## Test Plan Document: CubeSat Size Growing Autonomous System Version 1

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## **Test Verification Matrix**

This document maps each project requirement to specific test cases to ensure full specification coverage. It details the verification method for each requirement—Analysis, Test, Demonstration, or Inspection—and assigns measurable success criteria to ensure a structured, traceable verification process. Conducted on a pass/fail basis, this approach checks the project deliverables meet the defined requirements.

Req#	Function	Requirement	Test Method	Success Criterion	Test Case	Pass/ Fail
1	ME	The plant chamber shall be capable of fitting within a 3U space	Inspection	The CubeSat is measured in U which equates to a 10 cm x 10 cm x 11.35 cm dimension. A 3U would be 10 cm x 10 cm x 34.05cm. The plant chamber must be measured using a ruler to verify if it is smaller than 3U.	Is the plant chamber smaller than 3U?	
2	EE	Circulate air through the chamber at a velocity of 0.3-0.5 m/s using fans	Inspection	Mark a spot on the fan and count the number of revolutions in each time to get the RPM. Find the velocity using the RPM and radius of the fan and compare it to the estimated speeds according to the user manual.	Does the fan speed calculation align with the 0.3-0.5 m/s speed required?	
3	EE	The grow light shall provide an intensity of 200- 250 µmol/m2/s with a light wavelength of 400-700 nm for 16-18 hours daily.	Test	Use the VEML light sensor to detect the LED intensity in terms of lux. Complete a day cycle using the sensor and compare the data recorded to verify our light is providing the correct intensity throughout each cycle of the day. We will showcase this through a plot displaying the recorded light intensity throughout the day	Does the light sensor detect an intensity in the given range of provide an intensity of 200- 250 µmol/m2/s?	
4	EE	The microcontroller should have, at the minimum, the same number of I/O pins as sensors with room for	Test	The total number of final sensors and external devices must be counted. The total must then be less than the I/O ports of the board and have stackable headers to add shields on top of the board.	Does the total number of devices exceed the given I/O interfaces in the microcontroller?	

		expansion boards.				
5	EE	The antenna must communicate from the weather balloon to the ground station, about 25 km-35 km.	Demonstration	The launch of the weather balloon will be the opportunity to see if communication reaches the required distance and a complete data set must be sent and received to be confirmed. Preliminary trials of testing the antennas capability to transmit from a long distance will also be considered.	Is the system capable of transmitting readable data to the ground station from the weather ballon?	
6	EE	Temperature sensor to measure the desired range of 50-80 degrees F	Test	Simulate different temperature conditions from different ranges using a thermostat to control the environment. The sensor must be able to detect within ±4 degrees of the actual temperature within the given range.	Does the temperature sensor measure in the desired range with the appropriate error range?	
7	EE	Humidity sensor to measure the range of 40%- 80% RH	Test	Control the environment using a humidifier and dehumidifier and measure the change. The sensor must be able to read data in the RH range given.	Does the humidity sensor measure within the 40%-80% RH range?	
8	EE	CO2 sensor measure range of 400-1500ppm	Test	Move sensor to different environments with higher and lower CO2. The sensor must be able to give values within the ppm range given.	Does the CO2 sensor sense change and can it measure within the appropriate ppm range?	
9	EE	O2 sensor measure range of 160,000 - 209,000 ppm	Test	Move the sensor to different environments with higher and lower O2 levels. The sensor must be able to detect within the given ppm range.	How effective and reliable is the O2 sensor in measuring the specified range?	
10	EE	Ethylene sensor measure range of 0-100ppb	Test	Move the sensor to different environments with higher and lower ethylene levels possibly besides various plants. The sensor	Does the ethylene sensor give a reading within 2% error	

				must be able to sense the changes and measure up	and measure up to 100ppb?	
				to 100 ppb.		
11	EE	The solar panels and battery will generate/store enough power to allow the CubeSat to operate autonomously.	Demonstrate	Use datasheets of each component, develop a power budget, and see if the device is powered during operation. The solar panels of the mechanical teams must be tested in the normal day conditions and the total power must be measured and compared to the power budget.	Will we have enough power to continuously run the system, in sleep mode, and operating?	
12	EE	Optical/fisheye camera imaging on root zone and sprout zone	Test	Take multiple images in different orientations and positions of different plants in various stages. The images must be identifiable.	Are the images clear enough to give us information about the plant's health?	
13	EE	Payload shall include hyperspectral camera imaging on the leaf zone	Test	A camera will be used to simulate a hyperspectral camera. At given time periods the LED's will change to provide different lighting on the plant. This will be then run through filters to give a clear image.	Does the camera provide clear images under different light conditions that allow us to illuminate certain parts of plants to further analyze?	
14	EE	The acquired payload images and sensor data shall be capable of modeling through MATLAB and machine learning for comprehensive analysis.	Test	Run multiple images and sensor data cycle. Then, have the ability acquire the data in an organized manner to further process, if necessary, into MATLAB or another program to give us more insight on the plant's health.	Will the data be of enough quality and quantity to analyze in another program?	
15	EE	Communication between sensors must be SPI, UART, I2C	Test	Send data or packets between the microcontroller and sensors to verify whether the protocol is properly working and receiving the correct information	Is the data sent comprehensible between the sensors and microcontroller?	