Inver Hills Community College

Team: Everyday

Draft of Design

Our team has chosen to complete **three** rocket builds:

The Binder Design EXCEL has been chosen for us by the competition, and has been team-built with the oversight of Dr. Flaten and Sophia Vedvik. This rocket has been successfully test-fired previously, in early December.

The LOC-IV IRIS was chosen by Kelly Behlen as the Level-1 Certification flight solo-built rocket. It has been modified with assistance from LOC-IV into a dual-deployment configuration. Kelly Behlen will be the only team member attempting a certification flight during this competition; no members of the team hold certification at any level.

The Enceladus was chosen by the team as the secondary team-built rocket. This kit was retired from production by Mach1 Rocketry; however, they agreed to a one-off run of the kit, and modified the design to include both an electronics bay and a dual-deployment upper tube.

Design Diversity:

	Excel	Enceladus	IRIS
Diameter:	3.0"	2.6"	4.0"
Length:	57.5"	62"	78"
Body Material:	Phenolic Cardboard	Fiberglass	Phenolic Cardboard
Fin Count:	3	3	4
Fin Type:	Plywood	Fiberglass	Plywood
Fin Shape:	Trapezoidal	Trapezoidal	Clipped Delta
Nose Type:	Polypropelene Ogive	Aluminum-Tipped Fiberglass Ogive	Nylon-12 3D Printed 4:1 Ogive
Deployment Type:	Two-Chute Dual Deployment	Two-Chute Dual Deployment	Two-Chute Dual Deployment
Kit/Scratch:	Kit	Heavily Modified Kit	Modified Kit
Team/Solo Built:	Team	Team	Solo - Kelly Behlen
Data Logging:	Jolly Logic Altimeter 2	Jolly Logic Altimeter 2	Jolly Logic Altimeter 2
Commercial Altimeter:	TBD: Raven4/StratoLogger	AIM USB Altimeter (Mach Capable)	AIM USB Altimeter
Chute Release:	Electronically Initiated	Electronically Initiated	Electronically Initiated
Arming Switch:	External Screw	Internal Magnetic Switch	External Screw
Motor Size:	38mm	38mm	54mm
Grain Count:	2-Grain in 3G Casing w/Spacer	6-Grain in 6XLG Casing	2-Grain in 3G Casing w/Spacer
Motor Maker:	Cesaroni	Cesaroni	Cesaroni
Motor Class:	H-Class	J-Class	I-Class
Motor Designation:	H225 - White Thunder	J530 - Imax	I-100 Red Lightning Longburn
Feature (1):	Microphone/Audio Proof Electronic Chute Ejection	Mach 1+	(Possible Custom-Made Chute) (Time Allowing)
Feature (2):	Rail Buttons	Fully Fiberglass	Nylon-12 3D Printed Nose Cone
Feature (3):	Alternative Altimeter	Flyaway Rail System	Rail Guides
Recovery Aid:	MicroBeacon Audio Beeper	MicroBeacon Audio Beeper	MicroBeacon Audio Beeper
		Radio Frequency Location Tracking	

Due to availability constraints, we will be using Cesaroni reloadable motor casings of various lengths and diameters for all three rocket builds. While a great opportunity to familiarize ourselves with Aerotech products we were unable to take advantage of this during this competition timeframe.

The Enceladus kit will be using an aluminum motor retainer that is epoxied to the motor tube with a screw-on cap. This will house the motor casing within the motor retainer after it is screwed closed.

However, the other two builds will share a commonality in that the motor casing is secured against the aft thrust ring positioned at the rear of the tube, and the motor casing's nozzle thrust ring will seat against the aft thrust ring, being mechanically secured by screws and clamps in both cases.

The fins in all three cases will be prepared similar to each other. The fins are first trued using mechanical means, then lightly tacked with cyanoacrylate to secure their position. Once this is done, they are then firmly secured to the motor tube with RocketPoxy, stabilized and epoxied to and between the aft thrust ring and the middle/forward centering ring. On the body tube at the space aft of the root edge of each fin (when placed in its final build position) is cut open, and the fin-can assembly is inserted into the body tube (with appropriate epoxy). The aft thrust ring is epoxied into place along with the aft portions of the body tube (then secured tightly to the body to secure them behind the fins.)

Because we have a relatively limited budget, and no legacy equipment, we are restricted to using our electronics across each built (similarly, we cannot afford the expense of an Aerotech Motor System, and are borrowing Cesaroni casings for the competition.)

As such, we will be using the same Jolly Logic Altimeter 2 for general data logging of our flights. We will, similarly, be using the AIM USB Altimeter that was provided by Dr. Flaten; it is Mach 1+ capable. We will be using a similar ejection system within each rocket; each rocket's ejections will be managed by the AIM USB Altimeter at apogee and at 500' AGL.

Additionally, we will provide audio recording within the drogue tube of the Excel rocket that will verify that the drogue was fired by electronic impulse. To do this we will mount it within the tube itself. If fired correctly one will hear a sharp crack from the electronic ejection charge, a rush of fabric and air, and then a sharp crack from the charge further down inside the tube from the motor itself.

If fired incorrectly one will hear a sharp crack from the motor ejection charge, a rush of fabric and air, and then a much weaker crack from the electronic ejection charge 8-10' outside the lower body tube; as it is not constrained within the lower body tube it should be noticeably different in comparison.

Across the three builds we are making small changes to facilitate a better build. For the phenolic cardboard builds we are using cyanoacrylates along all edges (including vent holes), this provides a very durable, and solid edge that is unaffected by curling and rolling.

We are also securing our terminal blocks, and blasting caps mechanically to the bulk plates. Additionally, we are increasing the size of the blasting caps slightly; to facilitate the extra dimensional space we are using threaded couplers to standoff our forged eyebolts connected to the electronics bay by one inch. This will allow for more room along the plate's outer surface in all instances.

We will also be attaching a MicroBeacon Audible Screamer to the aft plate of each nose cone for audible recovery. And, as the Enceladus rocket will require additional tracking, we will also be using a radio frequency tracker attached likewise on this particular rocket.

The Enceladus kit will also feature a number of custom 3D-printed parts to support the electronics bay needs. And, to facilitate easy access to the electronics tray all three kits will have exactly dimensioned trays that abut the interior of each end of the electronics bay plates, holding the tray steady without the need for additional mechanical hardware.

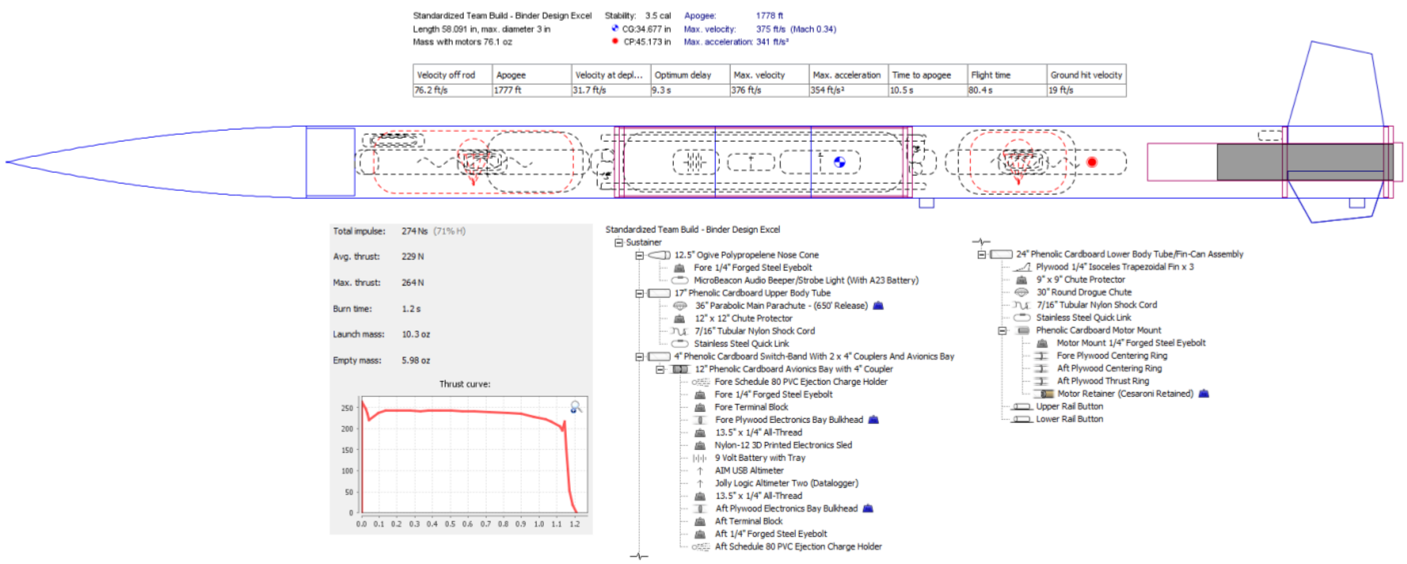
We have chosen, as our competition motors: **(Excel)** Cesaroni 38mm – H225 – White Thunder; **(Enceladus)** Cesaroni 38mm – J530 – IMax; and **(IRIS)** Cesaroni 54mm I100 – Red Lightning Longburn.

We have chosen, as our test flight motors: **(Excel)** Cesaroni 38mm – H225 – White Thunder (*already flown*); **(Enceladus)** Cesaroni 38mm – I212 – Smoky Sam; and **(IRIS)** will not be test flown.

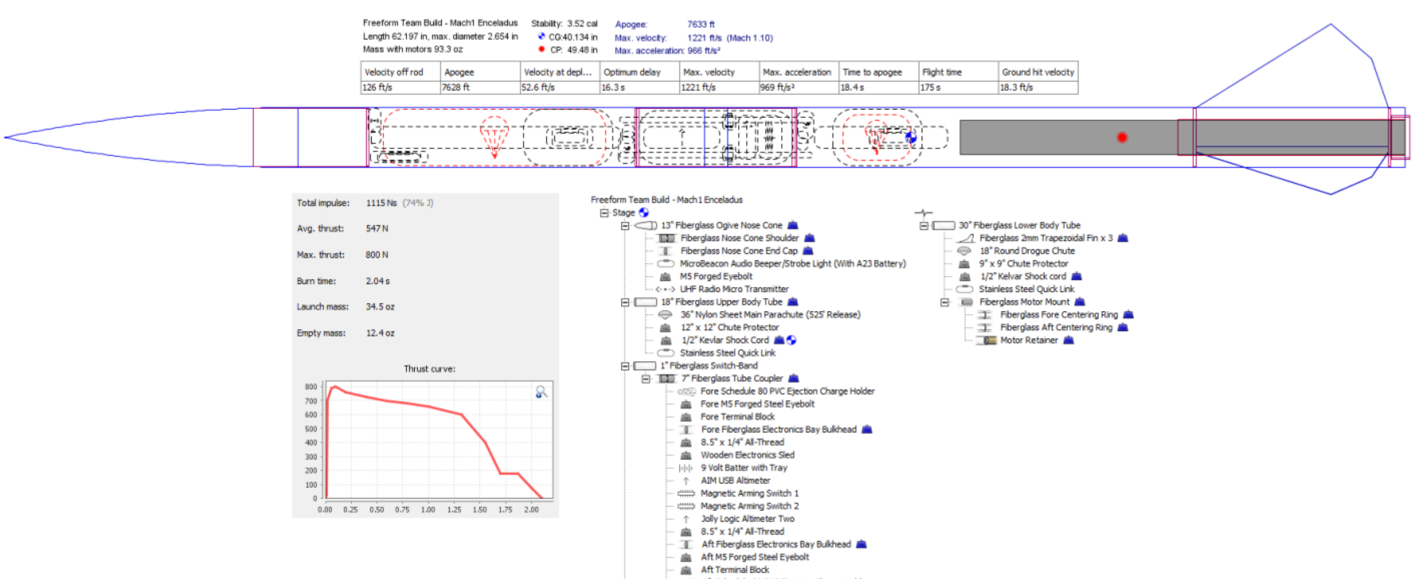
This leaves only the Enceladus as a test flight, and as such we will only need the single test flight motor: 38mm I212 – Smoky Sam.

And, finally, as an attempt to learn as much as possible from this competition, our team will be designing, and printing, a flyaway mechanism for our Enceladus rocket. As we wish to make Mach 1.1+ we are attempting to streamline the exterior of the rocket by removing the arming switch, and extemporaneous holes, and any launching mechanisms from the body tube.

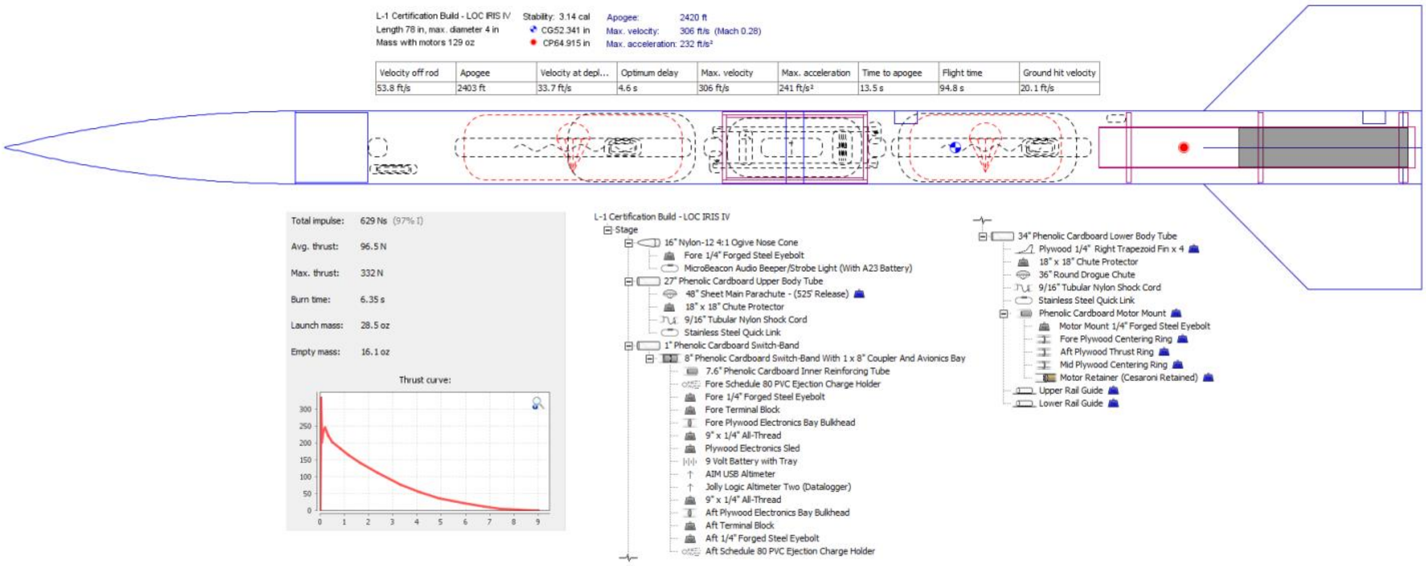
Standardized Team Build – Binder Design Excel (using competition motor):



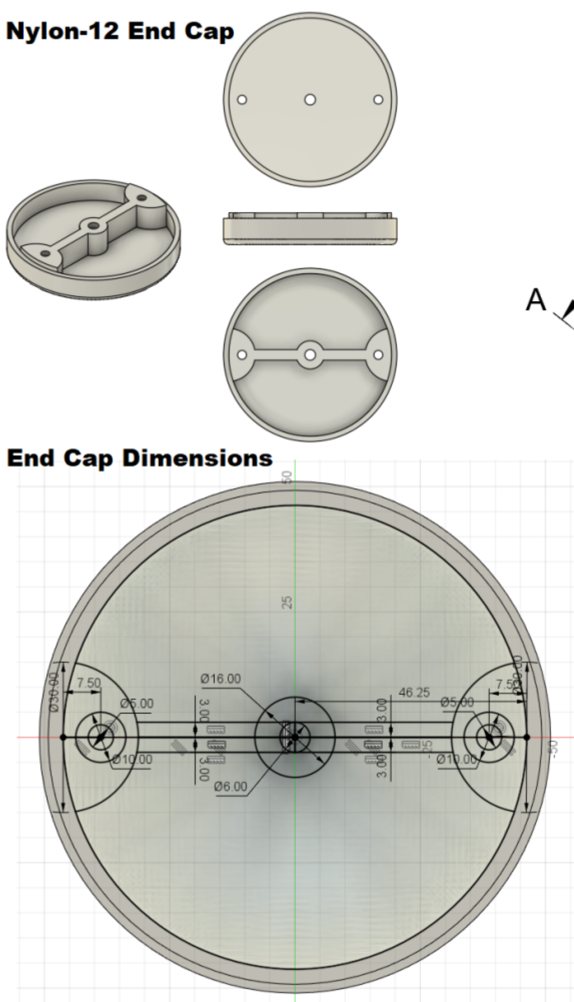
Freeform Team Build – Mach1 Enceladus (using competition motor/modified for dual deployment and electronics bay):

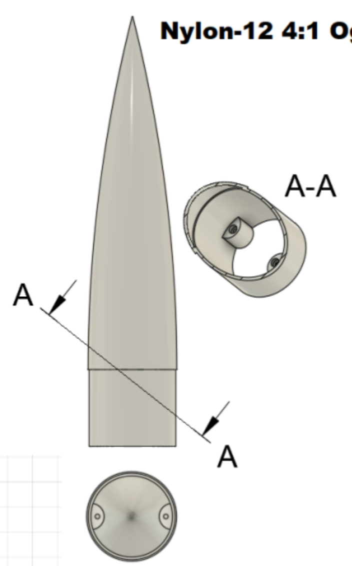


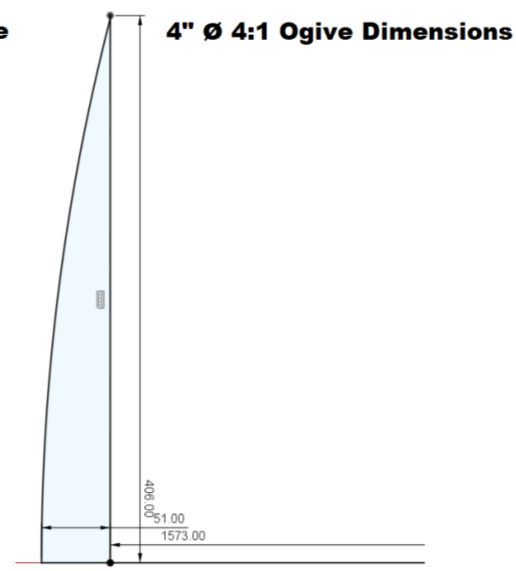
L-1 Certification Build – LOC IRIS IV (using competition motor/modified for dual deployment):



Dimensions and Design of Removable-Cap Nylon-12 3D Printed Nose Cone for LOC IRIS IV L-1 Build:







Proposed Nose Cone for L1 Certification Build (IRIS.) 4" ø by 20" Length Cap-To-Tip Nose Cone with Perfect 4:1 Ogive Printed Using Nylon-12 Polymer ((C12H23NO)n.)

Nylon-12 Is Known for its Toughness, Tensile Strength, Impact Strength, and Ability to Flex Without Fracturing. End Cap Designed for Easy Removal for Nose Cone Cargo Stowage.

Design by Kelly Behlen