

# COMPOSITE TOOLING DESIGN



## Composite Tooling Design Introduction

The composite manufacturing process

- Computer-aided design

- Composite manufacturing methods

Support tools for composites manufacturing

- Ply & core kit-cutting templates

  - Automated ply & core cutting

- Ply & core locator templates

  - Laser ply projection systems

- Layup molds

- Mandrels

- Cores

- Trim fixtures

  - Waterjet cutting/CNC systems

- Drill jigs & fixtures

## Tooling Materials Introduction

Choosing one tooling material over another

- Parts production quantities

- Service temperature requirements

  - Coefficient of thermal expansion/CTE

Glass Reinforced Polyester/Vinyl-Ester Laminated Tooling

Carbon Fiber Reinforced Epoxy/Bismaleimide Tooling

Invar

Invar coated carbon fiber reinforced tooling

Steel

## Tooling Design Introduction

Draft angle requirements

Spring-in issue

Mold requirements for room temperature curing

Mold requirements for elevated temperature curing

Mold requirements for vacuum bag curing

- Layup/spray up tooling

- VIP/VARTM tooling

- RTM tooling

- Automated fiber placement/tape laying tooling

- Pultrusion tooling

Master/part model

Laminate fabrication

- Common fabrication issues

Laminate support structures

Mold transportation/handling