

Rob Thompson

**Manufacturing
Processes for
Design
Professionals**

 **Thames & Hudson**

Contents

How to use this book 8

Introduction 10

The importance of materials and manufacturing knowledge for successful design practice



Part One

Forming Technology

Plastics and Rubber

Blow Molding 22

- Extrusion Blow Molding (EBM)
- Injection Blow Molding (IBM)
- Injection Stretch Blow Molding (ISBM)

Thermoforming 30

- Vacuum Forming
- Pressure Forming
- Plug-assisted Forming
- Twin Sheet Thermoforming

Rotation Molding 36

Vacuum Casting 40

Compression Molding 44

- Compression Molding Rubber
- Compression Molding Plastic

Injection Molding 50

- Moldflow analysis
- Gas-assisted Injection Molding
- Multishot Injection Molding
- In-Mold Decoration

Reaction Injection Molding 64

Dip Molding 68

Metal

Panel Beating 72

- Dishing
- Jig Chasing
- Wheel Forming
- Planishing

Metal Spinning 78

Metal Stamping 82

- Secondary Pressing

Deep Drawing 88

Superforming 92

- Cavity Forming
- Bubble Forming
- Backpressure Forming
- Diaphragm Forming

Tube and Section Bending 98

- Mandrel Bending
- Ring Rolling

Swaging 104

- Rotary Swaging
- Hydraulic Swaging

Roll Forming 110

Forging 114

- Drop Forging
- Roll Forging

Sand Casting 120

Die Casting 124

- High Pressure Die Casting
- Low Pressure Die Casting

Investment Casting 130

Metal Injection Molding 136

Electroforming 140

Centrifugal Casting 144

Press Braking 148

Glass and Ceramics

Glassblowing 152

- Studio Glassblowing
- Machine Blow and Blow
- Machine Press and Blow

Lampworking 160

- Blowing
- Hole Boring
- Bending
- Mandrel Forming

Clay Throwing 168

Ceramic Slip Casting 172

Press Molding Ceramics 176

- Jigging
- Ram Pressing

Wood

CNC Machining 182

Wood Laminating 190

- Kerfing
- Solid Wood Lamination
- Veneer Lamination

Steam Bending 198

- Circle Bending
- Open Bending

Paper Pulp Molding 202

Composites

Composite Laminating 206

- Wet Lay-up
- Pre-preg Lay-up
- Resin Transfer Molding

DMC and SMC Molding 218

Filament Winding 222

3D Thermal Laminating 228

- 3D Laminating (3DL)
- 3D Rotary Laminating (3Dr)

Layered Manufacturing

Rapid Prototyping 232

- Stereolithography (SLA)
- Selective Laser Sintering (SLS)
- Direct Metal Laser Sintering (DMLS)

Part Two

Cutting Technology**Chemical**

Photochemical Machining 244

Thermal

Laser Cutting 248

Electrical Discharge Machining 254

Die Sink EDM

Wire EDM

Mechanical

Punching and Blanking 260

Die Cutting 266

Water Jet Cutting 272

Glass Scoring 276

Part Three

Joining Technology**Thermal****Arc Welding** 282

Manual Metal Arc Welding (MMA)

Metal Inert Gas Welding (MIG)

Tungsten Inert Gas Welding (TIG)

Plasma Welding

Submerged Arc Welding (SAW)

Power Beam Welding 288

Laser Beam Welding (LBW)

Electron Beam Welding (EBW)

Friction Welding 294

Rotary Friction Welding (RFW)

Linear Friction Welding (LFW)

Orbital Friction Welding (OFW)

Friction Stir Welding (FSW)

Vibration Welding 298**Ultrasonic Welding** 302**Resistance Welding** 308

Projection Welding

Spot Welding

Seam Welding

Soldering and Brazing 312

Conduction Method

Torch Method

Furnace Method

Staking 316

Hot Air Staking

Ultrasonic Staking

Hot Plate Welding 320**Mechanical****Joinery** 324**Weaving** 332**Upholstery** 338**Timber Frame Structures** 344

Part Four

Finishing Technology

Additive Processes

| | |
|------------------------------|------------|
| Spray Painting | 350 |
| Powder Coating | 356 |
| Electrostatic Spraying | |
| Fluidized Bed Powder Coating | |
| Anodizing | 360 |
| Electroplating | 364 |
| Galvanizing | 368 |
| Vacuum Metalizing | 372 |

Subtractive Processes

| | |
|--|------------|
| Grinding, Sanding and Polishing | 376 |
| Wheel Cutting | |
| Belt Sanding | |
| Honing | |
| Lapping | |
| Electropolishing | 384 |
| Abrasive Blasting | 388 |
| Photo Etching | 392 |
| CNC Engraving | 396 |

Printing

| | |
|-----------------------------|-----|
| Screen Printing | 400 |
| Pad Printing | 404 |
| Hydro Transfer Printing | 408 |
| Foil Blocking and Embossing | 412 |

Part Five

Materials

| | |
|---------------------------|-----|
| Introduction to Materials | 418 |
|---------------------------|-----|

Plastics

| | |
|--------------------------|-----|
| Introduction to Plastics | 424 |
| Thermoplastic | 430 |
| Thermoset | 440 |
| Bioplastic | 446 |

Metals

| | |
|------------------------|-----|
| Introduction to Metals | 448 |
| Ferrous | 454 |
| Non-Ferrous | 457 |

Wood and natural fibres

| | |
|----------------------|-----|
| Introduction to Wood | 464 |
| Softwoods | 470 |
| Hardwoods | 472 |
| Natural fibres | 480 |

Ceramics and Glass

| | |
|------------------------------------|-----|
| Introduction to Ceramics and Glass | 482 |
| Ceramics | 488 |
| Glass | 490 |

Directory

| | |
|---|-----|
| Glossary and Abbreviations | 496 |
| Featured Companies | 502 |
| Organizations and Other Sources of Information | 512 |
| Further Reading | 516 |
| Illustration Credits | 519 |
| Acknowledgments | 522 |
| Index | 524 |