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. Exterior walls should be at least 2' thick.	**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. 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. **Verification:** The microcontroller will be able to handle the six primary inputs, and four primary outputs, and communicate with the other modules. Testing will ensure the microcontroller is communicating with the application.	Team

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 set temperature for each compartment, ability to change settings (GPS enable, locking mechanism enable, LED light enable, low-power mode enable), and able to save profile.	**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 Smartphone.	Reuben
Refrigeration	Thermoelectric Cooler: ESUMIC 12V	Regulate refrigeration in both compartments. Refrigeration unit will be able to lower the temperature in a compartment to a minimum of -2.0°C.	**Justification:** Use active refrigeration to extend the ice retention of the cooler. **Verification:** Monitor the temperature with a separate thermometer in the compartments, and verify that it can be cooled to -2.0°C.	Team
Entertainment	Pyle Marine Speakers	Speakers should be no deeper than 2' Speakers should operate between 50-200W	**Justification:** Narrow footprint so that they can be placed in the walls of the Smart 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.	**Justification:** Exceed minimum Wattage needs for both Speakers. **Verification:** Speakers should properly operate with the wattage provided from the AMP.	Clarence
Sensors	Temperature: DHT11 Temp. and Humidity Sensor	Monitor Temperature in compartments to an accuracy of ± 1.0°C in real time	**Justification:** The Temperature of the compartments is used to govern when the refrigeration units are turned on. **Verification:** Monitor the temperature with a separate thermometer in the compartments.	Reuben
	Exterior Light: Photo-sensitve Sensor	Exterior light sensor will change output voltage in low light conditions in real time.	**Justification:** Interior lights are needed for operation after dark. **Verification:** Will test and confirm that output voltage changes when ambient light is low.	Reuben
Lid Opening Mechanism	Servo: BETU 25Kg Gusodor Led Strip Lights	Allow the user to remotely open and close the lid. Track lid status and change output voltage based on lid position in real time.	**Justification:** The opening mechanism will open and close the lid quickly. **Verification:** Mechanism shall correctly trigger interior LED during opening tests.	Clarence

	Servo Controller: SunFounder PCA9685	Shall drive the servos for the lid opening, cutting board, and lock in less than 3 seconds.	**Justification:** Provide the input and outputs required for the servos. **Verification:** Servo operation will be tested and cycled no less than 25 times.	Team
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	**Justification:** Needed to power active cooling 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
	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	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

Note: The top of the first table contains the continued text "inputs are used to pass."

Charging Module	Qi Wireless Charging Transmitter	Output at 5W at a minimum of 100 KHz	**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	Close and lock the Smart Cooler using the APP touch screen or RFID Keyless entry.	**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:** Should respond to the inputs of up to 5 fingers at once.	Clarence
Cutting Board	BETU 25Kg Servo 3D printed parts	Supply the user with a retractable cutting board that is in the lid.	**Justification:** In camping settings a cutting board could be very useful. **Verification:** Should extend and retract cutting board no less than 25 times without fouling.	Team