

Ultimate Endeavour Level 3 Project Outline

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Aim

Satisfactory construction, safe flight and recovery of a rocket powered by a single M class hybrid motor.

Background

The hybrid motor is the latest in a series of motors. The M class variant draws on the knowledge gained from the design and successful static firing of a progression of engines from a 23mm proof of concept model, to a 38mm J340 and up to the current 76mm M611. This M class engine has been static fired repeatedly, performed safely each time and meet its design parameters.

Considerations

As this will be a unique Level 3 project, several considerations have been factored into the design to reduce the unknowns.

The airframe is planned around the popular PML Ultimate Endeavour but modified for the hybrid engine. The airframe of an unmodified Ultimate Endeavour can be flown on large 54mm solid propellant motor (1). The forces the airframe is subjected to should be no greater with the M611 hybrid motor than if a 54mm solid motor such as the Cesaroni K660 was fitted (Table 1). The airframe will be constructed from PML parts as listed for their off the shelf kit and in accordance with the manufacturers instructions. Additional strengthening of the parts and fittings, including fibre glassing will be performed, as appropriate.

The recovery system will be based on the PML piston system (2). Altimeters will be an RDAS 4.0 and a Perfect Flight HiAlt45k. These will be built into the forward airframe. A rear facing piston will deploy a

streamer whilst the forward facing piston will deploy the main chute. In essence this will be a scaled up version of the recovery system I have successfully flown in my Super-stretched Eclipse, and therefore one I am fully familiar with (Figure 1 insert).

In order to demonstrate the air worthiness of the airframe prior to the level 3 attempt I propose to fly it initially on a Cesaroni K660 solid. A level 3 attempt would not be made until satisfactory completion of this flight.

Provisional Design

The airframe will be in the order of 12 ft long and constructed of 6 inch diameter phenolic tubing. This will be glassed for extra strength. The fins will be 0.09 inch G10, mounted through the wall and epoxied to the motor mount. Additional stability will come from filling the void between the motor mount and the airframe with expanding foam. The fins will also be glassed onto the frame. This construction technique has worked well in the past. The addition of expanding foam should help to ensure recovery if the rocket were to land in a body of open water.

The estimated mass of the airframe, by Rocsim 8.2, is 7.867 kg without engines or avionics. This does not allow for glassing and paint. On my Super-stretched Eclipse project, which was fully glassed, this increased the mass by 3% of that predicted by Rocsim. Applying this same correction factor would predict a mass of 8.103 kg.

	Altitude	Max Velocity	Max Acceleration
Cesaroni K660	4900ft	192 m/s	100m/s/s
Rhodes Propulsion Systems M611	6700ft	189 m/s	48m/s/s

Table 1. Simulated Flight Performance. Data from Rocsim 8.2.

Length: 4353.80 mm , Diameter: 156.46 mm , Span diameter: 435.86 mm
Mass 8.103000 kg , Selected stage mass 8.103000 kg (User specified)
CG: 2244.64 mm, CP: 3492.97 mm, Margin: 8.06 Overstable
Shown without engines.

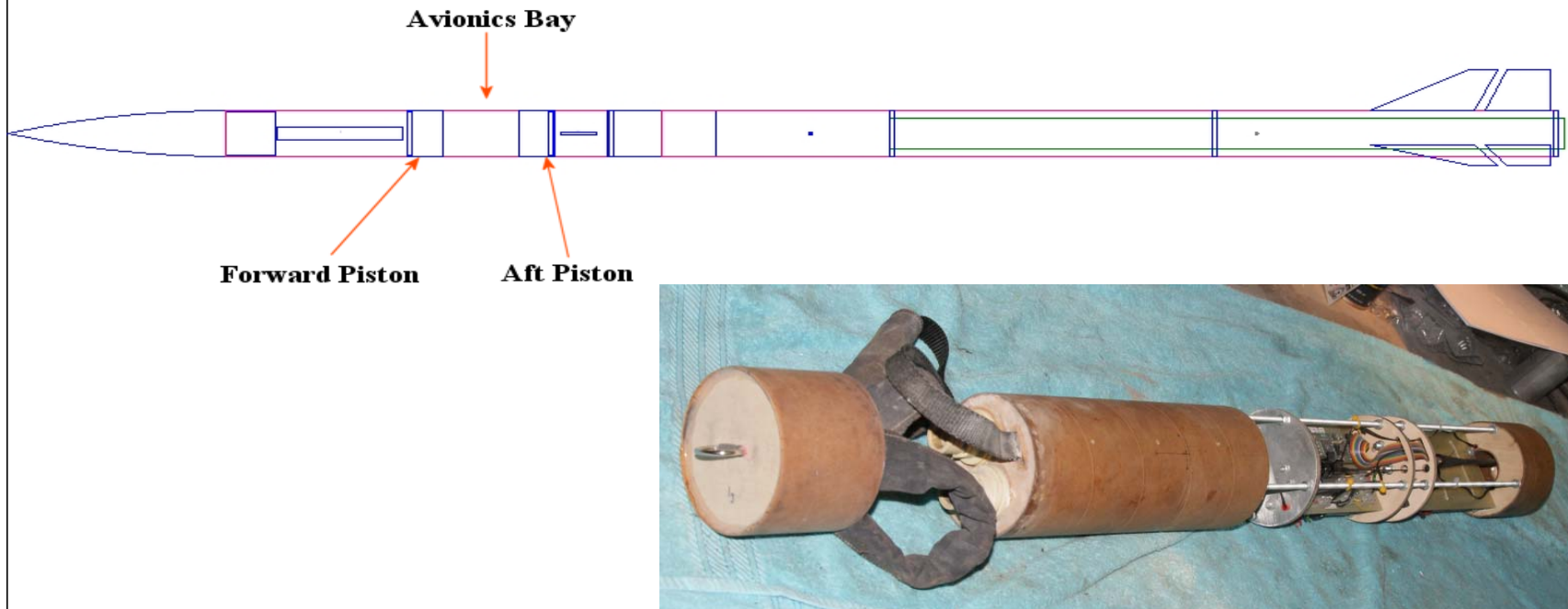


Figure 1. Rocsim plan of the modified Ultimate Eclipse design. The recovery system will be housed in the forward airframe and will be similar to one I have previously flown in the Super-stretched Eclipse (insert).

Reference List

1. PML Motor Recommendations 36 ALL [Data File]. Public Missiles Ltd. 2006 Jul 22.
2. Ultimate Endeavour Assembly Instructions [Data File]. Public Missiles Ltd. 2005 Aug 20.