1.4 Target Summary

Table 2: Targets and Methods of Validation

Function	Target	Method of Validation	Tools for Validation
Supports payload	Payload storage space of 10 X 10 X 30 cm	Direct Measurement	Measuring Tape
Prevents damaging impact	Impact velocity of less than 1 m/s	Parachute Drop Test	Accelerometer
Imitates microgravity	Duration of at least 4 seconds of microgravity	Official Drop Test	Stopwatch and video footage
	Magnitude of 10^{-6} G of microgravity	Official Drop Test	Accelerometer
N/A	Maximum air vehicle weight of 15 kg	Direct Measurement	Scale

Critical Targets/Metrics

1. Duration of at least 4 seconds of microgravity
2. Magnitude of 10^{-6} G of microgravity
3. Impact velocity of less than 1 m/s
4. Maximum air vehicle weight of 15 kg
5. Payload storage space of 10 x 10 x 30 cm

Derivation

A duration of microgravity lasting at least 4 seconds is a critical target because it is the main goal of the project - that the air vehicle to be able to imitate microgravity. The target of 4 seconds was given as a specification for the competition. This is phase 2 of the Florida Space Institute's four-phase microgravity competition timeline, requiring a longer microgravity event than in the past. Along with the required duration, the definition of microgravity is a gravitational magnitude of 10^{-6} G, making this a critical target to hit as

well. These specifications were both provided by the sponsor's liaison, Michael Conroy, as a criterion of the competition.

The impact velocity target of less than 1 m/s was derived as a quantitative goal to be met to decrease the risk that the impact places on the integrity of the air vehicle. One meter per second is roughly walking speed for the average person; therefore, team 506 assumed that if we were to be walking and bump into a grass wall (see 'assumptions' for landing condition for competition), no significant damage would incur. If the air vehicle were to approach a walking speed prior to impact with the ground, damage risk can be minimized.

The maximum weight of 15 kilograms for the air vehicle, including the payload, is a result of the maximum weight the drone can support. This is critical because if the drone cannot carry the air vehicle to the required height, the test can't be done and therefore our team would be eliminated from the competition.

The payload storage space must be at least 10 x 10 x 30 cm to accommodate the payload that will be supplied to the team. The competition specifications assign the size of the payload to be the size of a 3U CubeSat. Upon further research, the group determined one 1U CubeSat to be 10 x 10 x 10 cm, with "3U CubeSat" implying that the payload is the size of three 1U CubeSats. With three cubes with 10 cm sides aligned in a row having the combined dimensions of 10 x 10 x 30 cm, this is the total payload size the air vehicle must accommodate.

Method of Validation

Team 506 plans to accomplish two major tests before the competition date: the first being to verify the timing and functionality of the parachute deployment system and the second being an official drop test of the entire assembly. This test will be scaled down due to restrictions in drop height feasibility, therefore the duration of microgravity will be less than 4 seconds. However, the 4 second microgravity event will be validated using a GoPro camera and a stopwatch. The GoPro will monitor pebbles placed in a glass container, with the duration of their suspension in the box determining the length of the microgravity event. This will be the validation method for critical target 1. Along with a GoPro recording the motion, the accelerometer will record the noise of the pebbles. This data will be used to calculate and plot the gravity of the payload throughout the drop. The average gravity during the microgravity event will be used to verify that microgravity, or critical target 2, was reached.

Critical target 3 will be validated by way of a preliminary parachute deployment drop test. This test will comprise of the parachute deployment system, the microcontroller that reads data from the accelerometer, and added mass to simulate the weight of the air vehicle. The tools to validate the speed of the parachute compartment will primarily be the accelerometer data, but also, as a back-up, a video recording to provide a qualitative, rather than quantitative, analysis.

To measure scalar values such as length and mass, the team plans to use direct measurement with the standard tools available for each measurement. Critical target 4 will be validated by weighing the payload with a scale. Either a mass scale or a weight scale will work for our measurements; if a weight scale is used, the output value must be divided

by the gravitational constant to obtain mass. Critical target 5 will be validated by simply measuring the payload storage space within the air vehicle with a measuring tape or a caliper.