

Autonomous LSEV Platform Development (Year 2)

Testing Procedures

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Winter-Spring 2026

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1 Testing Procedures (TPs)

Testing is an important aspect of the engineering process to ensure all requirements of the product are met. An important part to testing is ensuring a controlled testing environment, procedure, and measuring of the outcomes for the sake of repeatability, accuracy, and sophistication. Below are several tests we plan to run to test our different engineering specifications.

1.1 Testing Procedure 1: Top speed limiter test

The goal of this test is to ensure the engineering specification of a limited top speed (3 MPH) is met. We expect to complete this test by week 8.

1.1.1 Testing Procedure 1: Objective

This test will be run in an open straight away on campus using the manual controls of the EV.

We will run the test by maximizing acceleration on the straight away measuring top speed using both onboard speedometers as well as external measuring devices.

A passed test will have a top speed of less than 3 MPH as per engineering specifications.

1.1.2 Testing Procedure 1: Resources Required

- EV
- Manual controller
- Stopwatch
- Video recorder
- Cones
- Computer
- Open Space

1.1.3 Testing Procedure 1: Schedule

The goal is to perform this test around week 8. It should take no longer than an hour. The only functional requirement that needs to be met before the test is the restoration of the basic functions of the EV.

1.2 Testing Procedure 2: Auto stopping feature test

This test will ensure the engineering specification that the EV stops within 5 feet as well as work as a general test and benchmark for the auto stopping featuring of the EV. We plan to have this completed by week 8.

1.2.1 Testing Procedure 2: Objective

The test will be run using the autonomous navigation to steer a designated test route (straight line) towards with large orange cone, or something similar, in its path. We will want to run the tests several times with the cone in several different locations to ensure that the EV will stop not only when an object is directly in front of it but when it is in its peripheral view too.

1.2.2 Testing Procedure 2: Resources Required

- The EV
- Large cone or similarly sized object
- Manual steering remote
- Measuring tape
- Tape (to create autonomous navigation line)
- Navigation and auto stopping team members (Shion Britten and Nathan Nguyen)
- Open and clear area
- Computer

1.2.3 Testing Procedure 2: Schedule

The test should take no more than 1 to 1.5 hours from setup to finish. We will want to run the test around week 8 as we require the autonomous navigation portion to be completed by this time.

1.3 Testing Procedure 3: Emergency stop test

This test will ensure the engineering specification of stopping within five feet is met as well as testing an overall customer requirement of the implementation and creation of an emergency stop feature. This test will be conducted around week 8.

1.3.1 Testing Procedure 3: Objective

The objective of this test is to test the emergency stopping feature. We will do this by manually controlling the EV then pressing the emergency stop button on the controls. We will want to run this test at different speeds to ensure stoppage is quick. To measure how quick and effective the emergency stop is we will place a line of tape down and activate the emergency break when the front wheels of the EV reach the line, then we will measure the distance from the tape to the front wheels of the EV where it stopped to see how far it moved after activating the emergency break.

1.3.2 Testing Procedure 3: Resources Required

- EV
- Manual steering remote
- Emergency stop device
- Tape
- Measuring tape
- Open and clear area
- Emergency break team (Camden Galen and Eric Jensen)
- Open space
- Computer

1.3.3 Testing Procedure 3: Schedule

We hope to run this test around week 8. This test should take around an hour from setup to completion.

We will require that the vehicle manual controls are back up to functional order and that the emergency stop system has been installed.

1.4 Testing Procedure 4: Waterproofing/IP Testing

This test will ensure the engineering specification of an IP65 rating is met as well as ensure a general safety factor for the vehicle as it can be expected that the EV will be exposed to rain. The goal is to complete this test by week 8.

1.4.1 Testing Procedure 4: Objective

The objective of the waterproofing/IP testing is to ensure that the EV electronics are able to withstand exposure to water as this will likely occur when in actual use in the form of rain. To conduct this test we will want to perform a basic functionality test of the EV as a baseline, then spray the vehicle with a hose with varying amounts of water intensity and amount. This will help us ensure our engineering specification of the vehicle being IP65 rated.

1.4.2 Testing Procedure 4: Resources Required

- EV
- Hose/water
- Open space
- EV manual controller
- Stopwatch

1.4.3 Testing Procedure 4: Schedule

We hope to run this test by week 8. This test should take no longer than one hour. This test will require that all systems on the EV have been installed and all waterproofing measures have been installed for them as well.

1.5 Testing Procedure 5: Autonomous Navigation Test

This test is a multipurpose test to test a few engineering specifications that is safety features such as beeping and flashing lights, the use of a variety of sensors, working brake lights, and headlights as well as the testing of our autonomous line following system. We expect to complete this test by week 8.

1.5.1 Testing Procedure 5: Objective

Test the autonomous line following navigation system.

Test will be used to ensure the Engineering specification of the ability to follow the line accurately, as well as engineering specifications that go along with this function such as functional beeping and flashing lights, a variety of sensors, headlights, and working brake lights.

To perform test we will be creating a route between the basement of Rogers and Merryfield using tape. We will follow the EV as it runs its route taking notes and recording video for later analysis.

A passing run will look have no steering mishaps (vehicle running off route), no collision, and no need for intervention by us, as well as an acceptable runtime that we will determine at a later time.

1.5.2 Testing Procedure 5: Resources Required

- EV
- Tape
- Open space

- Permission from campus to run test
- Stopwatch
- Recording device
- Manual controller

1.5.3 Testing Procedure 5: Schedule

The goal is to run this test by week 8, it will require that the EV is up and running, the autonomous line following system is up and running, as well as the automated stopping system.

2 Safety Plan

As an initial safety precaution and in the nature of the title, LSEV, the vehicle will have a limited speed to around 5 mph for testing. This prevents any potential large damages that could be a result of a collision during the testing of the vehicle. Also, one of the divisions of the team is an emergency break group, whose focus is on the installation of the safety braking system and the connection to the collision detection system. Within this group, a wireless remote e-stop will be installed, so there are multiple redundant safety systems in place.