Senior Design 2018/2019

Maroon Five

Anas Alhamad

Arik Espineli

Jasmine Gill

Jeff Smith

Miranda Sweigert

Test Plans

5/7/1

Table of Contents

T001: Object and Stop Speed Detection 3

T002: Structure Test 7

T003: Limit Switch Test 10

T004: Bluetooth Compliance 13

T005: Electronics Fire Resistance 15

T006: Current Draw and Emergency Stop Button 18

T008: Drop Test 24

T010: Liquid Ingress Test (T009 has been omitted and combined with T005) 27

T011 Solid Ingress Test 32

T012: Data Rate Measurement 37

T013: Time to Detect Fire 40

T014: Field of View 43

T015: Detection Accuracy Test **Error! Bookmark not defined.**

T016: False Alarm **Error! Bookmark not defined.**

T017: Gantry Range Test 46

T018: Gantry Movement Speed Test 50

T019: Gantry Movement Accuracy Test 54

T020: System Scalability Verification 58

T021: Extinguisher Fire Type Verification 61

T022: System Fire Size Capabilities 64

T023: Actuation Device Test 68

T024: Extinguisher Accessibility Test 72

T025: Time to Actuation Test 76

T026: Total Cost Calculation 80

T001: Object and Stop Speed Detection

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	Object and Stop Speed Detection
Test ID Number:	T001
Relevant functional specification(s) being tested:	S001: The gantry system shall come to a complete stop if an unexpected obstacle is detected within 0.5 foot of the system. The gantry system should come to a complete if an unexpected obstacle is sensed within a foot of the system. S002: From maximum speed (M003) the gantry shall come to complete stop in 0.2 second. From maximum speed (M003) the gantry should come to complete stop in 0.1 second.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	Test if the ultrasonic sensors are able to detect an object 0.5ft - 1.0ft away from the gantry system. Test the amount of time it takes for the gantry system to come to a complete stop after the stop sequence has been initiated. This test will be conducted 10 times
Equipment List:	Gantry system, ultrasonic sensors, measuring tape, video recording device
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	Dummy fire location to be sent to the gantry MCU from the sensor box. The location is arbitrary, it has to allow for the gantry system to reach its top speed and still have enough room to possibly trigger the ultrasonic sensor from 3ft away. S001: A dummy obstacle, 8x8” cardboard cutout to represent a hand. The sensor will detect the cutout and the MCU will start the stop sequence. S002: No dummy values necessary, the stop signal will be sent to the system once an obstruction has been detected.
Description and / or images of test setup	The system will be triggered by a button on the sensor box to go to the location of the “fire.” After reaching its top speed it should detect the object in its way and come to a complete stop.

Inputs or input ranges to be used (include number or test points and increments)	The placement of the cardboard cutout must be at least 3 ft away from the distance that it would take it to reach its top speed (time & distance to top speed calculated on paper).
Anticipated results/outcomes	S001: Detection of object 0.5 - 3 ft away from the gantry system. S002: Complete stop of the system within 0.2 seconds.

Specification Test Log

Date/Time of testing:	5/4/19
Test participants:	Test Lead: Jasmine Gill, Participants: Arik & Miranda
Test ID Number:	T001
Relevant functional specification(s) being tested:	~~S001~~ S002

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

Trial #	S001: Detection Distance (ft)	S002: Stop Time (s)
1	n/a	Instantaneous
2	n/a	Instantaneous
3	n/a	Instantaneous
4	n/a	Instantaneous
5	n/a	Instantaneous
6	n/a	Instantaneous
7	n/a	Instantaneous

8	n/a	Instantaneous
9	n/a	Instantaneous
10	n/a	Instantaneous

Test Deviations

Deviations from the test as written in the test plan:

We were unable to test S001 because the method to detect objects wasn't implemented. We measured stop speed using limit switches.

Test Results (circle)

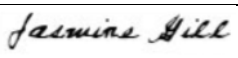
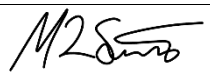
Complete Pass	Partial Pass	Fail

For S002 only.

Test Commentary

The partial pass is because we were unable to test S001. The tests for S002 were passed using limit switches. The stop time was instantaneous when the limit switch had been depressed.

Signoff

Name	Signature	Role
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T002: Structure Test

Team/Project:	Maroon 5: AGES
Test Name:	Structure Safety
Test ID Number:	T002
Relevant functional specification(s) being tested:	S003: Structure - **The support structure shall be able to support 30 kilograms (66 pounds). The support structure should be able to support 40 kilograms (88 pounds).**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The Purpose of this test is to ensure the safety of our system by proving that each ceiling support has been designed to support a load twice as heavy as our system. One bracket will be tested three times for both weights, 30kg and 40kg The bracket will be set up without the gantry and the weights will be attached via a rope that will be attached prior to adding any weights. Weight will be added until the required payload is reached, then the bracket will be checked for any damage
Equipment List:	rope, weights
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	None
Description and / or images of test setup	Set up one ceiling bracket without attaching the gantry system. Attach rope rated for enough strength to bracket Attach weights via a rope and carabiner rated for strength, the carabiner will be attached to the rope that is on the bracket.
Inputs or input ranges to be used (include number or	30kg weight, 40 kg weight

test points and increments)	
Anticipated results/outcomes	We anticipate that the ceiling brackets will be able to support the 40kg payload without deformation or failure.

Specification Test Log

Date/Time of testing:	5/1/2019
Test participants:	Jeff, Arik, Miranda
Test ID Number:	T002
Relevant functional specification(s) being tested:	S003

Test Results

The bracket proved its strength supporting the cyclical loading of the 30kg weight as well as the 40kg load. During the loading of the bracket there appeared to be no yielding. After further inspection we concluded that there were no signs of deformation to the bracket or welds. The total weight tested was 43kg which was fully supported with no issues

Test Deviations

None

Test Results (circle)

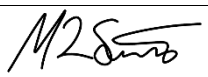
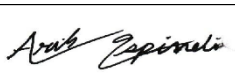
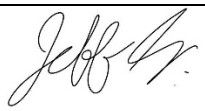
Complete Pass	Partial Pass	Fail

Test Commentary

n/a

Signoff

Name	**Signature**	**Role**
Jasmine Gill	Jasmine Gill	CPE/EE

Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T003: Limit Switch Test

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	Limit Switch Test
Test ID Number:	T003
Relevant functional specification(s) being tested:	S004: The gantry system shall come to a complete stop within 6 inches of the end of the gear rack. The gantry system should come to a complete stop within 4 inches of the end of the gear rack.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The test is being performed to check if the limit switches properly stop the gantry system from reaching the edge of the tracks without falling over. This is necessary so that we can ensure that the gantry system can travel to the edges of the tracks. This test will be conducted 10 times
Equipment List:	Limit switches, gantry system, measuring tape, tape
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	There are no dummy inputs necessary for this test.
Description and / or images of test setup	With the gantry system set a start signal will be sent to the system. After the system starts moving the limit switch will be used to trigger the stop sequence. The distance that the gantry system travels from where the limit switch is triggered to the complete stop of the gantry system will be measured with a measuring tape. The limit switches will be placed on the rail so that the gantry system can trigger them and simulate having reached the end of the rail.
Inputs or input ranges to be used (include number or test points and increments)	Limit switch trigger
Anticipated results/outcomes	We anticipate the test to be successful within 0.5” of the target.

Specification Test Log

Date/Time of testing:	5/4/19
Test participants:	Test Lead: Jasmine Gill, Participants: Miranda Sweigert
Test ID Number:	T003
Relevant functional specification(s) being tested:	S004

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

The results of this test were the same as the T001. The gantry system comes to a complete stop instantaneously when the limit switch is depressed.

Deviations from the test as written in the test plan

None

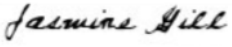
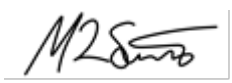
Test Results (circle)

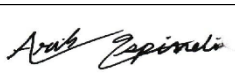
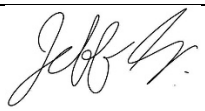
Complete Pass	Partial Pass	Fail

Test Commentary

n/a

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE

Arik Espineli		**ME**
Jeff Smith		**ME**

T004: Bluetooth Compliance

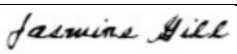
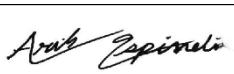
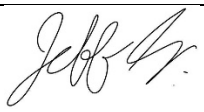
Team/Project:	Maroon 5/A.G.E.S
Test Name:	Bluetooth Compliance
Test ID Number:	T004
Relevant functional specification(s) being tested:	S006: The sensor box and microcontroller will be compliant with IEEE 802.15.1: WPAN / Bluetooth.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The data sheet reflects IEEE Compliance and therefore it is not necessary to run a test on this specification because the bluetooth chip being used on the PSoC6 Prototyping Board is compliant with IEEE 802.15.1
Equipment List:	n/a
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	n/a
Description and / or images of test setup	n/a
Inputs or input ranges to be used (include number or test points and increments)	n/a
Anticipated results/outcomes	Datasheet that reports compliance with IEEE 802.15.1

FCC

FCC NOTICE:

The device CYBLE-416045-02 complies with Part 15 of the FCC Rules. The device meets the requirements for modular transmitter approval as detailed in FCC public Notice DA00-1407. Transmitter Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Signoff

Name	Signature	Role
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T005: Electronics Fire Resistance

Team/Project:	Maroon Five/AGES
Test Name:	Electronics Fire Resistance
Test ID Number:	T005
Relevant functional specification(s) being tested:	S007: Electronics Fire Resistance – **The electronics will be compliant with ULC-S139.** D003: Sensor Box Operating Temperature - **The sensor box housing shall be able to operate at a temperature of 440 F and should operate at a temperature of 980 F**. D006: Gantry System Operating Temperature - **The gantry system shall be able to operate in a temperature of 440 F and should operate at a temperature of 980 F**.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The purpose of this test is to show that our electronics inside the housings will not overheat during the occurrence of a fire. To test this, we will put a thermocouple inside the housing without the electronics present. The box will be set at 8 feet above the fire. We will then create a fire of size 8”x8”x8” and let it be under the housing for 30 seconds, as this is longer than the box would be exposed to this condition with the system fully functional and extinguishing the fire. Then after 30 seconds, we will record the temperature reading. The box will then be opened and allowed to cool. Repeat this three times Both the sensor box and electronics housing will be tested
Equipment List:	Fire, fire containment, thermocouple
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	N/A

Description and / or images of test setup	Fire containment box on ground, electronics housing will be at 8 feet above this fire area. Someone will need to stand on a ladder to maintain the height of the electronics housing.
Inputs or input ranges to be used (include number or test points and increments)	Fire size of 8x8x8 inches
Anticipated results/outcomes	The internal temperature reading shall not exceed 65 deg C, as this is the maximum working temperature of the motor drivers.

Specification Test Log

Date/Time of testing:	5/5/2019
Test participants:	Arik, Miranda, Anas
Test ID Number:	T005
Relevant functional specification(s) being tested:	S007, D003, D006

Test Results

The average temperature inside the sensor box after 30 seconds was 20 deg C. the average temperature inside the sensor box after one minute was 25 degrees C. This was when the box was held at 7’10” above the fire, with a fire size of approx. 8”x8”x8”.

The recorded field of view was less than what was calculated because it was at a lower height than was calculated for. If able to be adjusted to the correct height, then the calculation will be accurate.

Test Deviations

Electronics box was not tested because there was not a safe way to hold it above the fire, as it has a significant weight and we were limited in terms of vertical space.

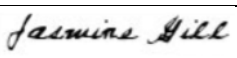
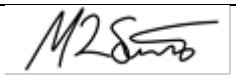
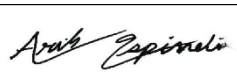
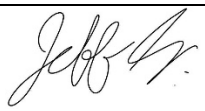
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

Partial pass because the electronics box was not tested above the fire. Based on the results of the sensor box, we can say that the electronics box should not exceed a temperature inside of more than 25 degrees C under the expected operating conditions.

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T006: Current Draw and Emergency Stop Button

Team/Project:	Maroon 5
Test Name:	Current Draw and Emergency Stop Button
Test ID Number:	**T006**
Relevant functional specification(s) being tested:	**S005:** The gantry system will cut off the current to all of the components once the stop button has been pressed. **S008:**The main unit will operate on a wall outlet, 120VAC, and the drawn current will not exceed 13 Amps.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The stop button will be tested using a Multimeter connected to its both ends to measure the resistance when the stop button is closed and when open. An open circuit, infinite resistance, indicates the current is no longer present. This test will be conducted 5 times The current draw test will be conducted using the motors data sheet since they are the only main parts that require high current. Power max. = I^2 *R * Phase = (5)^2 * 1 * 2 = 50 W The maximum Current pulled by the motor = 50/5 = 10 A at 5VDC Thus, the main power outlet, 120VAC, will see a current of 50/120 = 0.42 A Both motors will then make 0.42 * 2 = 0.84 A at 120VAC Since the system uses a wall outlet, 120VAC, this pulled current only makes about 15% of the designed maximum Current.
Equipment List:	Multimeter: to measure the resistance
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	N/A
Description and / or images of test setup	The Multimeter needs to be placed between both ends of the stop button.
Inputs or input ranges to be used	N/A

(include number or test points and increments)	
Anticipated results/outcomes	The Multimeter will read infinite resistance when the stop button is pressed. The sum of all needed current to run the motors at max is less than 7 Amps.

Specification Test Log

Date/Time of testing:	
Test participants:	Test lead: Anas Alhamad
Test ID Number:	**T006**
Relevant functional specification(s) being tested:	**S005** **S008**

Test Results

The stop button was tested as directed and the Multimeter read zero Ohm when pushed and infinity when pulled back.

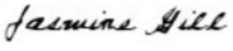
Test Results (circle)

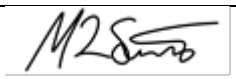
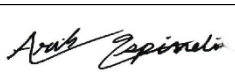
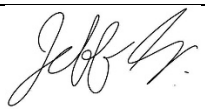
Complete Pass	Partial Pass	Fail

Test Commentary

N/A

Signoff

Name	Signature	Role
Jasmine Gill		CPE/EE

Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T007: System Lifetime

Team/Project:	Maroon 5 *A.G.E.S*
Test Name:	**System Lifetime**
Test ID Number:	**T008**
Relevant functional specification(s) being tested:	D001: System Lifetime – **The system shall remain operational for 2 years with annual maintenance. The system should remain operational for 5 years with annual maintenance.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The *A.G.E.S* should work for an extended time period in order for the product to be a viable option for consumers. This test will be done by determining the critical resource of the system and using that to determine the maximum lifetime of the critical resource to tell us the minimum lifetime of the system, and when the critical resource will need to be replaced, assuming that regular maintenance to the system has been performed.
Equipment List:	Gantry System
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	
Description and / or images of test setup	Calculation
Inputs or input ranges to be used (include number or test points and increments)	N/A
Anticipated results/outcomes	We anticipate that the minimum lifetime will be at least 2 years

Specification Test Log

Date/Time of testing:	5/2
Test participants:	Test Lead: Jeff
Test ID Number:	T008
Relevant functional specification(s) being tested:	D001: System Lifetime – **The system shall remain operational for 2 years with annual maintenance. The system should remain operational for 5 years with annual maintenance.**

Test Results

After thorough research and in depth analyses of our system components we have determined that without any standby or active redundancies our system will have a lifetime of 4.8 years. At normal operating conditions the strength of the materials chosen in the mechanical system will be able to withstand cyclical loading of 40kg without any yield or failure. Trusting the supplier of the PCB and our own soldering craftsmanship, the electrical components will last decades before they reach their lifetime. However the lifetime of a Nema 34 stepper motor is about 10,000 operation hours which makes out to about 4.8 years. The stepper motors are our system critical resource and therefore the lifetime of the system is limited by the motors lifetime.

Test Deviations

N/A

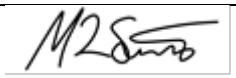
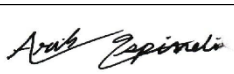
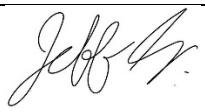
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

It is difficult to determine what is meant by 10,000 operation hours. Our system is always on standby which means that the motors are always powered, but the only time they actually move is in the scenario of a fire which would total to much less than an hour of movement in a year. The 4.8 year system lifetime meets our threshold value and comes just below our objective however we are confident that with the limited motor movement our system lifetime will exceed five years.

Signoff

Name	Signature	Role
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T008: Drop Test

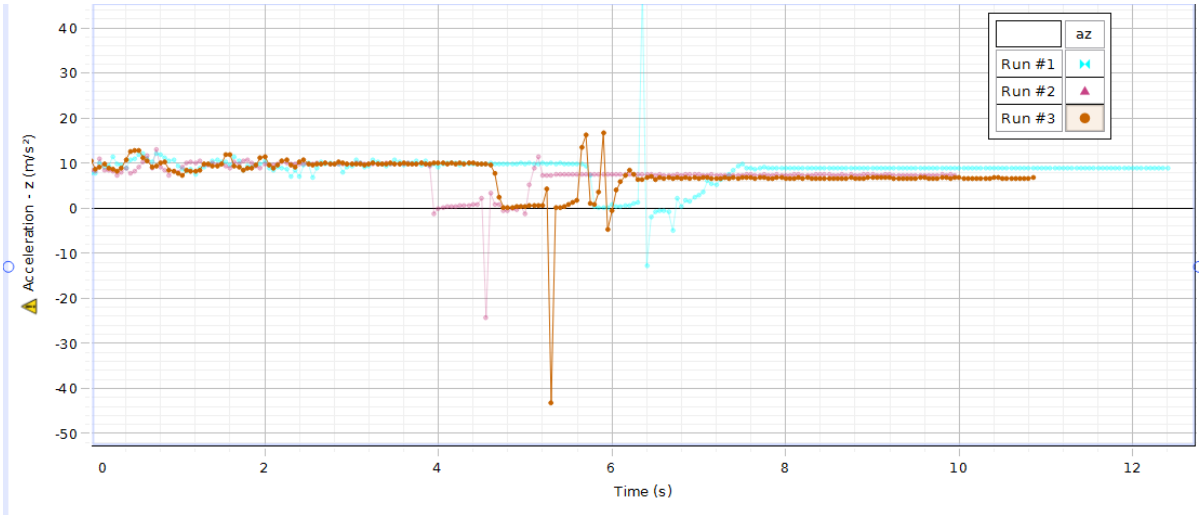
Team/Project:	Maroon 5 *A.G.E.S*
Test Name:	Drop Test
Test ID Number:	T009
Relevant functional specification(s) being tested:	D002: Sensor Box Durability - **The housing for the sensor box shall withstand multiple falls from 6 foot above ground and should withstand multiple falls from 10 feet above the ground**.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	This test is being done to ensure that the sensor box will still work if it falls from its place on the system. The sensor box can be positioned anywhere in the shop and may be improperly placed which could lead to the box falling. This test will prove that the box still functions after a fall. This will be tested by measuring different heights (6 feet, 8 feet, 10 feet). The sensor box will be dropped 3 times at each height. After each drop, the box will be visually inspected for damage, and the dummy electronics will be tested for basic functionality by running a current through and measuring with a Multimeter to check that the current runs where it is laid out to run. The box will be dropped three times from each height.
Equipment List:	ladder, empty sensor box, measuring tape, Multimeter
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	
Description and / or images of test setup	The box will be dropped from a ladder and the height of the drop will be measured with a measuring tape. Inspect the box and test the electronics after each drop
Inputs or input ranges to be used (include number or test points and increments)	Dropping from different height ● 6 Feet ● 8 Feet ● 10 Feet

Anticipated results/outcomes	The sensor box shall not have visible damage after being dropped

Specification Test Log

Date/Time of testing:	**5/6/19 9:00pm**
Test participants:	Test Lead: Arik
Test ID Number:	T009
Relevant functional specification(s) being tested:	D002: Sensor Box Durability - **The housing for the sensor box shall withstand multiple falls from 6 foot above ground and should withstand multiple falls from 10 feet above the ground**.

Test Results



This graph is a view of the data from the accelerometer that was placed inside the box during the drops.

The box did not have any significant damage after being dropped three times at a height of six feet.

Test Deviations

The box was only tested at a height of six feet. This was decided because we were worried about the drops from a higher height causing significant damage. An accelerometer was placed inside the box to determine the max acceleration.

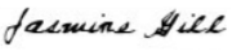
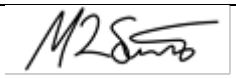
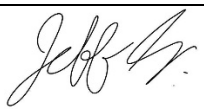
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

n/a

Signoff

Name	**Signature**	**Role**
Anas Alhamad		EE
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Arik Espineli		**ME**
Jeff Smith		**ME**

T010: Liquid Ingress Test (T009 has been omitted and combined with T005)

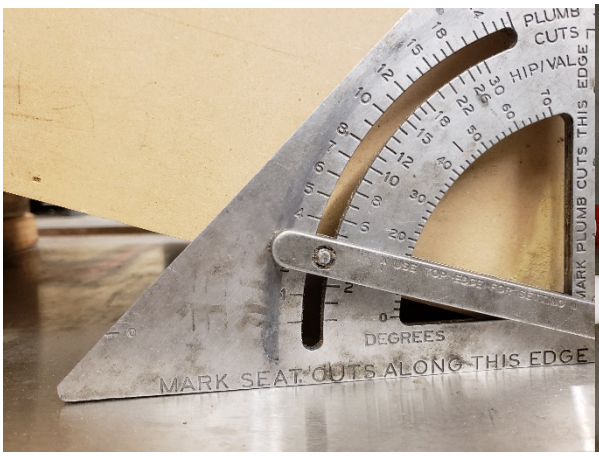
Team/Project:	Maroon 5 *A.G.E.S*
Test Name:	Liquid Ingress Test
Test ID Number:	T010
Relevant functional specification(s) being tested:	D004: Sensor Box IP Liquid Rating – **The sensor box shall have an IP liquid rating of 3. The sensor box should have an IP liquid rating of 4.** D007: Electronics Housing Water Resistance IP Rating – **The electronics housing shall have an IP liquid rating of 1. The electronics housing should have an IP liquid rating of 2.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The sensor box and the electronics housing will be operating in a machine shop or manufacturing environment. There is the risk of both to be exposed to liquids such as water, oil, or lubricants. In order to protect the electronics housing and the sensor box will need to stop liquids from entering. The test will be conducted by dripping or splashing the devices with water depending on the desired IP rating. This will include dripping water, splashing water at different degrees. A piece of paper will be placed in the box to indicate if any water got into the box. The test will be repeated 10 times to ensure proper sealing from liquids.
Equipment List:	Water Hose, spray bottle Protractor, Bucket, Stand for box/ housing
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	N/A
Description and / or images of test setup	Place device in bucket and adjust angle if needed. Have the hose above the device
Inputs or input ranges to be used (include number or test points and increments)	N/A

Anticipated results/outcomes	IP Liquid Rating 1 – Vertical Drips 2 – Water drips up to 15 Degrees 3 – water spray up to 60 degrees 4 – Splashing water from any direction No water observed inside the box after testing. Piece of paper free from water damage

Specification Test Log

Date/Time of testing:	5/6/19 7:00pm
Test participants:	Test Lead: Arik Espineli
Test ID Number:	T010
Relevant functional specification(s) being tested:	D004: Sensor Box IP Liquid Rating – **The sensor box shall have an IP liquid rating of 3. The sensor box should have an IP liquid rating of 4.** D007: Electronics Housing Water Resistance IP Rating – **The electronics housing shall have an IP liquid rating of 1. The electronics housing should have an IP liquid rating of 2.**

Test Results



Test Deviations

Test Repeated 3 times instead of 10

Test Results (circle)

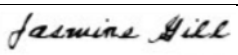
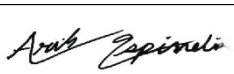
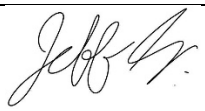
Complete Pass	Partial Pass	Fail

Test Commentary

Sensor Box achieved a Liquid IP rating of 3

Electronics Housing achieved a Liquid IP rating of 2

Signoff

Name	Signature	Role
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T011 Solid Ingress Test

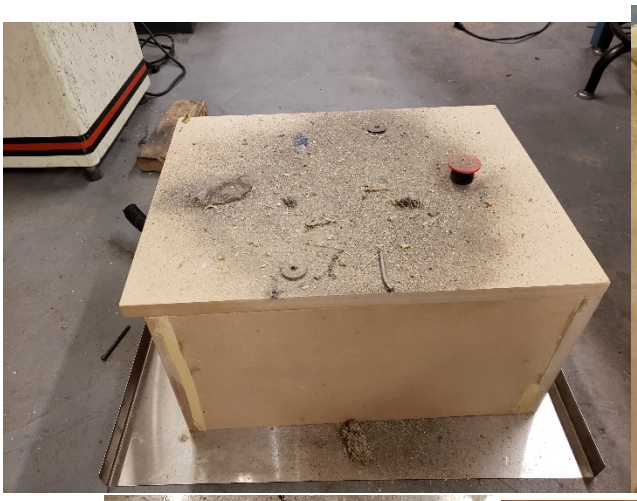
Team/Project:	Maroon 5 *A.G.E.S*
Test Name:	Solid Ingress Test
Test ID Number:	T011
Relevant functional specification(s) being tested:	D005: Sensor Box IP Solid Rating – **The sensor box shall have an IP solids rating of The sensor box should have an IP solid rating of 6** D008: Electronics Housing Dust Resistance IP Rating - **The electronics housing shall have an IP solids rating of 5. The electronics housing should have an IP solid rating of 6.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The sensor box and the electronics housing will be operating in a machine shop or manufacturing environment. There is the risk of both to be exposed to solids such as dust, metal chips, or sawdust. In order to protect the electronics housing and the sensor box will need to stop small particulates from entering. The test will be conducted by exposing the devices to saw dust and metal chips. The particles will be sprinkled on the devices. Depending on the desired IP rating little to no particles should enter the housing. The test will be repeated 10 times to ensure proper sealing from solid particles.
Equipment List:	Bucket, metal chips, saw dust
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	N/A
Description and / or images of test setup	Place device in bucket or container and sprinkle particles on device
Inputs or input ranges to be used (include number or test points and increments)	N/A

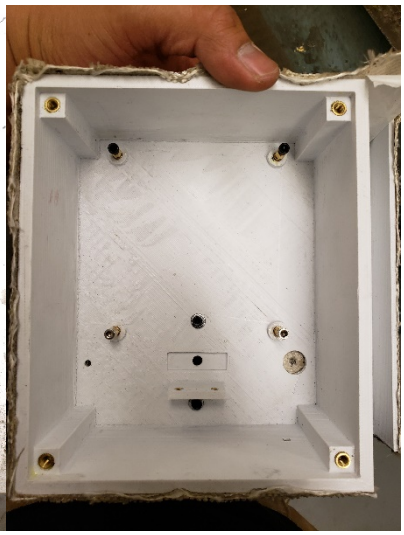
Anticipated results/outcomes	IP Solid Rating 5 - Ingress of dust is not entirely prevented, but it must not enter in sufficient quantity to interfere with the satisfactory operation of the equipment; complete protection against contact. 6 - No ingress of dust; complete protection against contact

Specification Test Log

Date/Time of testing:	5/6/19 6:00pm
Test participants:	Test Lead: Arik Espineli
Test ID Number:	T011
Relevant functional specification(s) being tested:	D005: Sensor Box IP Solid Rating – **The sensor box shall have an IP solids rating of The sensor box should have an IP solid rating of 6** D008: Electronics Housing Dust Resistance IP Rating - **The electronics housing shall have an IP solids rating of 5. The electronics housing should have an IP solid rating of 6.**

Test Results





Test Deviations

n/a

Test Results (circle)

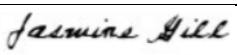
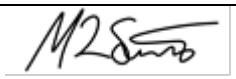
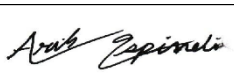
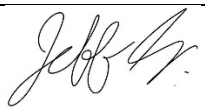
Complete Pass	Partial Pass	Fail

Test Commentary

Electronics Housing achieved a solid IP rating of 6

Sensor Box achieved a solid IP rating of 5

Signoff

Name	Signature	Role
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T012: Data Rate Measurement

Team/Project:	Maroon 5/A.G.E.S
Test Name:	Data Rate Measurement
Test ID Number:	T012
Relevant functional specification(s) being tested:	DE001: The data to trigger the fire suppression system shall be transmitted at a rate of 1Mbps. The signal should be transmitted at a rate of 2Mbps.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The purpose of this test to determine the speed of the bluetooth modules on the sensor box MCU and the gantry MCU are able to communicate with each other. This test will be conducted 10 times.
Equipment List:	Gantry System MCU, Sensor Box MCU
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	The sensor box MCU will be sending a data struct of size 2 bytes with “fire trigger” values to the gantry system MCU.
Description and / or images of test setup	The two microcontrollers will activate their bluetooth modules and establish a connection with each other. Once connected the gantry MCU will prompt the sensor box MCU for data and the sensor box MCU will send the struct with the dummy data.
Inputs or input ranges to be used (include number or test points and increments)	There will be no inputs, the process will be automated and the data rate will be saved in a text file via PuTTY.
Anticipated results/outcomes	The result will be close to 2Mbps. The exact number might be a little higher or lower due to rounding errors.

Specification Test Log

Date/Time of testing:	4/18/19
Test participants:	Test Lead: Jasmine Gill, Participants: None
Test ID Number:	T012
Relevant functional specification(s) being tested:	DE001

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

Trial #	Data Rate (Mbps)
1	0.97
2	1.03
3	0.92
4	1.1
5	1.06

Avg Data Rate = 1.01 Mbps

Test Deviations

Deviations from the test as written in the test plan

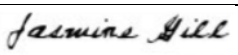
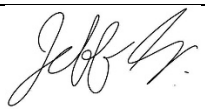
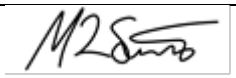
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

Additional notes on the test. If partial pass, you must comment on *what passed* and *what didn't*. If fail, you must comment on *why the system failed* and *what would be involved in meeting the specification* (i.e. how much work for the company, how much cost, etc.).

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Arik Espineli		**ME**
Jeff Smith		**ME**
Miranda Sweigert		**ME**
Anas Alhamad		EE

T013: Time to Detect Fire

Team/Project:	Maroon 5/A.G.E.S
Test Name:	Time to detect fire
Test ID Number:	T013
Relevant functional specification(s) being tested:	DE002: The sensor box shall detect a fire within 2 seconds or less. The sensor box should detect a fire in 1 second or less.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The purpose of this test to determine the amount of time it takes for the sensor box to detect a fire within its field of view. There will be an 8x8" metal containment that will contain a fire. The sensor box will be placed above the fire and a camera will record the sensor box as it tries to detect the fire (fire detection indicated by LED). The time is measured by counting the frames from when the sensor box is turned on to when the LED is turned on. This test will be conducted 3 times.
Equipment List:	Sensor Box, controlled fire ~8x8", LED to indicate fire detection, video recording
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	There will be no dummy inputs necessary for this test.
Description and / or images of test setup	The fire will be sit in an empty garage area near the testers house. There will be a fire extinguisher present.
Inputs or input ranges to be used (include number or test points and increments)	No direct inputs, the fire will be used to test the sensor box.
Anticipated results/outcomes	The sensor box should detect the fire within 2 - 2.5s.

Specification Test Log

Date/Time of testing:	May 5, 2019 / 8:30pm
Test participants:	Test Lead: Jasmine Gill, Participants: Anas Alhamad
Test ID Number:	T013
Relevant functional specification(s) being tested:	DE002

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

The average time that takes the sensor box to detect the fire is 0.807 seconds .

Trial #	Time to detection (s)
1	**0.681**
2	**0.770**
3	**0.971**

Test Deviations

Deviations from the test as written in the test plan

An alarm sound was added to the sensor box to allow time measuring without the need to record the LED. The sensor box was reset after each time it detect the fire and the time was measured from the point after each reset to the next alarm sound.

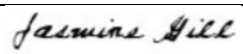
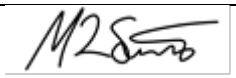
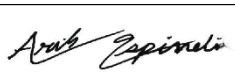
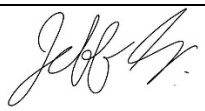
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

n/a

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T014: Field of View

Team/Project:	Maroon 5
Test Name:	Field of View
Test ID Number:	**T014**
Relevant functional specification(s) being tested:	**DE003:** The sensor box will have a field of view that covers a circular area with a diameter of 9.8 ft where it will detect the fire.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	To ensure the sensor box is covering the needed area, the sensor box will be placed 7'6" (from IR sensor to fire) away from a small fire (8"x8"). A fire will be lit in a contained metal area with a footprint of 8" by 8". This will be done by putting lighter fluid in a contained metal containment and lighting via a small paper lit on fire. This way the fire will burn out after no longer than 2 minutes. This will happen at the edge of a garage to make sure that heights can accurately be measured and wind will not interfere with the fire. A fan will be placed to help air out the space. The sensor box will be placed at the ceiling height above the fire and will be secured, and a team member will also stand on a step ladder to be able to press the rest button on the PSOC during testing. The sensor box (measure from lens center) will be placed at a horizontal distance away from the fire far edge of 3'9". (tan(50/100) * 7'6" = 3'9") The sensor box will be powered, then once it alarms (that fire has been detected), the reset will be pressed to allow it to alarm again. The box will be moved away from the location it detects, to verify the range of the sensor box. It will be moved by 4" away from the initial alarm location (safety distance to avoid outsider flames) and there should be no alarm then. Each location will be tested three times, by pressing the reset on the psoc to allow the sensor box to alarm in that location.
Equipment List:	Use the lens tube and IR sensor that is placed on the sensor box
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	This test needs to be conducted using real fire that follows the wanted size (8"x8").

Description and / or images of test setup	
Inputs or input ranges to be used (include number or test points and increments)	No direct inputs, the fire will be used to test the sensor box field of view.
Anticipated results/outcomes	The system needs to detect the fire only within the wanted range in order to pass.

Specification Test Log

Date/Time of testing:	5/5/19 7:00PM
Test participants:	Test lead: Anas Alhamad Participants: Arik Espineli, Miranda Sweigert
Test ID Number:	**T014**
Relevant functional specification(s) being tested:	**DE003**

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

After performing this test, the found results indicates a limitation in the seen area with an error percentage of 15.9 (22.35 instead of 26.57). The sensor box was not able to detect the fire placed at the edge of the calculated circular area. The team increased the vertical distance to the point where the sensor box was able to alarm. This vertical distance allowed for more circular area to be covered.

	Covered area (radius)	Sensor box angle
First Test (calculated)	3’9”	26.57 degrees

Second Test (Actual)	3’1”	22.35 degrees

Test Deviations

After finding this change in the angle used to find the covered area. The test was completed based on this new tested angle. To test the uncovered area, the fire was placed 4” away from its initial place.

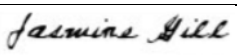
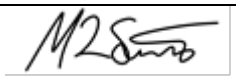
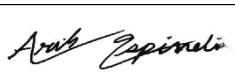
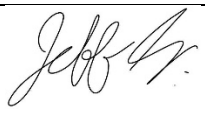
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

The results indicate an error of 15.9% in the field of view. This could be due to the fabrication of the sensor box tube, IR sensor positioning, and flame direction. When doing the test we noticed that the flame was mostly directed away from the sensor box direction. Since the fire was placed at the edge of the calculated covered area, we indicated that we will be able to check for any small error in the covered area. This test is marked as partial pass due to the found change in the covered area. However, after using the new tested angle the system behaved as expected and completely passed the test.

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Miranda Sweigert		**ME**
Anas Alhamad		EE
Arik Espineli		**ME**
Jeff Smith		**ME**

T017: Gantry Range Test

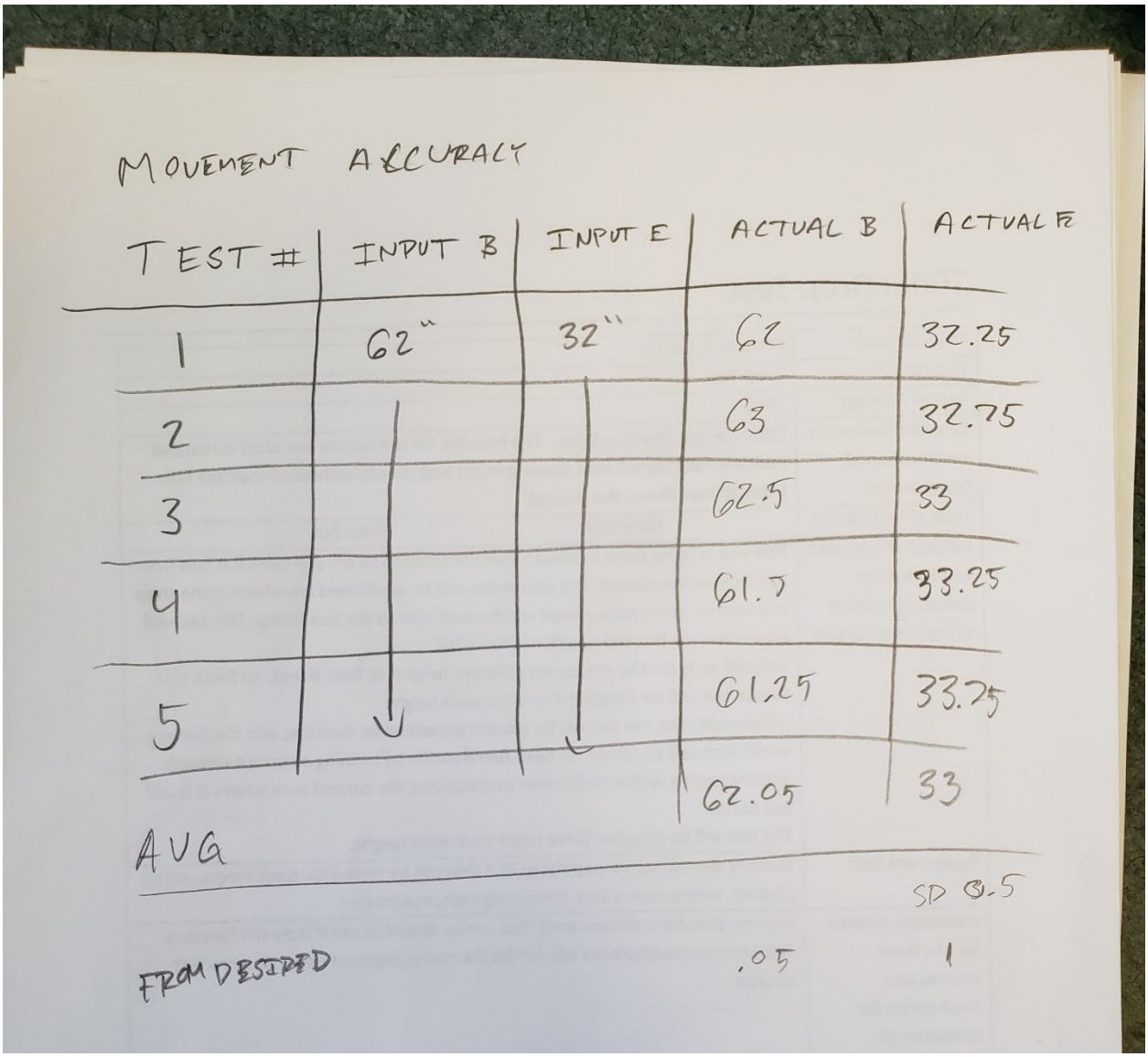
Team/Project:	Maroon 5: AGES
Test Name:	Gantry Movement
Test ID Number:	T017
Relevant functional specification(s) being tested:	M001: X Movement Range- M001: X Movement Range - The gantry system **will move a minimum of 3 feet in the X-axis, 1.5 feet in both positive and negative directions.** This has been determined sufficient for proof of concept, working in conjunction with specification M005, that the system will be demonstrably scalable, which allows for arbitrary geometry. This will be tested by measuring the full range of motion of the axis. M002: Y Movement Range - M002: Y Movement Range - The middle bar of the 'H', or gantry, shall successfully move in the Y-axis between the other two beams. **The beam will move a minimum of 5 total feet in the Y-axis, 2.5 feet in positive and negative directions.** This scale was established as suitable for proof of concept, working in conjunction with specification M005, that the system be demonstrably scalable, thus allowing for arbitrary geometry. The accuracy of placement is defined by specification M004 and is not relevant to this range specification. This will be tested by measuring the full range of motion of the axis.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The Purpose of this test is to prove that our system can cover the entirety of the specified area of 16 square feet. To test this we will have each axis motor set at zero and send step commands to the end of the respective x and y axis and verify with a measuring tape the distance covered by the gantry in each direction. We will run this test twice per axis because we can expect that the only factors in altering the distance traveled are the step count in code which is set and the gear rack length which is also set.
Equipment List:	Measuring Tape
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	None

Description and / or images of test setup	1. With the X axis motor at zero (middle of rack) send the appropriate code to the end of the rack in the positive direction. Observe that the gantry should hit the limit switch and stop. Measure the distance from zero position to the center of the pinion. 2. Repeat this process but send the gantry in the negative direction. 3. Repeat steps 1 and 2 for Y axis
Inputs or input ranges to be used (include number or test points and increments)	+-900 steps in code for x axis +- 300 steps in code for y axis
Anticipated results/outcomes	We anticipate that the gantry will travel within 1'' of it's maximum length (3ft for x axis, 1.5ft for y axis).

Specification Test Log

Date/Time of testing:	May 5 2019
Test participants:	Jasmine, Arik
Test ID Number:	T017
Relevant functional specification(s) being tested:	M001, M002

Test Results



MOVEMENT ACCURACY

TEST #	INPUT B	INPUT E	ACTUAL B	ACTUAL E
1	62"	32"	62	32.25
2			63	32.75
3			62.5	33
4			61.7	33.25
5			61.25	33.75
AVG			62.05	33
				SD 0.5
FROM DESIRED			.05	1

Test Deviations

Deviations from the test as written in the test plan

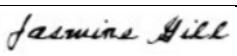
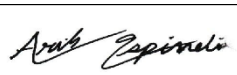
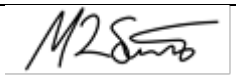
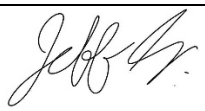
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

Additional notes on the test. If partial pass, you must comment on *what passed* and *what didn't*. If fail, you must comment on *why the system failed* and *what would be involved in meeting the specification* (i.e. how much work for the company, how much cost, etc.).

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Arik Espineli		**ME**
Miranda Sweigert		**ME**
Anas Alhamad		EE
Jeff Smith		**ME**

T018: Gantry Movement Speed Test

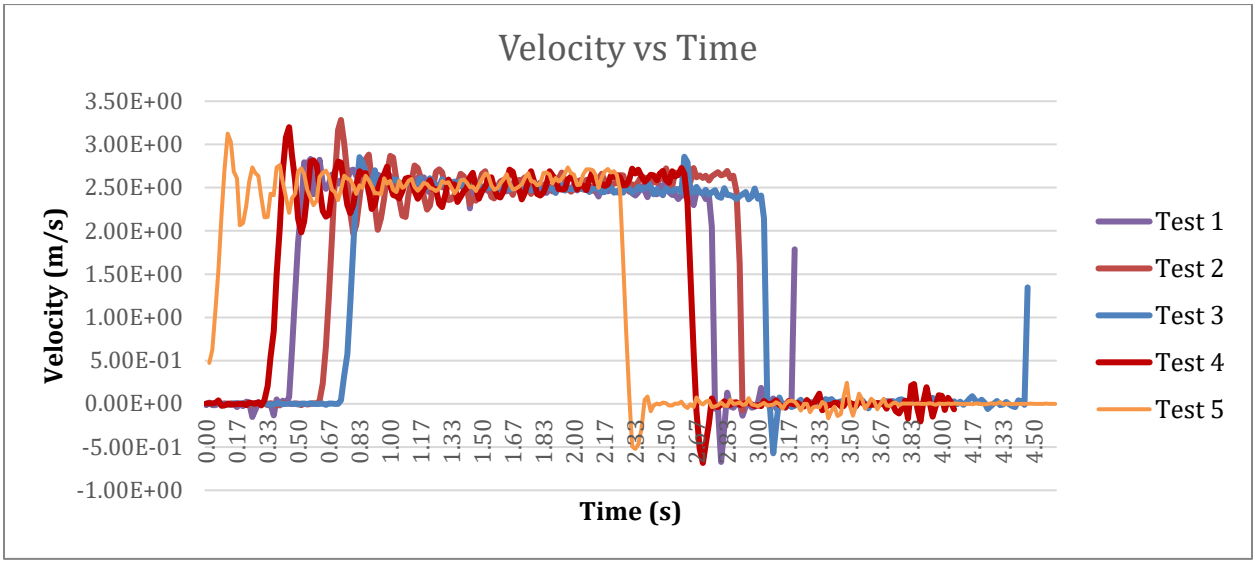
Team/Project:	Maroon 5: AGES
Test Name:	Gantry Speed
Test ID Number:	T018
Relevant functional specification(s) being tested:	M003: Movement Speed - **The system shall move at a speed of 4 feet per second, and should move at a speed of 8 feet per second**.
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The purpose of this test is to prove that our gantry not only meets our speed spec of 4ft/ sec but to prove that our system is a fast and effective fire extinguishing system. With the X axis motor at the end of the rack send the according code for a 2ft travel distance. Record the time it took to travel the distance. (This does not include acceleration because the motor either goes or does not go). Same for Y-axis. Every 6 inches is marked on both axes, so record the timestamp at each 6 inch marking. Calculate the velocity based on the timestamps from each 6 inch marking. Repeat this 5 times and take the average time and compute the average speed for both axes.
Equipment List:	Measuring Tape, stopwatch
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	Code for 2 feet of travel
Description and / or images of test setup	
Inputs or input ranges to be used (include number or	2ft: -+400 steps 4ft: +-800 steps

test points and increments)	6ft: +-1200 steps
Anticipated results/outcomes	We anticipate that the gantry will be able to reach a velocity of 4 m/s.

Specification Test Log

Date/Time of testing:	
Test participants:	Test Lead: Arik Espineli
Test ID Number:	T018
Relevant functional specification(s) being tested:	M003: Movement Speed - **The system shall move at a speed of 4 feet per second, and should move at a speed of 8 feet per second**.

Test Results



Test Deviations

N/A

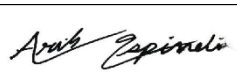
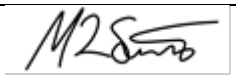
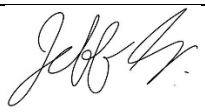
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

System was measured to be moving at 2.5m/s which is slower than or threshold speed of 8m/s. We were unable to meet this spec because when we increased the frequency of our signals the system moved erratically and with a loud grinding noise. This is most likely due to a mechanical connections but with better connections the system may be able to move even faster.

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Arik Espineli		**ME**
Miranda Sweigert		**ME**
Anas Alhamad		EE
Jeff Smith		**ME**

T019: Gantry Movement Accuracy Test

Team/Project:	Maroon 5: AGES
Test Name:	Gantry accuracy
Test ID Number:	T019
Relevant functional specification(s) being tested:	M004: Extinguisher Location Accuracy - **The housing shall move within a 3-inch radius of the location and should move within a 1-inch radius of the location.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	The Purpose of this test is to prove the accuracy of movement to the fire location. This test will be repeated 10 times to average positional accuracy. With the Gantry started at home position (0,0), trigger the sensor, sending the gantry to the location of the triggered sensor. Measure the horizontal distance from the extinguisher nozzle to sensor location. Repeat three times for three different sensor box locations. Take the average of the distances from nozzle to sensor
Equipment List:	Measuring Tape, meter stick
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	N/A
Description and / or images of test setup	Starting point is at (0,0), which will be when both x and y axes are at their minimum, which with the current set up of the gantry in OMH is at the southeast corner of the gantry.
Inputs or input ranges to be used (include number or test points and increments)	Three different sensor box locations that the gantry will move to
Anticipated results/outcomes	We anticipate that the gantry shall be able to land within a 3 inch radius of each location

Specification Test Log

Date/Time of testing:	
Test participants:	Test Lead: Arik Espineli
Test ID Number:	T019: Gantry Movement Accuracy Test
Relevant functional specification(s) being tested:	M004: Extinguisher Location Accuracy - **The housing shall move within a 3-inch radius of the location and should move within a 1-inch radius of the location.**

Test Results

The extinguisher moved to the desired location accurately within 1 inch each time. The discrepancies in location came from moving the axes back to home position manually. This caused discrepancies because we did not move it back to the exact home location each time.

Test Deviations

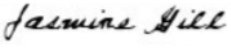
Test Results (circle)

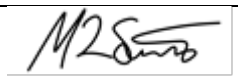
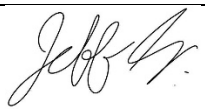
Complete Pass	Partial Pass	Fail

Test Commentary

Additional notes on the test. If partial pass, you must comment on *what passed* and *what didn't*. If fail, you must comment on *why the system failed* and *what would be involved in meeting the specification* (i.e. how much work for the company, how much cost, etc.).

Signoff

Name	Signature	Role
Jasmine Gill		CPE/EE
Arik Espineli		**ME**

Miranda Sweigert		**ME**
Anas Alhamad		EE
Jeff Smith		**ME**

T020: System Scalability Verification

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	System Scalability Verification
Test ID Number:	T020
Relevant functional specification(s) being tested:	M005: Gantry System Scalability – **The system will be designed to able to be adapted to a variety of spaces, such that the size and range can be modified to fit different sized rooms.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	To ensure that our system is demonstrably scalable and can be adapted to be put in practice in a variety of spaces. This test will be completed by reviewing the supports, beams, motors, and sensor boxes to ensure that the system could grow.
Equipment List:	gantry
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	N/A
Description and / or images of test setup	For each part of system as mentioned above, document how it is scalable
Inputs or input ranges to be used (include number or test points and increments)	N/A
Anticipated results/outcomes	Written documentation assuring that each system aspect can be scaled to allow for implementation in different sized area

Specification Test Log

Date/Time of testing:	
Test participants:	
Test ID Number:	T020: System Scalability Verification
Relevant functional specification(s) being tested:	M005: Gantry System Scalability – **The system will be designed to able to be adapted to a variety of spaces, such that the size and range can be modified to fit different sized rooms.**

Test Results

Major System Element	How it is Scalable
Electronics for gantry	The motor drivers do not need to be changed unless the area becomes so great that new motors are required to meet a higher speed specification. In that case, motor drivers will be designed for the new motors that require a greater load. The emergency stop would not need to change. The PCB can be altered to accommodate new motors if need be. Therefore, making the electronics for the gantry scalable.
Sensor Box	We know the range of the sensor box. Therefore, whatever the range of the area desired for system implementation is will determine the amount of sensor boxes required, thus allowing the sensor box to be a scalable system element.
Motors	The motors would not need to change unless the area desired for coverage was so large that it required a faster speed. If so, motors with a larger load capacity can be selected, thus making this element scalable
Ceiling Supports	Additional supports can be added if necessary to support an additional length of the x or y bars of the gantry.
Gear Racks	Length can be added to the gear rack to allow for expanding range of the system

Bridge	Length can be added to the bridge bar to allow for scalability.
Trolley	The trolley that carries the extinguisher would not need to be changed unless a desire for a fire extinguisher with a greater capacity was desired. in which case, the trolley could be adapted to support the load of a new extinguisher with additional support and materials.
Cable Management	The cable management tracks can have added length to accommodate for added cable lengths due to a greater area being covered.

Test Deviations

N/A

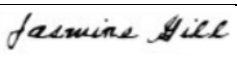
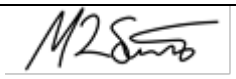
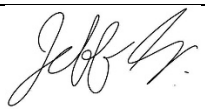
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

All system elements are scalable.

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Anas Alhamad		EE
Miranda Sweigert		**ME**
Arik Espineli		**ME**
Jeff Smith		**ME**

T021: Extinguisher Fire Type Verification

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	Extinguisher Fire Type Verification
Test ID Number:	T021
Relevant functional specification(s) being tested:	E001: Fire Type – **The system shall be able to extinguish type A, B, and C fires. The system should be able to extinguish type A, B, C, and D fires.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	To ensure the fire type able to be extinguished by the chosen extinguisher
Equipment List:	Fire extinguisher
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	n/a
Description and / or images of test setup	Check the rating on the extinguisher. Make sure it is rated for type A, B, and C fires. The extinguisher also needs to be mountable to be integrated in the gantry system.
Inputs or input ranges to be used (include number or test points and increments)	n/a
Anticipated results/outcomes	Properly rated and mountable extinguisher

Specification Test Log

Date/Time of testing:	
Test participants:	Miranda Sweigert - lead
Test ID Number:	T021: Extinguisher Fire Type Verification
Relevant functional specification(s) being tested:	E001: Fire Type – **The system shall be able to extinguish type A, B, and C fires. The system should be able to extinguish type A, B, C, and D fires.**

Test Results

The extinguisher mounted is rated for type A, B, and C fires. The extinguisher is mountable with the existing design of extinguisher mount.

Test Deviations

n/a

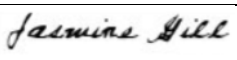
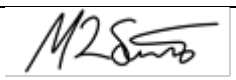
Test Results (circle)

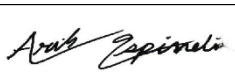
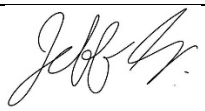
Complete Pass	Partial Pass	Fail

Test Commentary

n/a

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Anas Alhamad		EE
Miranda Sweigert		**ME**

Arik Espineli		**ME**
Jeff Smith		**ME**

T022: System Fire Size Capabilities

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	System Fire Size Capabilities
Test ID Number:	T022
Relevant functional specification(s) being tested:	E002: Fire Size - **The system shall extinguish fires that cover an area of 0.44 square feet (8" x 8"). The system should extinguish fires that cover 16 square feet (4' x 4')**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	This test is to verify the size of the fire that is able to be extinguished by the AGES system. This test will run through code where once actuation has occurred, the extinguisher will cover a rectangular area. A video will be recorded and a meter stick will be used to verify the distance covered by the nozzle. This test will be repeated ten times. Fire extinguisher are rated for a certain amount of area, so the rating on the fire extinguisher must also be verified for the desired area.
Equipment List:	Meter stick/measuring tape, video camera
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	'dummy' code will be written to actuate and then move. This code will not require fire sensing, it will simply begin with actuation and then the movement. The extinguisher should *not* be connected to the actuation system for this test
Description and / or images of test setup	First, verify the rating of the extinguisher and make sure it is rated for the desired area to be covered. To set up this test, first AGES must be set up appropriately on the ceiling. Then the extinguisher mounted. The code will then be run to move. Record the distance moved in both x and y by the nozzle, calculate square area covered with these values Repeat ten times

	Take an average of the areas moved, this value will be used to determine if the test is passed or failed.
Inputs or input ranges to be used (include number or test points and increments)	The code will be input and the output will be the value of the area covered.
Anticipated results/outcomes	It is anticipated that the area covered by the nozzle will be at least .44 square feet and at most 16 square feet.

Specification Test Log

Date/Time of testing:	
Test participants:	
Test ID Number:	T021
Relevant functional specification(s) being tested:	E002: Fire Size - **The system shall extinguish fires that cover an area of 0.44^2 feet (8" x 8"). The system should extinguish fires that cover 16^2 feet (4, x 4')**

Test Results

System is able to be programed to move the extinguisher in a sweeping motion that can cover various fire sizes.

Test Deviations

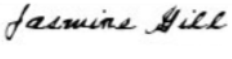
Test Results (circle)

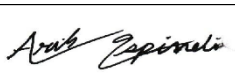
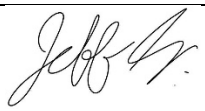
Complete Pass	Partial Pass	Fail

Test Commentary

Additional notes on the test. If partial pass, you must comment on *what passed* and *what didn't*. If fail, you must comment on *why the system failed* and *what would be involved in meeting the specification* (i.e. how much work for the company, how much cost, etc.).

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Anas Alhamad		EE

Arik Espineli		**ME**
Jeff Smith		**ME**

T023: Actuation Device Test

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	Actuation Device Test
Test ID Number:	T023
Relevant functional specification(s) being tested:	E003: Actuation Reliability - **The extinguisher actuator system shall successfully trigger an extinguisher 95% of the time. The extinguisher actuator system should successfully trigger the extinguisher 99% of the time.** E004: Actuation Time – **The extinguisher actuator system shall be triggered within 3 seconds of arriving at the fire. The extinguisher actuator system should be triggered within 2 seconds of arriving at the fire.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	This test is to test for the reliability of mechanical actuation. The code will be run and it will be recorded if actuation of the extinguisher occurred. It will also be recorded how long actuation takes, from the time the code is run to the extinguishing. It is assumed that the actuation will be implemented in the system immediately upon arriving at the fire location, so timing the process of actuation is sufficient to test E004 This will need to be repeated ten times
Equipment List:	Fire extinguisher, stopwatch
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	Code for just actuation will need to be input
Description and / or images of test setup	Set up the extinguisher mount in a location where fire extinguisher chemicals will not be a facilities issue. The mount can be set up closer to the ground and not attached to the AGES system. The mount must be set up as it acts in the system, meaning that the extinguisher is parallel to the ground, and the nozzle is perpendicular to the ground.

Inputs or input ranges to be used (include number or test points and increments)	Code for actuation will be input
Anticipated results/outcomes	It is anticipated that the reliability of the extinguisher will be at least 95%, this is the minimum acceptable reliability. The time needs to be at maximum 3 seconds to be acceptable.

Specification Test Log

Date/Time of testing:	
Test participants:	Miranda
Test ID Number:	T023: Actuation Device Test
Relevant functional specification(s) being tested:	E003: Actuation Reliability - **The extinguisher actuator system shall successfully trigger an extinguisher 95% of the time. The extinguisher actuator system should successfully trigger the extinguisher 99% of the time.** E004: Actuation Time – **The extinguisher actuator system shall be triggered within 3 seconds of arriving at the fire. The extinguisher actuator system should be triggered within 2 seconds of arriving at the fire.**

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

Test Deviations

Deviations from the test as written in the test plan

Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

Additional notes on the test. If partial pass, you must comment on *what passed* and *what didn't*. If fail, you must comment on *why the system failed* and *what would be involved in meeting the specification* (i.e. how much work for the company, how much cost, etc.).

Signoff

Name	Signature	Role
Jasmine Gill	Jasmine Gill	CPE/EE
Anas Alhamad		EE

T024: Extinguisher Accessibility Test

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	Extinguisher Accessibility Test
Test ID Number:	T024
Relevant functional specification(s) being tested:	E005: Extinguisher Access – **When the extinguisher is at its home position the extinguisher will be accessible.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	This test is being done to make sure that the extinguisher is accessible in the manner in which it is mounted. At least three people need to be able to access the extinguisher to show that it is accessible by more than one person. This will need to be repeated ten times.
Equipment List:	Ladder, humans, stopwatch
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	n/a
Description and / or images of test setup	Set up the AGES system on the ceiling infrastructure. Then, set up the ladder to access the extinguisher. Then remove the extinguisher from the mount. This should not take more than a total of five minutes The time to access the extinguisher should be recorded, from once the ladder is set up to once the extinguisher is removed from the mount. Replace the extinguisher in the mount and then descend from the ladder. Repeat this a total of ten times with at least three individuals.
Inputs or input ranges to be used (include number or test points and increments)	Different people to access extinguisher

Anticipated results/outcomes	If at least three individuals are able to access the extinguisher from the mount within five minutes, then the extinguisher is accessible.

Specification Test Log

Date/Time of testing:	
Test participants:	Miranda, people from outside the group
Test ID Number:	T024: Extinguisher Accessibility Test
Relevant functional specification(s) being tested:	E005: Extinguisher Access – **When the extinguisher is at it home position the extinguisher will be accessible.**

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

Test Deviations

Deviations from the test as written in the test plan

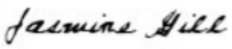
Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

Additional notes on the test. If partial pass, you must comment on *what passed* and *what didn't*. If fail, you must comment on *why the system failed* and *what would be involved in meeting the specification* (i.e. how much work for the company, how much cost, etc.).

Signoff

Name	**Signature**	**Role**
Jasmine Gill		CPE/EE
Anas Alhamad		EE

T025: Time to Actuation Test

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	Time to Actuation Test
Test ID Number:	T025
Relevant functional specification(s) being tested:	E006: Time to Extinguish – **The total time for the system to trigger the extinguisher shall be no more than 20 seconds. The total time for the system to trigger the extinguisher should be no more than 10 seconds.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	This test will be done to time the amount of time it takes from sensing the fire, to the actuation occurring. This will need to be repeated twenty times.
Equipment List:	Stopwatch, video camera
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	n/a
Description and / or images of test setup	Set up the AGES system on the ceiling. Then make sure it is powered. Use a lighter to set off the alarm, the sensor box can be close to the lighter in order to flood the field of view to ensure the alarm will go. Start recording the video, then light the lighter. Start the stopwatch once the lighter is lit. Then mark laps on the stopwatch when the alarm goes, the movement starts and then stop the stopwatch when actuation starts. Record these values. Repeat this twenty times, and take an average for each section, then calculate the total average amount of time. The video can be used for time if it is quicker than the human eye to determine when different systems start and stop. The videos can also be used to verify times.

Inputs or input ranges to be used (include number or test points and increments)	n/a
Anticipated results/outcomes	The maximum value for the average amount of time it can take is 20 seconds. If the system takes longer than 20 seconds, it will fail this test and requires redesign.

Specification Test Log

Date/Time of testing:	
Test participants:	Miranda
Test ID Number:	T025: Time to Actuation
Relevant functional specification(s) being tested:	E006: Time to Extinguish – **The total time for the system to trigger the extinguisher shall be no more than 20 seconds. The total time for the system to trigger the extinguisher should be no more than 10 seconds.**

Test Results

Include measured data, observations, etc. here in a format appropriate to your test

Test Deviations

Deviations from the test as written in the test plan

Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

Additional notes on the test. If partial pass, you must comment on *what passed* and *what didn't*. If fail, you must comment on *why the system failed* and *what would be involved in meeting the specification* (i.e. how much work for the company, how much cost, etc.).

Signoff

Name	**Signature**	**Role**
Jasmine Gill	Jasmine Gill	CPE/EE

T026: Total Cost Calculation

Team/Project:	Maroon 5/A.G.E.S.
Test Name:	Total Cost Calculation
Test ID Number:	T026
Relevant functional specification(s) being tested:	C001: Total Cost - **The total cost to the customer shall cost less than $1,500. The system should cost less than $1,000.**
Type of test (circle)	Black Box White Box
Purpose of test and test summary including number of replicates of test	This is to ensure that the final cost to customer will not be more than $1500. An evaluation will be made and calculated based on material and labor cost. An assumption that buying in bulk will cost 30% less and subtracting research and development cost will allow us to determine the final cost to customer. Add up BOM costs and estimated labor costs based on hours of work. 20% of our total cost thus far is considered R&D cost and will be subtracted from the cost per system for the customer, and then taken at 70% of that value
Equipment List:	calculator
Necessary dummy inputs, their source, and mechanism for validation of dummy inputs:	N/A
Description and / or images of test setup	Calculate the overall cost
Inputs or input ranges to be used (include number or test points and increments)	
Anticipated results/outcomes	

Specification Test Log

Date/Time of testing:	
Test participants:	Jeff
Test ID Number:	T026: Total Cost Calculation
Relevant functional specification(s) being tested:	C001: Total Cost - **The total cost to the customer shall cost less than $1,500. The system should cost less than $1,000.**

Test Results

As our system stands we have spent a total of $2550. Our R&D costs make up $950 or about 38% of that total which has been covered by investors. That leaves $1600 for cost of materials which can be reduced by 30% for bulk orders bringing the total cost to $1120 for one unit. Two laborers could assemble one system in 5 hours at $15 an hour each costing the company $150. Adding that to the total as well as 15% profit brings the total customer cost to $1460.5

Test Deviations

After further inspection we determined that 38% of our costs were R&D

Test Results (circle)

Complete Pass	Partial Pass	Fail

Test Commentary

We met our shall spec

Signoff

Name	Signature	Role
Jasmine Gill	Jasmine Gill	CPE/EE