Project Engineering Specifications

COOLER				
Module	**Specific Components**	**Engineering Specification**	**Justification and Verification**	**Responsibility**
Shell	Coleman 100qt	Should have cup holders, wheels, and be large enough to support multiple compartments, at least 1.5 cubic feet of space.. Exterior walls should be at least 2' thick. Maximum allowable empty weight of 40 lbs.	**Justification:** Anyone should be able to move or load the Smart Cooler. **Verification:** Smart Cooler should be lightweight, have large carrying capacity, and wheels to help with transportation and loading.	Clarence
Control	Microcontroller: Raspberry Pi 4	Controller will provide SPI (Serial Peripheral Interface) used for communicating with other boards or modules. At least 20 GPIO pins needed, with alt functionality for SPI and serial communication. Bluetooth will connect with app at a range of 15m, and microcontroller will operate between 3.5-5.5V.	**Justification:** The Pi 4 can handle the input and output traffic, and communicate with the other modules. While connecting to the HDMI touch screen or mobile app. **Verification:** The microcontroller will be able to handle the six primary inputs, and four primary outputs, and communicate with the other modules. The microcontroller has 27 GPIO pins total with up to 6 alternate functions. Testing will ensure the microcontroller is communicating with the	Team

			application.	
Mobile Application	Apple or Android Smartphone	Bluetooth will communicate with microcontroller at a range of 15m. Application will monitor temperature of each compartment, ability to activate locking and interior LED, ability to change settings (GPS enable, locking mechanism enable, LED light enable, speaker enable), and able to save profiles.	**Justification:** Providing Android and iPhone support allows for the majority of users to use the app. The app communicating with the microcontroller allows for remote monitoring and setting of the cooler. **Verification:** Testing will ensure the microcontroller is communicating with the mobile application using an Apple or Android Smartphone.	Reuben
Entertainment	Pyle Marine Speakers	Speakers should be no deeper than 2". Speakers should operate between 50-200W for a dB rating of 87 dB.	**Justification:** Narrow footprint so that they can be placed in the walls of the Smart Cooler. Speakers must be heard when near the cooler. **Verification:** Speakers should be able to be heard at least 5 meters away.	Clarence
	Amp: TPA3116 DAMGOO	Provide at least 200W for Speaker operation. Use class D amplifier for maximum efficiency.	**Justification:** Exceed minimum Wattage needs for both Speakers. **Verification:** Speakers should properly operate with the wattage provided from the AMP.	Clarence

Sensors	Temperature: DS18B20 Waterproof Temperature Sensors	Monitor Temperature in compartments to an accuracy of ± 1.0°C in real time, minimum range of at least 0°C	**Justification:** The temperature sensor will tell when the compartment is too warm and when ice needs to be replaced. **Verification:** Monitor the temperature with a separate thermometer in the compartments.	Reuben
Interior LED	Exterior Light: Photo-sensitve Sensor Alitove Led Strip Lights	Exterior light sensor will change output voltage in low light conditions in real time. LED light strip will provide illumination when light sensor detects it is dark outside.	**Justification:** Interior lights are needed for operation after dark. **Verification:** Will test and confirm that output voltage changes when ambient light is low. Light strip will activate when dark outside or manually.	Reuben
Power Input Control Module	Voltage Regulator 12V input power socket	Shall provide the cooler multiple charging options to accept 120V AC and 12VDC.	**Justification:** Allow for battery charging from Solar Panel, outlet plug, or automobile barrel jack. **Verification:** A digital multimeter will be used to confirm that the module is supplying the correct voltages when both inputs are used to pass.	Team
Battery	Battery: LiFePO4	Provide 12V to the Smart Cooler modules. Battery shall maintain active operation for at least 12 hours. To be charged by	**Justification:** Needed to power systems when outside power is not available. **Verification:** A digital multimeter will be used to confirm that the battery is supplying the correct voltages to pass.	Team

		charging module.		
	Solar Panel: Eco-Worthy 12V 10W	12-20V output voltage, at least 1.5A current output, at least 14.4W power output, at least 9.6Ah output	**Justification:** The solar panel will provide power to the battery during daylight hours and assist with charging for night time operation. **Verification:** A digital multimeter will be used to confirm that the module is supplying the correct voltages when both inputs are used to pass.	Clarence
Power Output Control Module	Voltage Regulator	Convert stored energy in the battery into voltages required for operation, 5V and 12V.	**Justification:** The Voltage Regulator will ensure that the voltages supplied by the batteries are the correct voltages to ensure the modules of the Smart Cooler operate properly without damaging components. **Verification:** A digital multimeter will be used to confirm that the voltage regulator is allowing the correct voltages to pass.	Team
	Exterior USB Charger: Damavo YM1218 USB C and USB A Charger socket	Should operate using either 5V or 12V input voltage. Will output 5V 2.1A for USB A & 5V 3A for USB C	**Justification:** The charger will allow wired charging of devices. **Verification:** Plug will be tested with several USB devices	Clarence
LID				

Module	Specific Component	Engineering Spec	Justification	Responsibility
GPS Module	BN-880 GPS Module	Module will accurately track location to within 3 meters.	**Justification:** Allow the user to mark the Smart Cooler and possible camp site. **Verification:** Google Maps will be used to confirm the accuracy of the GPS location.	Team
Charging Module	Qi Wireless Charging Transmitter	Output at 5W at a minimum of 100 KHz Provide 5V and 1A of charging power to devices.	**Justification:** Allows the user to charge other mobile devices in a timely manner. **Verification:** Capable of charging modern Smart devices especially cell phones.	Clarence
Lock	Locking Mechanism Sensor: Reed Switch Servo: SG90	Close and lock the Smart Cooler using the APP touch screen or RFID Keyless entry. Provide 180 degree rotation to position lock in place.	**Justification:** Secure the lid so that it can not be opened on accident, unauthorized people, or animals. **Verification:** The lock should engage and disengage when signalled by the Touch screen, Mobile app, and RFID keyless entry.	Team
Touch Screen	Sunfounder 7 inch	Shall support touchscreen functions and at least Wide SVGA resolution.	**Justification:** Allows the user to interact with the Micro controller and control the operation of the cooler. **Verification:** Touching screen interacts with GUI and sets or configures features on cooler.	Clarence