Spaceport America Cup Rocket

The Competition

The Spaceport America Cup Rocketry Competition is an international event with 20 countries and 152 teams competing. The goal is to build a rocket that delivers an 8.8 lb. payload as close to a 10,000 ft apogee as possible using a commercial off the shelf motor, and to achieve the precise apogee with an innovative design that pushes rocket engineering while maintaining safe practices. The rockets are being launched in New Mexico in June 2024. After the rockets launch, a panel of judges comprised of industry professionals evaluate each team based on rocket performance and design.

Results

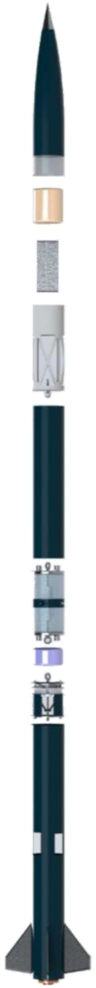
Through in-depth testing, simulations, and analysis, it is expected the rocket to experience over 8 g's at liftoff as the rocket accelerates to a trajectory of over 11,000 ft. After motor burnout, the altitude control system calculates the trajectory of the rocket 60 times per second and deploys air brakes to guide the rocket to its desired apogee of exactly 10,000 ft. At apogee, the air brakes close, and the rocket separates in two for the drogue parachute to deploy. The drogue parachute provokes a controlled decent velocity of 71 ft/s. At 1,000 ft above the ground, the main parachute deploys from the nosecone, slowing the decent velocity to 16.5 ft/s, and deploying the payload. Finally, the rocket returns safely to the ground just 4 minutes after liftoff without any damage, ready to be reused for another launch.

Flight Profile

TAURUS is expected to have a Utah State University Record breaking performance at the Spaceport America Cup Rocketry Competition this year.

TAURUS

TAURUS is a two-stage, carbon fiber rocket that stands 11'2" tall. The rocket uses a M2500T commercial off the shelf motor with a max thrust of 835 lbs.

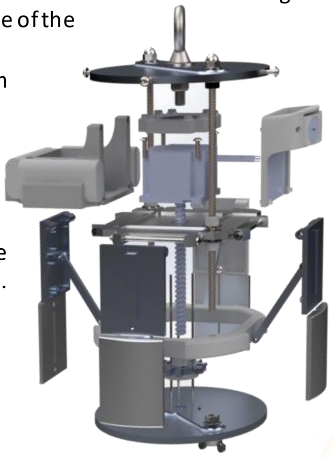


- Nosecone & GPS Bay
- Main Parachute
- Payload
- Deployment Piston
- Mid Airframe Assembly
- Recovery Bay
- Drogue Parachute
- Altitude Control System (ACS)
- Aft Airframe Assembly
- Motor Case

TAURUS is built in 3 sections, the nosecone, the mid-section, and the aft-section. The nosecone contains the GPS computers and antenna to enable the rocket's location to be tracked upon landing. The mid-section contains the main parachute, the payload, and the deployment piston. Between the mid and aft-sections is the recovery bay. The recovery bay contains the flight instruments and computers to control when parachutes are to be deployed. The aft-section contains the drogue parachute, the Altitude Control System (ACS), and the motor case.

Altitude Control System

The Altitude Control System (ACS) uses onboard instruments and computers to control a motor. The motor moves an actuator nut that controls the angle of the flaps. The angle of the flaps is determined by a control algorithm that uses the measurements from the instruments to calculate the rockets energy, then how much energy must be dissipated using drag. Over time the estimation becomes precise, resulting in a controlled accent to the target altitude.



Test & Analysis

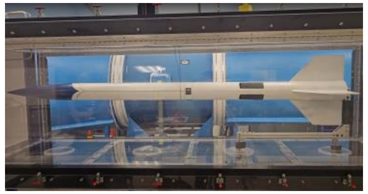
The team runs tests to ensure complete functionality of the rocket during operation and to comply with safety regulations. A summary of the major tests and analyses done are shown below:

Test Launches:

Test launches are critical to measure real world data and test critical and unique design, such as the ACS, payload deployment systems, and determine accuracy compared to computer simulations.

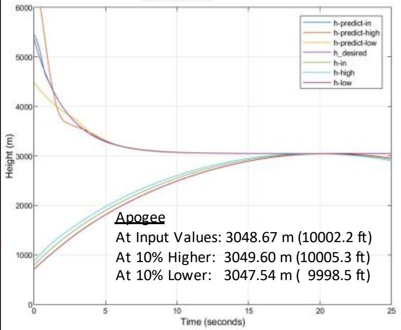
Wind Tunnel Testing:

The wind tunnel tests are used to determine the change in drag caused by the ACS flaps opening to a particular angle. This drag calculation is used by the computers to estimate control inputs.



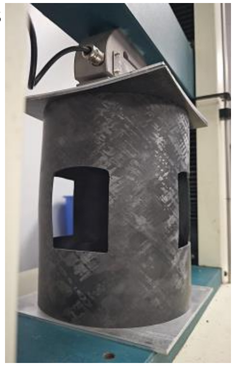
Computer Simulations:

The team developed personalized computer simulations to simulate flight conditions and control inputs and determine design solutions.



Rocket Body Crush Testing:

Crushing the body tube of the rocket to determine the strength of the design is one of many strength tests conducted. Tests to determine th e strength of bulkheads, motors, and all other critical flight performance was also conducted.



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