2.3986 B151.732 C314.87
Q370 X-.9917 Y-1.7338 Z2.4008 B150.43 C
Q380 X-.9917 Y-1.7338 Z2.406 B149.87
Q390 X-.9917 Y-1.7338 Z2.411 C314.87



Karlo Apro

**Full Color
Illustrations Throughout**

Table of Contents



Introduction	1
---------------------	----------

Chapter 1: History of 5-Axis Machines	3
--	----------

Common Misconceptions	4
-----------------------	---

Reasons to Use Multiaxis Machines	8
-----------------------------------	---

Chapter 2: Know Your Machine	13
-------------------------------------	-----------

Multiaxis Machine Configurations	14
----------------------------------	----

Table/Table Multiaxis Milling Machines	18
--	----

Machine Rotary Zero Position (MRZP)	21
-------------------------------------	----

Nesting Positions	26
-------------------	----

Rotary Table Dynamic Fixture Offset	27
-------------------------------------	----

Head/Table Multiaxis Milling Machines	31
---------------------------------------	----

Head/Head Multiaxis Milling Machines	36
--------------------------------------	----

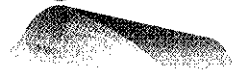
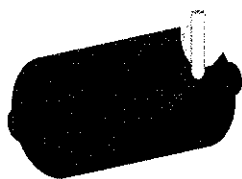
Finding the Pivot Distance	37
----------------------------	----

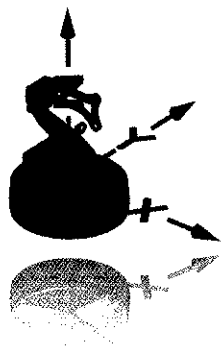
4-Axis Machines	39
-----------------	----

General Maintenance & Issues for Multiaxis Machines	40
---	----

Milling Machines With Five- or More-Axes	43
--	----

Chapter 3: Cutting Strategies	45
--------------------------------------	-----------





Chapter 4: Indexing Multiaxis Toolpaths49

Indexing Methods	51
How CAD/CAM Systems Handle Indexing Work.	56
Machine Coordinate Systems	57
Machine Home Position	57
Active Coordinate System	57
Machine Rotary Center Point	60
CAD/CAM System Origin	60
Synchronizing Machine and CAD/CAM Coordinate Systems .	61



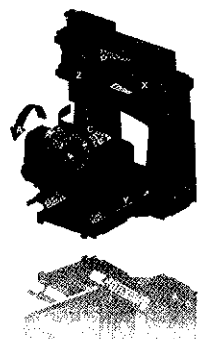
Chapter 5: Simultaneous Multiaxis Toolpaths. .65

The Optimum Work Envelope	70
Feedrates.	72
Inverse Time Feedrate	74
Post Processors.	76



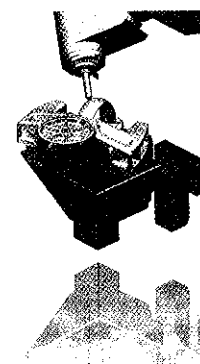
Chapter 6: Common Simultaneous Multiaxis CAM Toolpath Controls79

Cut Patterns	79
Tool Axis Control.	86
Tool Tip Control.	90
Collision Control	93
Additional Multiaxis Issues and Controls.	98
Dovetail Effect	98
Cutting Direction	100
Multiaxis Roughing	101



Chapter 7: Machine Simulation103

G-code Simulation Versus CAM Simulation	105
Configuring Virtual Machines For Simulation	105
Virtual Machine Building.	106
The Skeleton	106
Components vs. Models	107
Machine Simulation Interfaces	116
Using Machine Simulation	117



Chapter 8: Selecting The Right Machine For Your Application119

Head/Head Machines (<i>with long X or Y – axis linear travel, but limited rotary axes travel</i>)	121
Head/Table Machines (<i>with long X-axis travel</i>)	123
Head/Table Machines	126
Rotary Table – Tilting Head Combinations	128
Table/Table Machines.	132
Gantry Type Head/Head Machines.	134



Chapter 9: Choosing a CAD/CAM System For Your Application.137

Special Purpose Software.	137
CAD/CAM Toolbox	139
Multiaxis CAD/CAM Considerations	139
Multiaxis CAM.	140
Multiaxis CAD/CAM Training	144
Behind the Scenes: CAD/CAM Software Development . .	145
General Guidelines for Researching CAD/CAM Software. .	146

Chapter 10: Putting It All Together149

Why Use Multiaxis Machining Techniques?	152
What is a Standard 5-Axis Machine?	153
What is the Standard Axis Convention?	154
What are the Three Major Multiaxis Machine Types? . . .	154
What are the Major Building Blocks of a CNC Machine? .	156
What are the Most Important Physical Positions of a Multiaxis Machine?	157
What Tools are Needed to Find MRZP?	159
Description of Indexing/Rotary Positioning Work	159
What is a Post Processor?	159
Definition of an Axis	160
Defining a Simultaneous 5-axis Toolpath	160
What are the Three Common Simultaneous Multiaxis CAM Toolpath Controls	161
Multiaxis Machine Offsets	161
Finding Machine Rotary Zero Position.	162
Finding the Pivot Distance	164
Indexing/Rotary Position Work Overview	166
Picking a CAD/CAM System for Multiaxis Work	166
Machine Simulation	167
Conclusion	167