M2819 – Thermoplastic Composite Sunshields for Navy Ready Service Lockers

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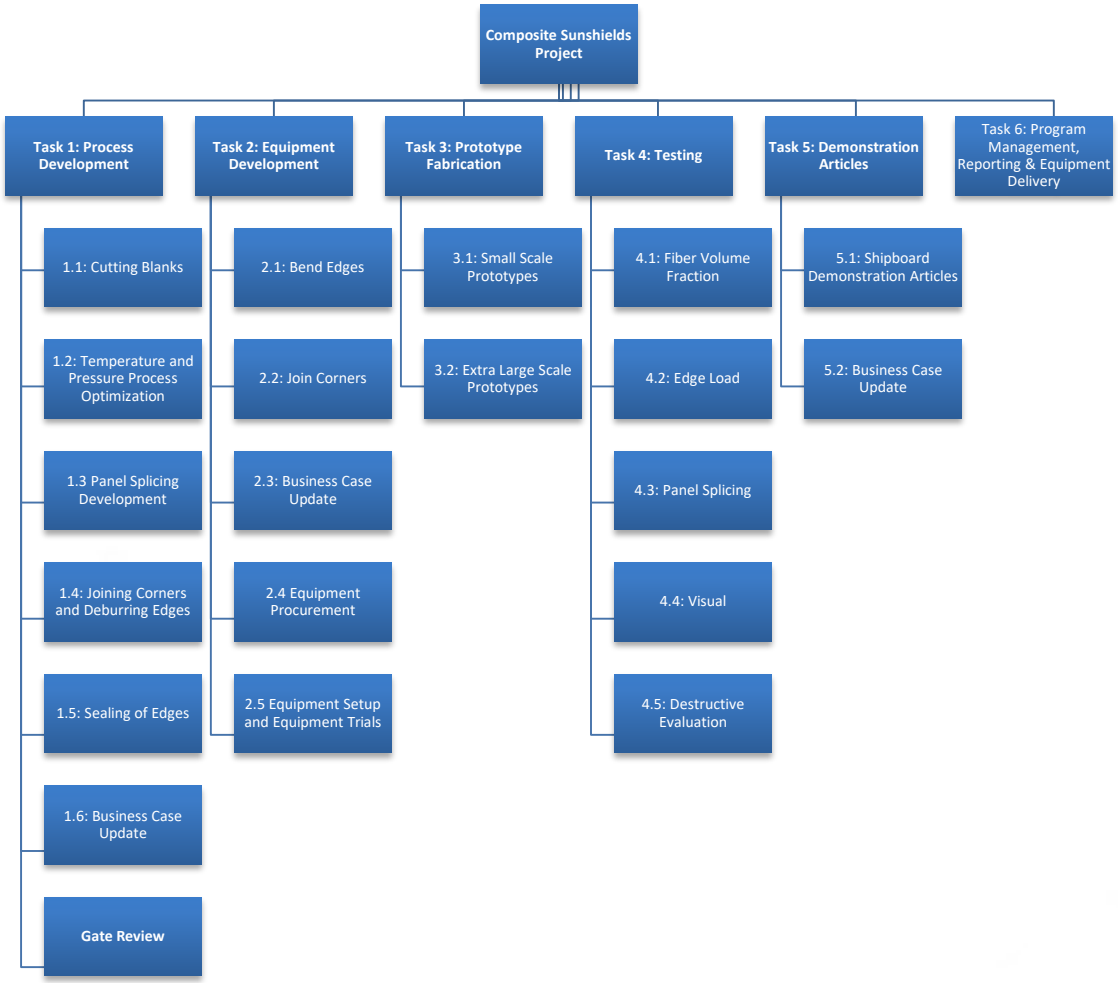
Project Objective

- Corrosion of metallic components requires significant labor and maintenance funding to repair and/or replace corroded components
- Components made out of composite materials offer more resistance to environmental effects, such has rust, and can eliminate or greatly reduce the total ownership cost of the component
- This project aims to fabricate and test the potential of a low cost composite sunshield that meets Navy requirements using commercially available materials(early feasibility tests completed by NSWC Carderock)
- 9 month period of performance

Technical Plan



Technical Plan-Initial

- Thermoplastic sheets cut to size
- Line heater used in conjunction with brake-mimics sheet metal process
- Gap in bent corners will be filled with PEI using hand held extruder

Technical Plan

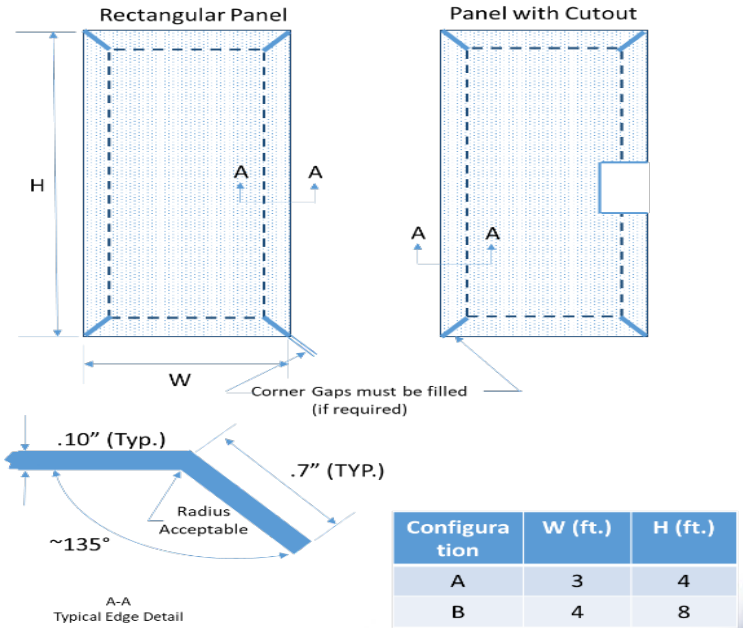
Legacy steel sunshields are rust formers and require frequent maintenance

Performance Requirements

Category	Test	Description	Requirement
Material Requirements	-	12 Ply Laminate	All material shall be composed of a glass fiber fabric (style 7781 or equivalent) reinforced Polyetherimide (PEI) resin composite material.
	ASTM D2584	Fiber weight Fraction	Composite sunshields shall have greater than 65% by weight of fiber
	ASTM D2584	Void Content	Composite sunshield material shall have less than 3% void content
Loading Performance	-	-	Composite sunshields shall be able to withstand a 300 lb. load when mounted in typical mounting configuration. The load shall be placed at the center of the composite sunshield at the midpoint between two mounting points.

Technical Goals

- The overall objective of this project is to develop a manufacturing technology that will produce a Thermoplastic Composite Sunshield to replace the incumbent metallic sunshields.
- Heat & Bend all four edges of TenCate Cetex TC1000 Ultem Glass Fabric sheets
- Seam panels together to make extra large Sunshields (56” x 65”)
- Corner joining

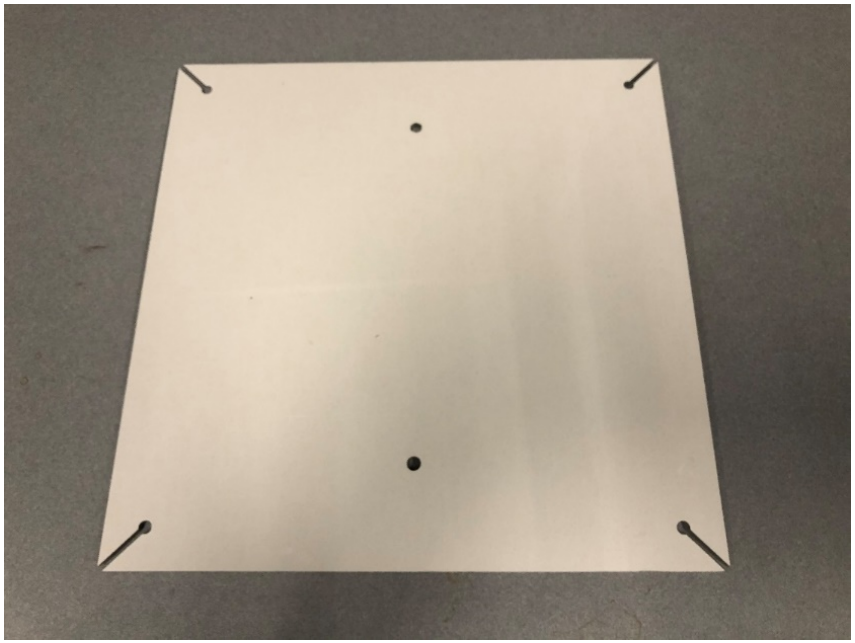


Configuration	W (ft.)	H (ft.)
A	3	4
B	4	8

Bending Equipment

- A strip heater is used to heat the bend line of the sunshield
- A box and pan brake is used to bend the edge of the sunshield along the heated line

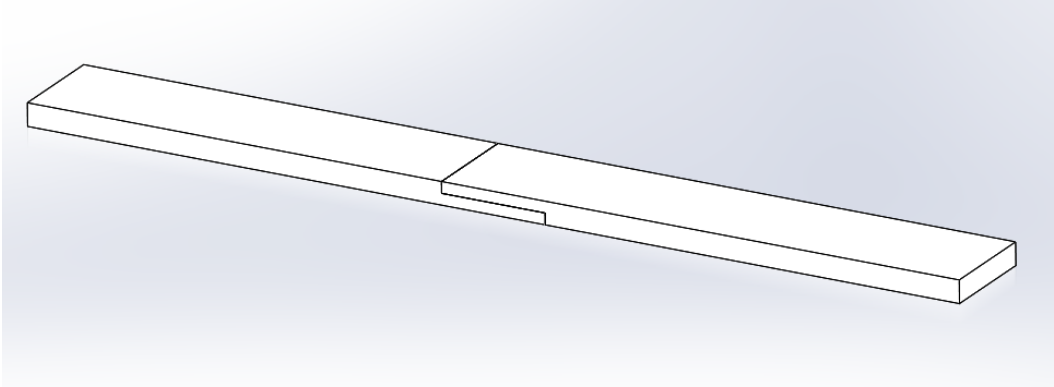
Sunshield Blank



- The Ultem Glass Fiber reinforced composite sheet is water jet cut from a large 4’ x 12’ sheet.

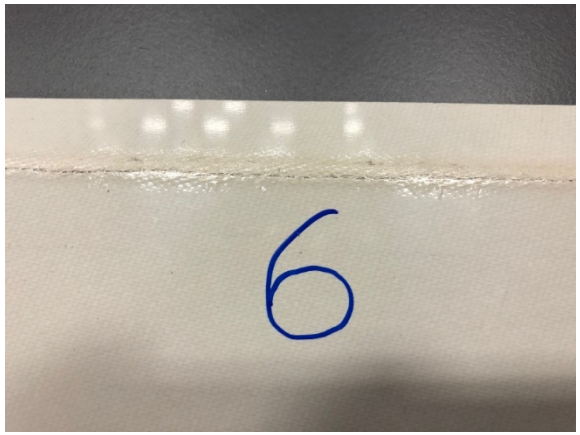
Seaming Sunshields

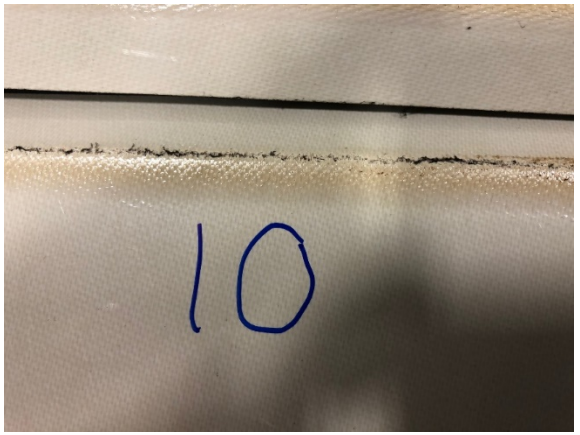
- Seamed sunshields will use an overlap tab for adhesive bonding as seen in the model below.



Early Bending trials

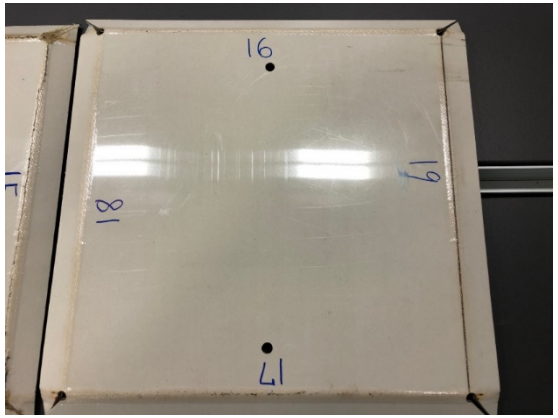
Heated box and pan break

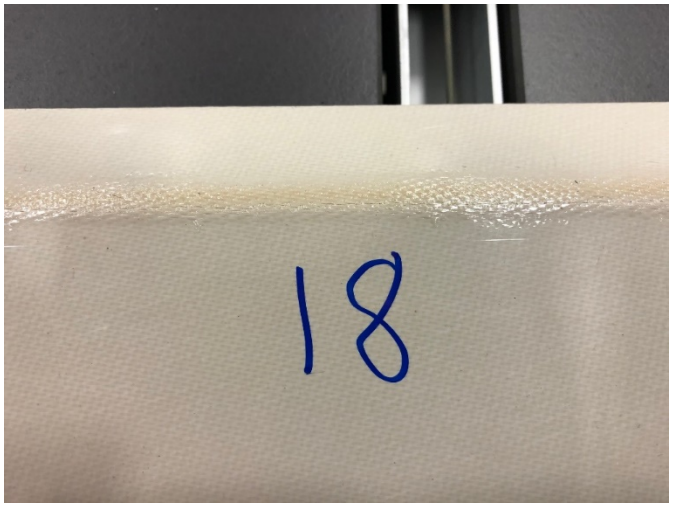




Too much heat being lost to the brake

Bending with CF PEEK Insulation



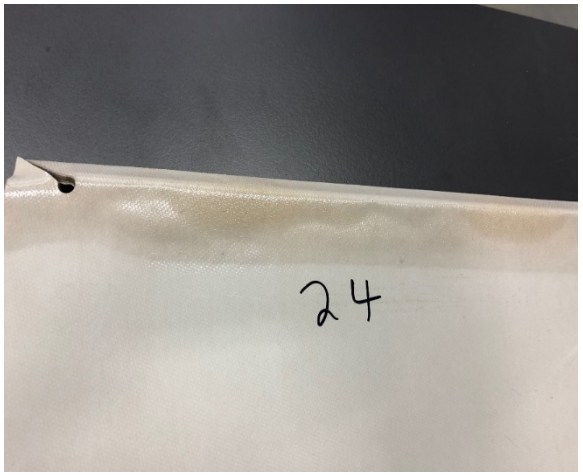


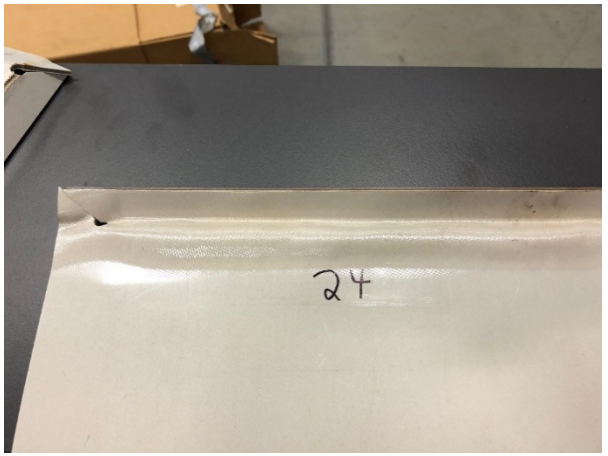
Middle Bending trials

Room temp Brake with Silicone pad

Bending with IR heater

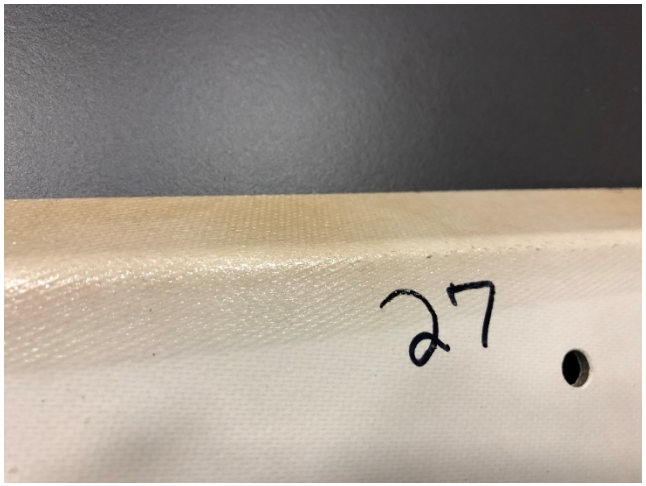
The IR heater works much faster and gets too hot quick

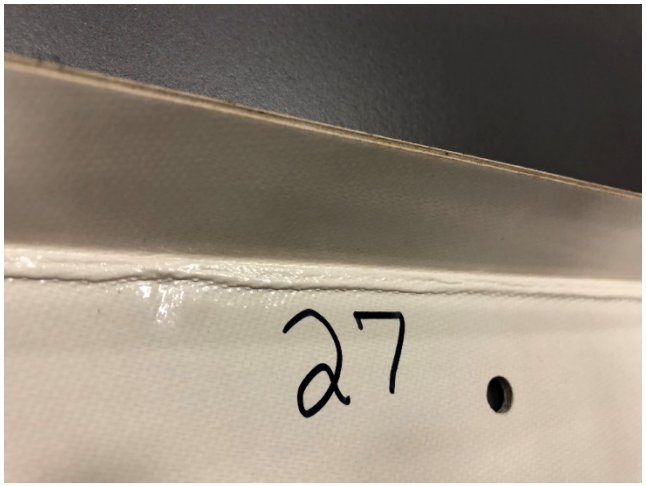




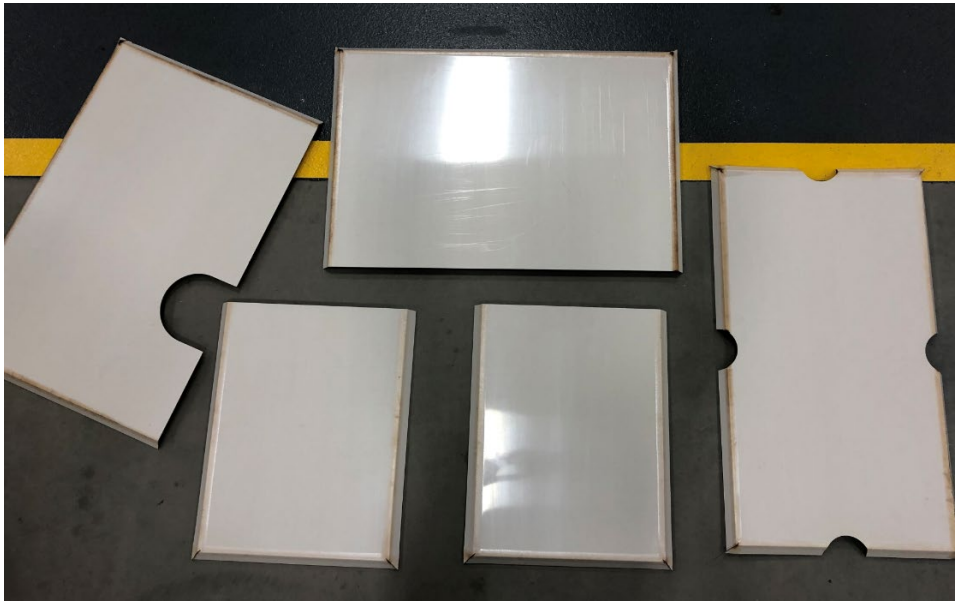
Bending with IR Heater

- Worked well, panel heated to 450F in one minute



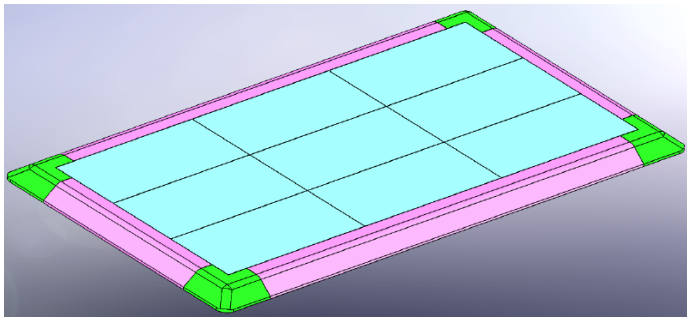


.50 Cal Sunshields Prototypes



Technical Plan

- If a functionally equivalent component can be developed and deployed using composite materials that meets the same requirements as the original steel component, there are significant repair time and material cost savings to be captured.
- In addition to the cost savings, there will be a reduction in on-dock time required for ongoing maintenance as well as potential weight savings.
- Vacuum form over tooling.

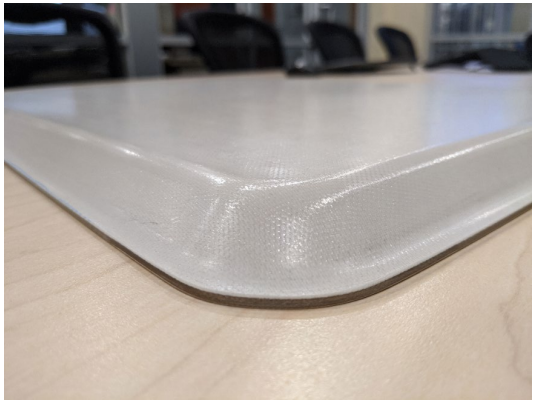
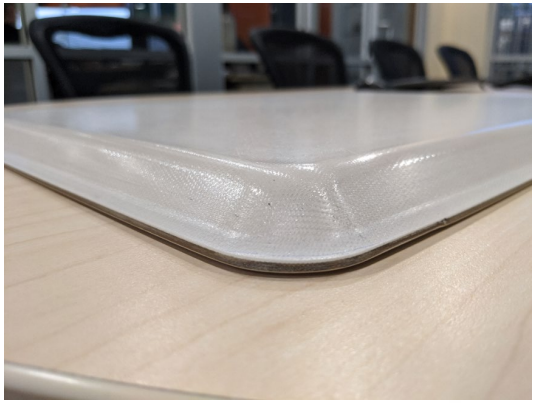


Task 1-Process Development

- Through various trials, the vendor determined that the use of a heated vacuum table, along with a female mold, was the preferred forming method.
- Modify a commercially available heated vacuum table to increase temperature limit.
- Material will be pre-dried in an oven, transferred to a mold located on the heated vacuum table, vacuum will be applied, and a separate heater will heat the molded portion of component until component edges are formed.
- After forming, the heated vacuum lid will be opened and will be transferred to cooling / machining fixture.

Production Forming



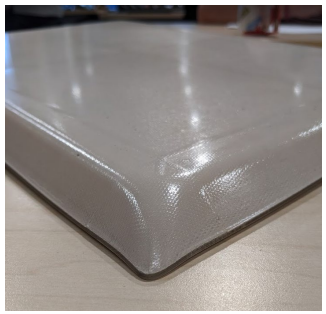
Modular Mold

- The modular mold strategy is an effective method of making these panels.
- While this method will reduce cost for larger molds, that have greater material cost and surface areas, at the smaller sizes a single piece mold may be more economical on labor time and materials.

50 Cal RSL Side Panel – Prototype Production

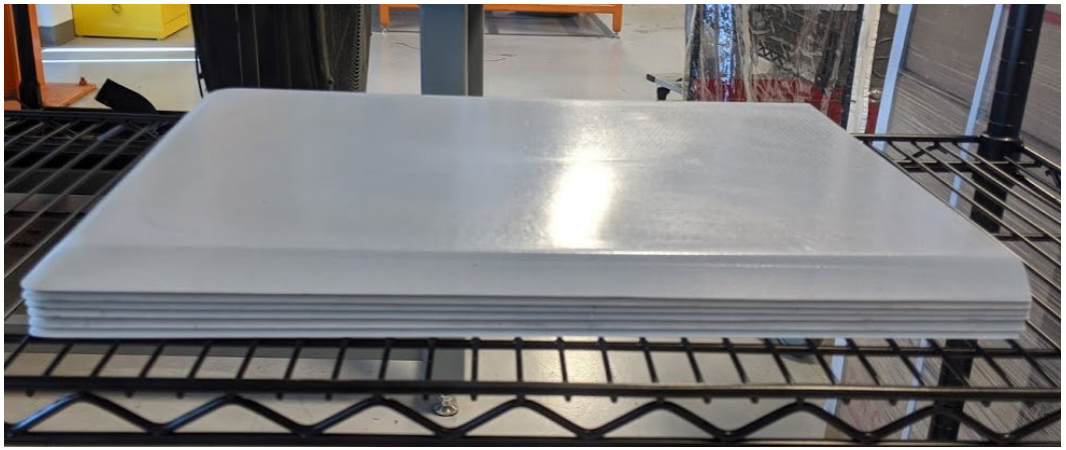
- Panels made on the modular mold and have been able to mostly capture the sharp corners per print.






50 Cal Side Panels Formed Without Induction Heating

- Formed .50 Cal Side Sunshields using only the heated vacuum table, and no induction heating.
- Note, Pre trim on left and post trim on right.



Benefits/Payoff

- **Assume 700 RSLs are refurbished every year throughout all the RMCs.**
  SWRMC estimates 250 RSLs per year and SERMC close to 100.
- **Assume 15 RSLs per ship with 5 sunshields each.**
- **Approximately 47 ships per year.**
- **Assume 20% sunshields need to be repaired, 10% need to be replaced.**
- **Composite material eliminates time to put in/out of furnace,**
- **repair/replace of sunshields and preparation and coating.**
- **Save approximately 8000 hours of labor at RMCs and extend normal maintenance cycle from 12-18 months to 3 to 5 years.**

Information taken from 2020 Fleet Maintenance & Modernization Symposium

Questions?