

Composite Part Manufacture Plan

***{Name and Description
of Part/System}***

Team: {Team Name}

Term: {School/Competition Term}

Team Lead: {Composites Lead Member}

Other Members:

{Names of members working
on this part/system}

Outline: *(Include sections which apply. Text in red is intended as guidance, remove or overwrite it as appropriate.)*

- I. Part Design
 - a. Description
 - *Nature of part and usage*
 - *Design history*
 - *Failures of previous designs*
 - b. Geometry
 - *Drawings*
 - *Constraints*
 - *Mounting / fixing*
 - c. Stress Analysis
 - *Loading – expected and worst-case*
 - *Assumptions, conditions and results*
 - *Consequences of part failure*
 - d. Material Selection
 - *Materials considered*
 - *Selection criteria*
 - *Final selection and justification*
- II. Processing
 - a. Process Selection
 - *Processes considered*
 - *Selection criteria*
 - *Final selection and justification*
 - b. Mold Design and Manufacture
 - *Options considered*
 - *Selection criteria*
 - *Final selection and justification*
 - *Material needs*
 - *Machining / prototyping needs*
 - c. Layup & Cure
 - *Material needs*
 - *Layup schedule*
 - *Cure cycle and equipment*
- III. Finishing
 - a. Trimming and fitting
 - *Tools, jigs and techniques*
 - b. Joining and fixing
 - *Fasteners and adhesives*
 - c. Surface Finish
 - *Filling, sealing and painting*
- IV. Evaluation
 - a. Time and Material Costs
 - b. Success Criteria

As you develop this document, consider including any additional information which may relate to the critique of your design or process at a later date. If you will be presenting at a competition or other final project review, those judging your work may be specifically interested in details which are not mentioned in this template. Including those details here may help to keep your project on the track intended by your judges or advisors.

I. Part Design

Description

Use this section to describe the nature and context of your part, and how it fits into the larger system or project. If you are re-designing a part, give a history of past designs and their merits and shortcomings. Provide some reasoning for building this part from composites.

Geometry

This section should lay out the size and shape of your part. Include figures with captions to illustrate your part – these may be CAD drawings or other sketches, but should provide sufficient detail to visualize your part accurately. Describe or illustrate the constraints on your design – for instance, minimum and maximum dimensions and clearances, maximum distortions, etc. Also describe or illustrate any points and methods of attachment to other parts.

Stress Analysis

Describe both the normal and worst-case loading scenarios for your part. State your assumptions regarding loading and mounting points. Perform some type of stress analysis as appropriate for the part. For instance, a simple non-moving support strut should need little more than hand-calculations of stresses during static loading. On the other hand, a complex-shaped member of a safety system should have a finite element analysis with convergence study and validations for assumptions regarding material properties. The results of the stress analysis will be your primary justification for material selection.

Material Selection

Based on the results of your stress analysis, and any other important criteria (cost, weight, competition constraints, etc.,) create a short list of viable material options. Before ruling out any particular materials, consider whether small changes to your design might affect your options. Present an organized analysis of costs and benefits – a decision matrix would be a good illustration – to justify your material choices.

II. Processing

Process Selection

Describe the composites manufacturing processes which you considered for your part. Describe the criteria which affect this decision – tolerance control, surface finish, mold investment, etc. – and which processes are suitable for addressing those criteria. Weigh the importance of these criteria to justify your decision.

Mold Design and Manufacture

Consider various approaches to designing your mold – some may require more manual effort, more out-sourced machining, more post-processing, etc. Weigh the pros and cons of various approaches to justify your decision. Similarly, review and select materials. Estimate the types and amounts of materials and supplies you will need. Also estimate the amount of CAM/machine work or rapid-prototyping work which will be required. If you are experimenting with unproven molding techniques, expect to make a small test-mold to demonstrate that the technique is viable.

Layup & Cure

If you will be using reinforcement fabric, describe the areal weights and layup schedule which you intend to use. This will likely have been a factor in your stress analysis, and changes may require that you re-run your analysis. Describe the cure cycle you intend to follow, and any equipment which will be required to maintain temperature or pressure during cure.

III. Finishing

Joining and Fixing

If your part will be bolted, glued or otherwise attached to another part, describe any post-processing required – for instance, drilling bolt holes, truing and prepping surfaces for adhesive bonding.

Surface Finish

If your part will be painted or clear-coated to achieve a high-quality finish, describe how you will sand, clean and prep the surfaces.

IV. Evaluation

Time and Material Costs

Estimate the time and materials to be used for the entire process, and the approximate costs. Include time for labor, machining, oven or autoclave curing, and consulting services. Include materials for the part, the mold, and any other material expenses or major supplies.

Success Criteria

Describe the criteria by which you will judge the success of your part design and manufacturing. This can include information such as timelines, budgets, performance goals, proofs of concepts, and educational goals. You will not be “graded” based on these goals, but they may serve as a guide and a standard for use by future teammates.