

# 16.810 Manufacturing Report

## Team V1

The following parts are required for the ingress/egress system:

- Canopy
- Rails
- Handles
- Existing Shell
- Locking Mechanism

### *Canopy*

After initial experiments to try and heat form plastic with heat guns, using the same mould used to create the shell, we decided that it would be impossible to make the transparent canopy ourselves.

Instead, the canopy fabrication was outsourced to a manufacturer in Florida, who normally made aircraft canopies and had created a canopy for Pulse, another VDS vehicle. Based on a three-view drawing we provided to him, he was able to send us a canopy on a turnaround of only 5 days, which was necessary to meet our tight deadline.



### *Rails*



The rails were designed to be cut on a waterjet, as the complicated curving shape was too difficult to cut by hand and too large for the mill.

In order to maximize stiffness against side loading, we originally chose to make the rails out of an aluminium-plywood 'sandwich' material. However, delamination occurred when cutting on the waterjet, and when we

tried to stick the layers back together, we found that stiffness was poor.

Instead, we chose to use ¼” aluminium (sticking with aluminium to save weight), and found this to be adequate for stiffness and strength. The internal faces of the rail were sanded to give a smooth opening motion.

### *Handles*

The ‘ribs’ were made out of 1/16” aluminium, and waterjetted as this was the fastest method of manufacture. The connecting aluminium tube was cut to length by hand, and the pieces were welded together by the MIT Central Machine Shop.



### *Existing Shell*



Marking an accurate curve on the existing shell was the hardest part of the manufacturing process; we carefully aligned the rails and used them to draw a curve on one side, extending it by eye to the nose of the vehicle. A grid was then created on the shell using masking tape and string to accurately reproduce this curve on the opposite side.

The shell was cut using a diamond cutting disk and a Dremel tool – this gave a reasonable finish, requiring a little sanding to give a smooth edge.

### *Locking Mechanism*

Although not implemented, we intended to use magnetic strips to hold the canopy in place while driving – we also intended to use foam or rubber tubing to ensure the canopy sat smoothly on the shell.

## Integration and Assembly

A major problem we encountered while trying to mount the canopy to the shell was that the canopy was made slightly too large in places, tending to bubble out where the shell was flatter. This made it very difficult to attach the two, as too much stress would cause the fragile canopy to break. After much deliberation, we cut the canopy to a smaller size, making it more flexible, and mounted it to the shell using Velcro, which proved to be an excellent choice due its strength in shear. (Some of the cut-out portion of the shell was used to reinforce the Plexiglas canopy.)

We also chose to use Velcro to attach the handles to the canopy, and U-Clamps were used to attach the rail system to the existing chassis. These allowed for easy removal of the ingress/egress system if required.

Unfortunately, due to the tight deadline, the system had not been fully finished and tested before having to leave for SolidWorks World, but it is anticipated the small amount of work still needed will be completed en route.



**16.810 Cost Estimation Sheet  
Team V1**

Section		Rate	Qty	Cost	
<b><i>I. Design and Engineering</i></b>					
	Labor Rate for Each Designer	\$75	10	\$750	
	Labor Rate for Each CAD/CAM Workstation	\$40	5	\$200	
<b><i>II. Materials Cost</i></b>					
	Aluminium Sheet	1/16" thick	\$40	1	\$40
		1/4" thick	\$80	1	\$80
	Aluminium Tube		\$20	1	\$20
	Miscellaneous Components		\$60	1	\$60
<b><i>III. Canopy</i></b>					
	Canopy		\$350	1	\$350
	Shipping		\$200	1	\$200
<b><i>IV. Waterjet Manufacturing</i></b>					
	Labor Rate		\$55	3	\$165
	Machine Use		\$75	3	\$225
<b><i>V. Other Manufacturing</i></b>					
	Shell and Canopy Cutting - Labor		\$40	4	\$160
	Miscellaneous Labor		\$30	8	\$240
<b><i>VI. Assembly and Testing</i></b>					
	Assembly Labor		\$30	3	\$90
			<b>TOTAL</b>	\$2,580	