Test Plan — Stage Base

Testing Criteria	Expected Result	Pass/Fail	Actual Result		Procedure:	
					1	Obtain a piece of wood with the following specifications: "36 x 16 x 1"
The stage's base is uniform, and will show no notable signs or disfigurement.	The stage's base will be within expected dimensions of 30x20x1 in.	Pass	Correct Dimensions		2	Visually inspect all sides of the wood ensuring that there are no large, compromising knots. Knots are dark impurities in wood grain that are circular and darker than the surrounding area.
The stage's base does not have any knots larger than 1/4 inch.	The stage's base will have no knots larger than 1/4 inch [3].	Pass	No knots		3	Visually inspect all sides of the wood ensuring that there are no large, compromising cracks. Cracks are a physical separation within a piece of wood that have potential to further split under a load
The stage's base has no cracks over 15 mm in size.	The stage's base will have no cracks over 15 mm in size [1].	Pass	No cracks		4	Physically inspect all sides of the wood ensuring that there are no large, soft spots. Soft spots can be identified through applying pressure throughout all outer sides of the wood piece. If a section of the wood feels weak, or your finger sinks through, identify this area as a soft spot.
The stage's base will have no soft spots.	The stage's base will have no soft spots.	Pass	No soft spots		5	Place the wooden board on the floor and place pressure throughout the face of the board. Rotate the board 90 degrees and apply pressure to the face of the board. After placing pressure on the face of the board, there should be no notable signs of warping present.

Test Plan — Stepper Motor

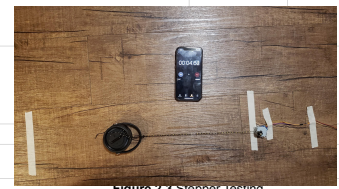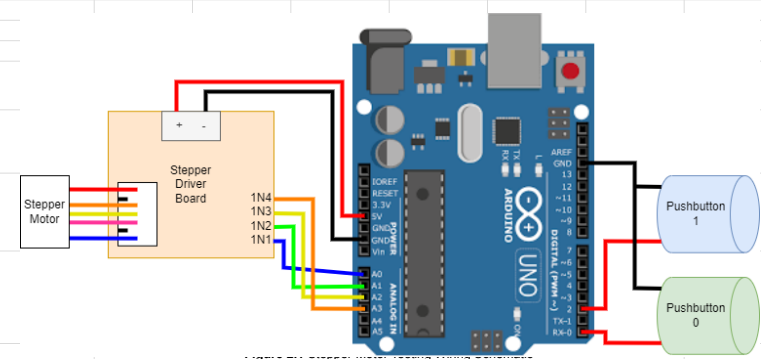| Testing Criteria	Expected Result	Pass/Fail	Actual Result		Procedure:	
					1	Refer to the tutorial at the following link to learn how to download HEX files to a microcontroller via AVRdude [2]. Link: https://www.elecrom.com/avrdude-tutorial-burning-hex-files-using-usbasp-and-avrdude/
					2	Connect microcontroller to computer and download the "Model Stage Curtain Arduino Files.zip" file. Once the file is unzipped, open the "Read_Me.txt" file and following the instructions contained to verify communication with the Arduino 328p Uno.
Power can be applied to the stepper polls.	Stepper poll LEDs light up with corresponding energized polls and the spindle does not rotate when acted upon by an outside force.	Pass	Correct LED's		3	After verifying communication between the computer and the microcontroller, upload the Hex file "Stepper_button_test.hex" to the microcontroller, continuing to follow the instruction is the TXT file "Read Me.txt". Refer to the sample command line tutorial in Procedure 1 for additional help using using AVRdude.
Stepper motor can rotate its spindle counterclockwise.	Stepper spindle rotates counterclockwise when pushbutton 0 is actuated and stops when released.	Pass	Ratates and Stops		4	Insert the red wire connected to pushbutton 0 into the digital pin D0 and insert the black wire into GND. Insert the red wire connected to bushbutton 1 into the digital pin D2 and insert the black wire into GND. Insert the 4 wire ribbon cable into analog pins A0-A3 as shown in **Figure 2.1**. Take note of which color wire is connected to analog pin A0.
Stepper motor can rotate its spindle clockwise.	Stepper spindle rotates clockwise when pushbutton 1 is actuated and stops when released.	Pass	Rotates and Stops		5	Connect the other end of the four-wire stepper poll output ribbon cable to the stepper driver board, connecting the wire leading to analog pin A0 to pin 1N1 on the stepper driver board. Then connect 5V to the '+' pin on the stepper driver board and GND to the '-' pin on the stepper driver board. Finally, connect the white wire harness to the stepper driver board. There are guides on the wire harness to acheive the correct orientation. Refer to **Figure 2.1** for a wiring diagram.
Stepper motor can drag a weight of 2 lbs smoothly and consistently a distance of 2 ft within 10 seconds.	Stepper drags a 2 lbs weight via a string wrapped around its spindle a distance of 2 ft in under 10 seconds.	Pass	Within parameters		6	Verify on the stepper motor encoder LEDs that two of the four polls are on and the spindle holds in its current position (first testing criteria).
					7	Press pushbutton 0 and verify the stepper spindle rotates counterclockwise (second testing criteria)
					8	Press pushbutton 1 and verify the stepper spindle rotates clockwise (third testing criteria).
					9	Mark a distance of 2 ft on a surface and attach a 3 ft long string to the spindle of the stepper motor and a 2 lbs weight that can be dragged as shown in **Figure 2.2**.
					10	Set up a visible timer counting in seconds, a camera set to record a top-down view of the timer and the 2 ft space to be dragged, and the stepper motor and 2 lbs weight across the 2 ft space as shown in **Figure 2.3** so the stepper motor is secured and can drag the 2.5 lbs weight across the 2 ft space without moving the motor itself.
					11	Start the recording device and timer.
					12	Press push button 0 until the 2 lbs weight is dragged the entire 2 ft length.
					13	Review the recording and verify using the recorded timer that the 2 lbs weight is dragged the 2 ft distance in 10 seconds or less (fourth testing criteria).

Figure 2.1 Stepper Motor Testing Wiring Schematic

Figure 2.3 Stepper Testing

Test Plan — Battery Pack

Testing Criteria	Expected Result	Pass/Fail	Actual Result		Procedure:	
					1	Remove battery from housing and keep the housing cover open.
					2	Inspect the battery on all sides. (See Criteria 1)
Battery corrosion, bulging, or leaks.	There should be no corrosion on the battery terminals, nor should there be any leaks. The battery should not have any ballooned areas.	Pass	Clean Battery		3	Connect the battery terminals to a multimeter. (see Criteria 2)
Battery nominal voltage	The battery's voltage should be close to the nominal voltage written on its packaging.	Pass	9 V		4	Inspect inside of the battery housing including the battery terminal connectors. (see Criteria 3)
Battery housing terminals	The battery housing should be clean and the terminal connectors should be clearly visible and shiny.	Pass	Clean Terminals		5	Inspect the wires and lightly bend the wiring to check for broken wires under insulation. (see Criteria 4)
Wiring	The insulation should cover the whole length of the wire without cracks. Upon lightly bending the wire the bent shape should be maintained an the resistance of metal bending should be felt.	Pass	Good Wiring			

Test Plan — Frame and Support - (Support Board)

Testing Criteria	Expected Result	Pass/Fail	Actual Result		Procedure:	
					1	Obtain a piece of wood with the following specifications: "30 x 20 x 1"
					2	Visually inspect all sides of the wood ensuring that there are no large, compromising knots. Knots are dark impurities in wood grain that are circular and darker than the surrounding area.

Testing Criteria	Expected Result	Pass/Fail	Actual Result		Procedure
The support board is uniform, and will show no notable signs or disfigurement.	The support board will be within expected dimensions of 30x20x1 in.	Pass	Correct Dimensions	3	Visually inspect all sides of the wood ensuring that there are no large, compromising cracks. Cracks are a physical separation within a piece of wood that have potential to further split under a load
The support board will not have any knots larger than 1/4 inch.	The support board will have no knots larger than 1/4 inch [3].	Pass	No knots	4	Physically inspect all sides of the wood ensuring that there are no large, soft spots. Soft spots can be identified through applying pressure throughout all outer sides of the wood piece. If a section of the wood feels weak, or your finger sinks through, identify this area as a soft spot.
The support board have no cracks over 15 mm in size.	The support board will have no cracks over 15 mm in size [1].	Pass	No cracks	5	Place the wooden board on the floor and place pressure throughout the face of the board. Rotate the board 90 degrees and apply pressure to the face of the board. After placing pressure on the face of the board, there should be no notable signs of warping present.
The support board will have no soft spots.	The support board will have no soft spots.	Pass	No soft spots		

Note: The frame and support start out as a singular piece of wood (i.e. support board)

Test Plan	Stage Curtain				Procedure:
				1	Holding the Stage Curtain, ensure that there are no visible tears or holes within the stage curtain material
Testing Criteria	**Expected Result**	**Pass/Fail**	**Actual Result**	2	Lying the Stage Curtain down, ensure that it fits within the intended dimensions of __x__ using an accurate standard measuring tool.
The Stage Curtain material fibers are free from any tears or holes.	The Stage Curtain material fibers are free from any tears or holes.	Pass	No Tears		
The stage curtain will be 15" X 33" (dimensions).	The Stage Curtain will be within the proposed dimensions	Pass	Correct Dimensions		

Test Plan	Data Transfer Medium - Wires				Procedure: For every wire used in the project, follow the instructions below:
Testing Criteria	**Expected Result**	**Pass/Fail**	**Actual Result**	1	Visually inspect the wire, and ensure every surface entirety omitting the two ends are fully encased in the wire casing and are not exposing the wire's interior.
The wire casing on every used wire will have not expose the inside contents of the wire except to provide connection to the two end terminals.	Every wire used in the system will not expose the inside contents except for the edges, which will be used to provide a connection to the two terminals	Pass	Good Insulation	2	Power on the digital multimeter and place two probes into the positive and negative terminals, and set the mode to 'continuity'.
Every wire used will pass the continuity check on the digital multimeter.	Every wire used in the system will pass as continuous by the digital multimeter.	Pass	Good wires	3	Place the negative probe on one side of the wire, and the positive probe on the corresponding side of the wire. Ensure that the Digital Multimeter indicates that there is continuity throughout the wire.

Test Plan	Track - Curtain Hanger				Procedure:
Testing Criteria	**Expected Result**	**Pass/Fail**	**Actual Result**	1	Visually inspect the curtain rod and ensure that there are no grooves or other impurities.
The curtain hanger's surface will be smooth and free from grooves that can obstruct an even flow of the stage curtain.	The curtain hanger will be smooth and consistent throughout.	Pass	No unexpected grooves	2	Place the curtain rod into the hook mount by applying a nominal amount of force to push the bar through. This step should not take a significant amount of force to secure the bar into the hook mount.
The curtain hanger will easily fit into the supportive hook mounts without excessive force	The curtain with minimal force will fit into the slotted hook mount.	Pass	Nice mounts	3	Once the curtain rod is placed in the hook mount, wiggle the curtain rod within the hook mount to ensure that it is fixed to the mount. Ensure that the fit is snug enough to mitigate excessive shifting of curtain rod within the hook mount.
The curtain hanger will be fixed within the supportive hook mount with no signs of excessive, performance impending shifting.	The curtain hanger will be fixed with no noticeable signs of excessive movement.	Pass	Fixed mounting hooks		

Test Plan	HMI - Pushbuttons				Procedure: For every Push Button used in the project, follow the instructions below:
Testing Criteria	**Expected Result**	**Pass/Fail**	**Actual Result**	1	Visually inspect the pushbutton and ensure that all exterior surfaces that would be interfaced with are free from sharp edges or other protrusions that pose a risk to injury.
Ensure that the exterior finishing of the pushbutton is smooth and free from sharp corners.	The pushbutton will be smooth on all areas where the user will interact, and free from any chances of injury.	Pass	Good plastic	2	With one hand grasp the pushbutton housing, and with the other hand the button. Lightly pull the two components, ensuring that each piece is properly fixed to each other.
Ensure that pushbutton does not pass a signal when not actuated, and passes a signal when actuated by using a digital multimeter continuity mode.	The pushbutton will pass a signal when actuated, and it will abstain from passing a signal when not actuated.	Pass	Good connections	3	On the bottom of the pushbutton there are two terminals. Place a probe at each respective terminal. Turn on the digital multimeter and place the mode setting to 'continuity.' While the pushbutton is not actuated ensure that the pushbutton is discontinuous. Then, actuate the pushbutton and ensure that the digital multimeter reads that there is a continuous path within the pushbutton.
Ensure that the pushbutton and housing are properly fixed and do not pose a risk of separation.	The push buttons two subassemblies will show no sign of separation and are properly conjoined.	Pass	Push buttons are a single piece		

RESOURCES:

[1] "3 cracks to look for to determine if you have foundation issues," Carolina Foundation Solutions, 09-Jun-2021. [Online]. Available: https://www.carolinafoundationsolutions.com/blog/cracksforfoundationissues/. [Accessed: 11-Apr-2022].

[2] Elecrom, "Avrdude tutorial : Burning hex files on Atmel AVR using USBASP and AVRdude," Embedded Electronics Blog, 31-May-2019. [Online]. Available: https://www.elecrom.com/avrdude-tutorial-burning-hex-files-using-usbasp-and-avrdude/. [Accessed: 11-Apr-2022].

[3] Family Handyman, "Drilling holes: Notching and boring holes in wood studs," Family Handyman, 21-Sep-2017. [Online]. Available: https://www.familyhandyman.com/project/drilling-holes-notching-and-boring-holes-in-wood-studs/. [Accessed: 11-Apr-2022].