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Version 1.3

Deliverable A

Requirements and Interface Document (Example)

System: MIT Formula SAE Racecar 2005

Component or Subsystem: Rear Spoiler

Team Name: "Need for Speed"

Team Member 1: Mario Andretti

Team Member 2: Jeff Gordon

1. Component Description

A new rear wing design is needed for the 2005/2006 model year MIT Formula SAE race car. The rear-mounted wing (Fig.1) is intended to maximize downward force (negative lift), while at the same time minimizing incremental drag and weight added to the vehicle. The wings have to conform to regulations (constraints) and be designed and manufactured in an economical fashion.

Aerodynamic efficiency is one of the most important elements in developing a competitive race car. Aerodynamic design is concerned with two primary elements: reducing drag (D) and increasing downforce (negative lift, L). Downforce is necessary in maintaining high speeds through the corners and forces the car to the track. In actual race car design there are complex interactions between the aerodynamics of the front wing, rear wing and the chassis as all three main components (in addition to the tires) contribute to both drag and downforce.

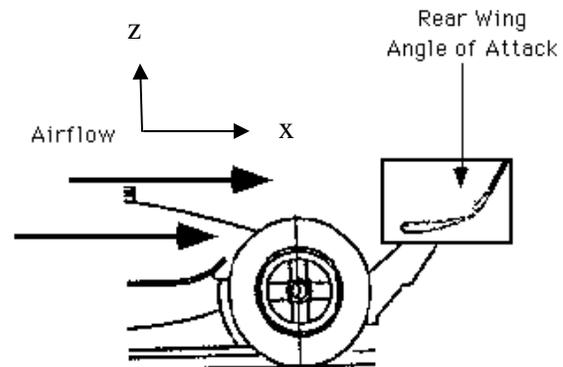


Figure 1: Race car rear wing

2. Functional Requirements

2.1 The rear wing shall produce a downforce of at least 250 N (Newtons of force) at the steady state operating condition in the $-z$ direction.

- 2.2 The rear wing shall not produce more than 75 N (Newtons of force) of drag at the steady state operating condition in the x direction.
- 2.3 The mass of the rear wing shall not exceed 2.5 kg.
- 2.4 The structural integrity of the rear wing shall be maintained over the entire operating regime of the vehicle, including all speeds and cornering conditions below 100 miles per hour (mph). A safety factor of 2 shall be used for all structural load cases.
- 2.5 The wing shall not deflect by more than 10 mm at any point below 100 mph.

3. Constraints

- 3.1 The steady state operating condition is defined as a straight line un-accelerated drive at 60 miles per hour (60 mph) over flat terrain
- 3.2 The rear wing may only be manufactured from 6061 aluminum, blue construction insulation foam (R-8 insulation value), fiberglass and epoxy adhesive. Manufacturing shall occur on an OMAX waterjet machine, assuming a rate of \$75/hour.
- 3.3 The wing shall be created as an extrusion of a 2D wing section, thus limiting the aerodynamic analysis to 2D section airfoils. There will be no taper or dihedral allowed.
- 3.4 No external energy source is allowed as part of the device.

4. Interface Definition

- 4.1 The maximum design envelope for the wing and its support structure is 20" x 20" x 40" (width, height, span).
- 4.2 The support structure must match the dimensions and the hole pattern shown in Fig. 2. There are two support brackets located 39.75 (+/-0.5) inches apart, from inside surface to inside surface. The two bolts holes (5/16th inch O.D.) on each side the supporting fixture are 16.0 inches apart, and 1.0 inch above the lower plane of the envelope.

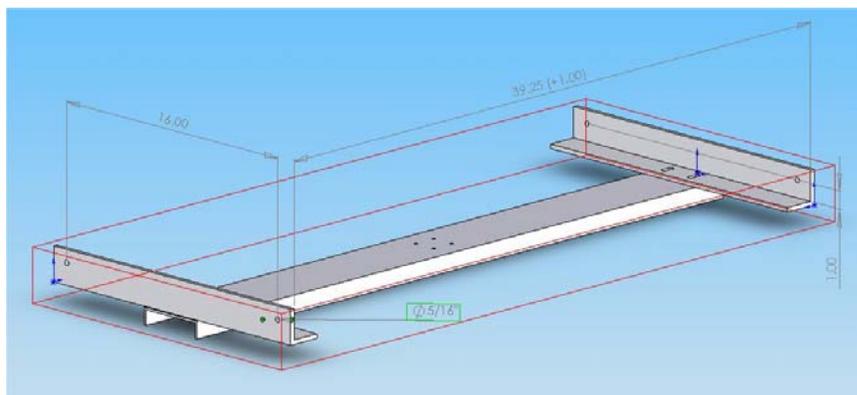


Figure 2: Wing support structure and attachment points

5. Verification

- 5.1 The rear wing will be mounted on the attachment structure (Fig.2) and a set of measurements will be taken in the MIT Wright Brothers wind tunnel with a six axis load cell. From these measurements the lift, drag and side force will be extracted and compared with requirements (2.1, 2.2 and 2.3), respectively.
- 5.2 The wind tunnel will be run between 10 to 100 mph in 20 mph increments. The safety of the wing will be verified throughout the operation by monitoring the test with video cameras from the control room (2.4)
- 5.3 A static load test will be performed. The maximum deflection limit (2.5), and safety factor for stress will be verified with laser distance measurement equipment and bonded strain gauges.

Signatures *Mario Andretti*
 Jeff Gordon