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Objective:

Evaluate the thermal resistance, solar heat reflectance, and microstructure durability of two novel paint additive technologies.

Background:

SEL has utility boxes that include electrical components and wires running through them for customers. To extend the battery lifespan of the enclosed electronics, SEL has asked our team to evaluate paint additives that could be used in their manufacturing process to reduce internal temperatures and provide insulative properties for the utility boxes. Two paint additives were evaluated, a Nano-Ceramic paint additive and a Phase change paint additive. These two paint additives were compared to the control paint that is used currently for SEL's cabinets.

Value Proposition:

- Because paint additive technologies are so affordable, any improvement in performance will be financially beneficial for the client.
- Extreme temperatures within the enclosure can reduce the useful life of electronics.
- Applications of these coating additives could be great for buildings, automotive, and other industries.

Test bed setup: the images below illustrate how we setup our tests with a control paint in each test to compare the additive.



(Nano-Ceramic and control thermal and temperature testing bed)



(Phase change additive and control testing bed)

Testing and characterization: We compared the Nano-Ceramic additive paint to the control paint based on thermal performance, microstructure and paint durability. We compared the Phase change additive paint to the control paint based on thermal performance. Performance in these testing and characterization methods are the basis of our evaluations and conclusions. The matrix below describes the tests we conducted in each of these categories:

Thermal tests	Microstructure evaluation	Paint durability testing
Temperature testing	Scanning Electron Microscope	Salt fog Spray test (ASTM B117)
Energy usage testing	Energy Dispersive Spectroscopy	Methyl Ethyl Ketone (MEK) Scratch Test
	Optical Microscope Imaging	Nano-Indentation testing

Summaries and conclusions:

- *Temperature data testing:* We found that the Nanoceramic paint additive was more efficient at higher temperatures and was able to meet the five degree reduction in higher temperatures.
- *SEM Testing:* While there is no catastrophic failure, there is no conclusive difference in the microstructure of the control or Nano-Ceramic after 1389 hours after Salt fog spray.
- *Phase change:* Energy testing showed that the PCM used 6.4% less kWh than the control coating

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Project Requirements

- Show a temperature reduction of 5 degrees Fahrenheit in warm weather
- Increase thermal resistivity to provide insulation and an increase from ambient temperature of 5 degrees
- Test the microstructure of the additive and measure impact of testing and application to the microstructure and material properties over time
- Meet Various ASTM standards for environmental simulation tests on each additive