Composite Materials Components for Reduced Maintenance and Total Ownership Cost

Dr. Maureen Foley

Mr. Richard Park

Naval Surface Warfare Center

Carderock Division

MEGARUST 2015

June 23-25 2015

NAVSEA
WARFARE CENTERS
Carderock Division

Outline

- **Introduction**
- **Methodology for New Component Development**
- **Legacy Components**
  - Grating, Vent Screens, Electrical Enclosures
- **Components in Transition**
  - Deck Drains, MIL-PRF-24758A End Fittings, Trough Cover Plate
- **Components in Development**
  - Composite Stowage Boxes, LPD 17 Stern Gate Control Panel
- **Components Planned**
  - Munition Box Sun Shield
- **Articles Available for Demonstration**
  - Composite Electrical Enclosures
- **Summary**

NAVSEA
WARFARE CENTERS
Carderock Division

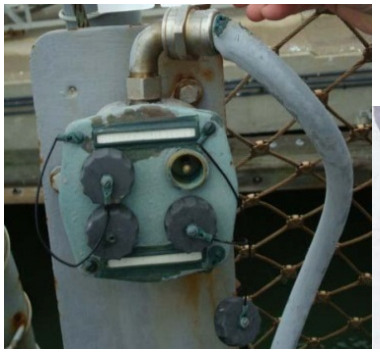
Introduction

- **Corrosion of metallic components in topside, well deck and catwalk areas requires significant sailor labor and maintenance funding to repair and/or replace corroded components.**
- **Components made out of composite materials offer the potential to be more resistant to environmental effects, lighter weight and in some cases, lower cost than the legacy metallic components.**
- **The goal of this presentation is make the fleet aware of the components that are currently available as well as those in development so that they can be utilized across the fleet to reduce total ownership cost.**

NAVSEA
WARFARE CENTERS
Carderock Division

Examples of Corroded Components

FLEET SUPPORT SEA 21 INTERNATIONAL INACTIVE SHIPS



Methodology for New Component Development

1. **Identification of Target Components**
   - Input from maintenance personnel, ships' forces, port engineers, and program office used to identify specific components which require frequent maintenance.
2. **Requirements Definition**
   - Analysis to determine the current requirements of the component.
   - Interactions with cognizant technical warrant holders.
3. **Prototype Fabrication, Evaluation and Demonstration**
   - Prototype of composite components fabricated and evaluated per the requirements defined during the Requirements Definition Phase.
   - Prototype iterated as necessary and ship change document (SCD) generated to allow of fleet demonstrations.
4. **Trial Inspection and Institutionalization**
   - Inspections performed of the fielded component dependent on ship availability.
   - Installations documented and ships' forces queried for feedback on success of installation and any lessons learned documented.
   - SCD's, Temporary Installation (TEMPALTS), NAVSEA Drawing packages, and National Stock Numbers (NSN) established as part of the Institutionalization process depending on the component. Preferred transition path determined through interactions with program office and stakeholders.

Composite Deck Grating (Approved for Use)

Installed Composite Deck Grating

LSD Wing Wall

CVN Catwalk

Benefits

- 45% weight by reduction on CVN class catwalk (14 ton reduction)
- Will not corrode like the legacy steel grating

Material

- New phenolic resin based composite material
- NAVSEA 803-6983499, Deck Grating, GRP Installation and Details, currently under revision.

Approved Suppliers

- Fibergrate
- Strongwell

Logistics

- NSN for M-clip
  - 5340-01-529-4180
- NSN for grating panel
  - 2040-01-529-4206

Composite Vent Screens (Approved for Use)

- Will not corrode like the legacy steel vent screen
- Widely installed across the fleet on CVN, L-ships and DDG classes

Material

- Modified Acrylic (MODAR) resin based composite material
- NAVSEA DWG 803-6983500 Vent Screen, GRP, Installation and Details

Approved Supplier

- Fibergrate

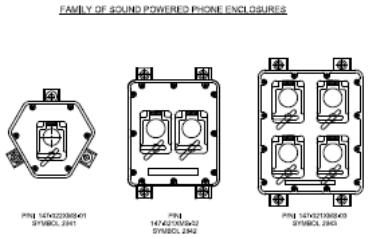
Logistics

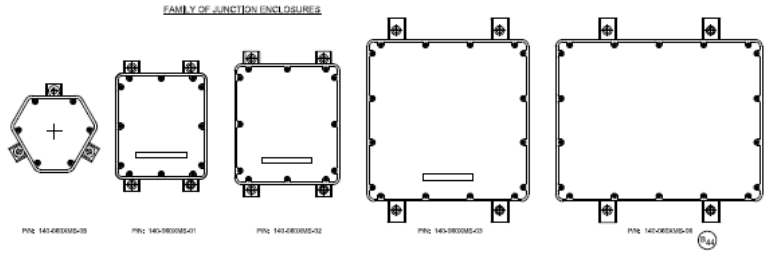
- Screen
  - NSN 5670-01-529-4266
  - Fibergrate P/N 269470
- M-Clip
  - Fibergrate P/N 734250

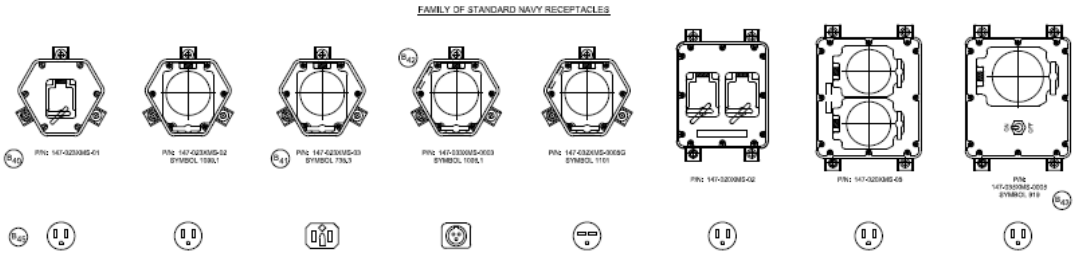
Composite Electrical Enclosures (Approved for Use)

CVN Aircraft Elevator Station

- **NAVSEA DWG 803-6983506 Electrical Enclosure, Composite Installation and Details, Rev B in process.**
- **SCD 6922 All Surface Ships**
- **Still looking to transition to CVN fleet on a more wide scale basis.**
  - Initial CVN specific SCD never completed







Approved Supplier

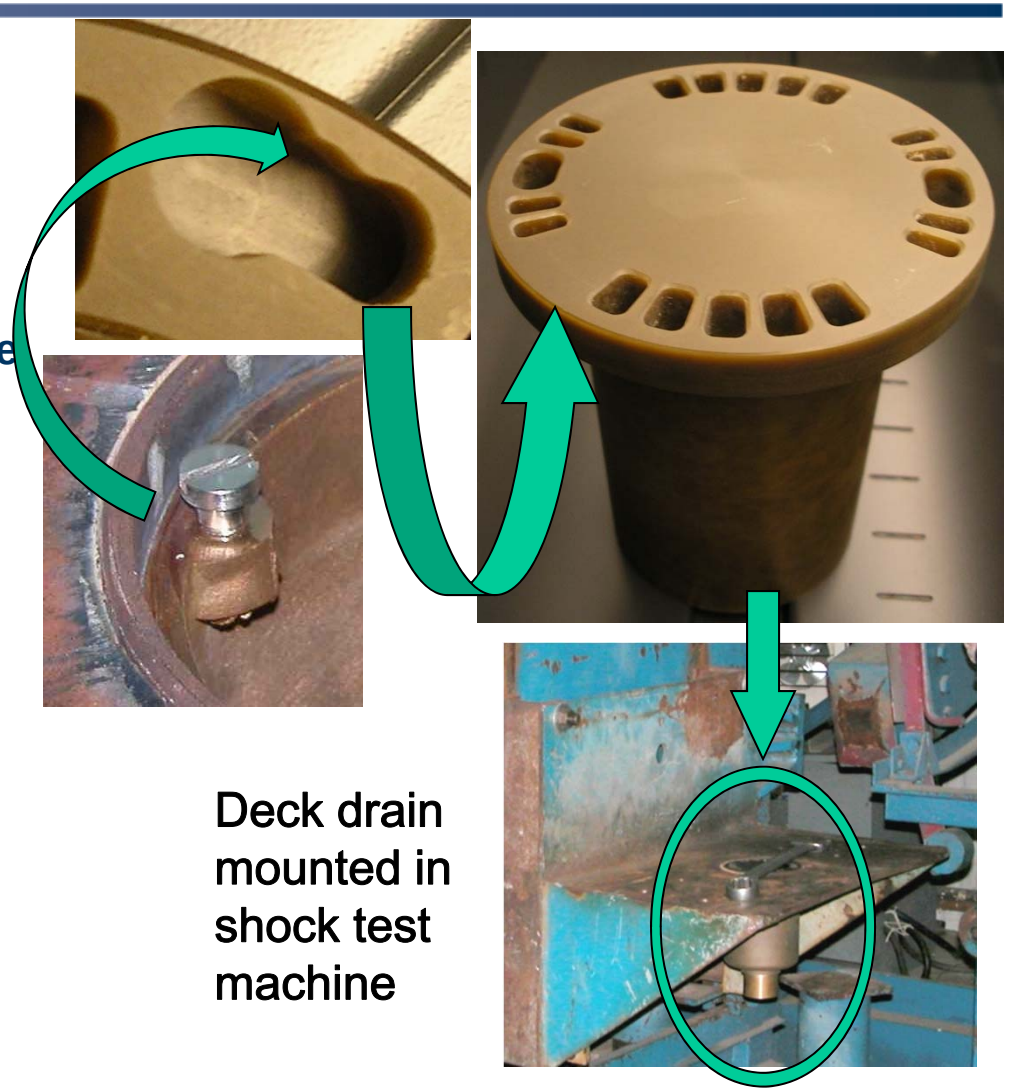
- Glenair

Logistics

- NSNs assigned for various enclosures and replacement parts

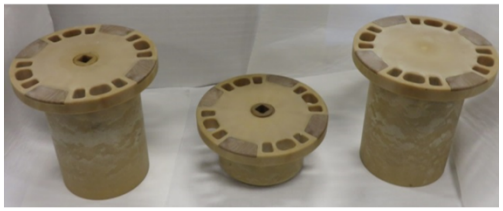
Composite Deck Drains (Approved for Use/SCD in Process)

- **Purpose: Ease of service, no tools, low/no maintenance.**
- **Problem: Fasteners corrode into drain preventing service.**
- **Solution: Make drain insert from composite with twist lock and install fasteners permanently. Finger holes provided to remove and service without tools.**
- **Material: GE ULTEM 2300 with 30% glass fiber reinforcement chosen for mechanical properties and fire performance.**
- **Non-valved passed Grade B shock test**
- **Valved passed Grade A shock test**
- **Evaluation on LHA 5 (2004), CG61 (2012), DDG84 (2013), CVN71 and CVN 75 (2014)**
- **NAVSEA DWG 803-6983511 Deck Drain Insert, Composite , 1.5 & 2.0 inch**
- **SCD 15867 Composite Deck Drain Insert**

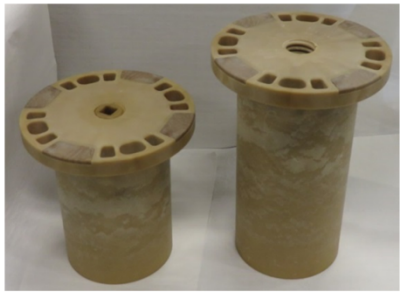


Deck drain mounted in shock test machine

Composite Deck Drains (Approved for Use/SCD in Process)



2 inch Type A 2 inch Type B 2 inch Type D
2 inch seal/trap 2 inch seal/trap



2 inch Type A 2 inch Type A
2 inch seal/trap 4 inch seal/trap

1.5 inch Type D 2 inch Type D
2 inch seal/trap 2 inch seal/trap
(unfinished)

2 inch Type D 2 inch Type D
2 inch seal/trap 4 inch seal/trap

2 inch Type C

Material

- Ultem 2300 (30% chopped glass PEI)
- NAVSEA DWG 803-6983511 Deck Drain Insert, Composite , 1.5 & 2.0 inch

Approved Suppliers

- BAE Systems San Diego Ship Repair

Logistics

- NSN for all configurations
- NSN for shoulder bolts

MIL-PRF-24758A Conduit End Fitting (Finalizing Testing/In Transition)

- **Glenair, an approved vendor of MIL-PRF-24758A conduit, has replaced the legacy CRES nut and sleeve on the MIL-PRF-24758A end connectors with a composite material to come up with a lightweight, environmentally durable, lower cost, hybrid end connector.**

MIL-PRF-24758A Conduit End Fitting (Finalizing Testing/In Transition)

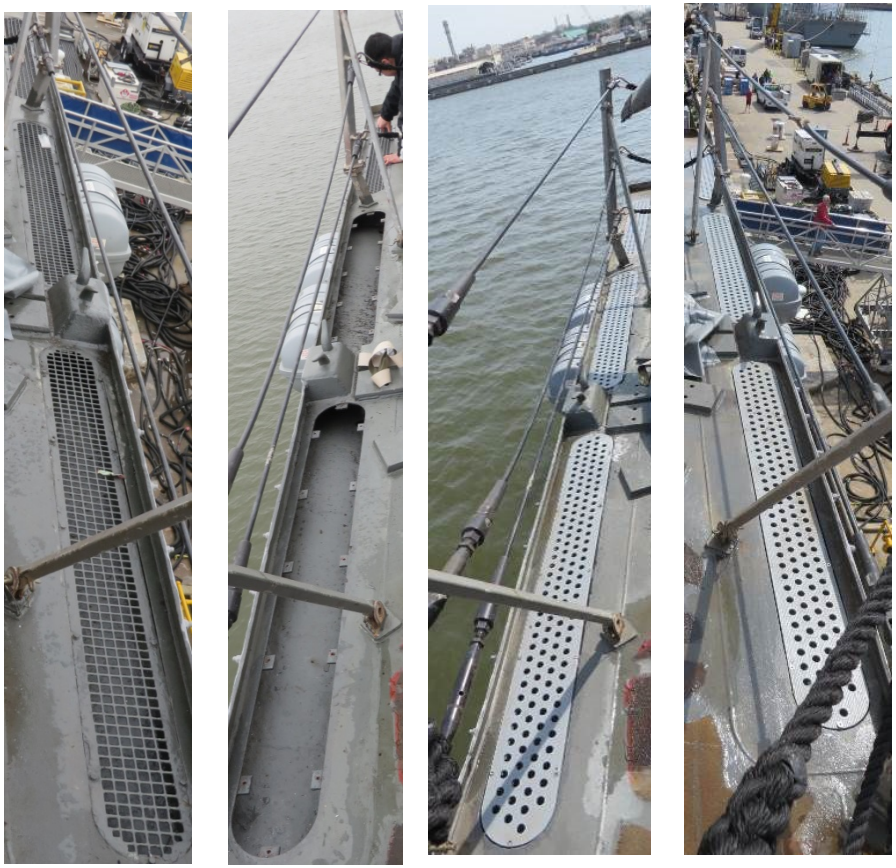
MIL-PRF-24758A Requirement/Verification Paragraphs	Test Description	Reference Source
3.5.2/4.5.2	Conduit Fitting Size	MII-PRF-24758A
3.5.3/4.5.3	Interchangeability	MIL-PRF-24758A
3.6/4.6	Conduit/Joint Systems	MIL-PRF-24758A
3.7.2/4.7.2	Impact	IEC 61035-1
3.7.3/4.7.3	Vibration	MIL-STD-167
3.7.4/4.7.4	Tensile Strength	IEC 60614-2-5
3.7.6/4.7.6	Resistance to Heat	IEC 60614-2-5 & 61035-2-3
3.7.7/4.7.7	Resistance to Flames	IEC 60614-1 & 60695-2-4/1
3.7.8/4.7.8	Acid Gas Emission	IEC 60754-2
3.7.9/4.7.9	Shock	MIL-S-901D
3.8/4.8	Weather Proofing	IEC 60529 Clause14.2.6
3.9/4.9	External Corrosion	ASTM B117
3.9.2/4.9.2	Solar Radiation	IEC 60068-2-5
3.10/4.10	EMI Signal Attenuation	IEC 60096-1
3.11.2/4.11.2	Conduit Fittings Marking	MIL-PRF-24758A

- **MIL-PRF-24758A does not have a QPD.**
- **First article testing to the MIL-PRF-24758A performance requirements in table were performed and documented in NSWCCD-65-TR-2010/03.**
- **Additional Testing per MIL-PRF-24758A 3.7.5/4.7.5 Flexing was required by TWH and is underway to finalize qualification testing.**

MIL-PRF-24758A Conduit End Fitting (Finalizing Testing/In Transition)

- **Based on a recent surveys of DDG 91/CVN68, it was determined that there are approximately 360 topside conduits on a DDG 51 class ship and 480 on a CVN68 class.**
  - Typically each conduit assembly has an end that attaches to a stuffing tube/kick pipe and the other end that attaches to the component.
- **For each conduit end connector there is a potential to save 0.28 lbs using the lightweight version.**
  - Outfitting a DDG 51 class ship could potentially save 194 lbs.
  - Outfitting a CVN 68 class carrier could potentially save 260 lbs.
- **For each conduit assembly there is a potential to save approximately $151 based on an initial cost estimate from the vendor.**
  - Outfitting a DDG 51 class ship could potentially save $54.4K.
  - Outfitting a CVN 68/77 class could potentially save $72.5K
- **Additional cost avoidance for repair (33% per year @$552) and replacement (8% per year @$1372) of corroded metallic fittings**
  - DDG 51 class ship - $100K per year
  - CVN 68 class ship - $140K per year

Composite Trough Cover Plate (In Transition)



Demonstration on USS NITZE

Summary

- Port Engineer identified problem components.
- Prototype Parts Fabricated at NSWC Carderock.
- Glass fiber reinforced vinyl ester composite material coated with Formula 150 and MIL-PRF-24635 silicon alkyd, haze gray.
- Matched Drilled shipboard to meet mounting hole locations.
- Initial 2 cover plate demonstration on USS BULKELEY April 2013.
- Full ship set installed April 2015 on USS NITZE.

Composite Stowage Boxes (In Development)

USS BULKELEY
(over 2 years installation)

USS NITZE
(over 4 years installation)

Summary

- Ultem 2300 (30% chopped glass PEI)
- Ultem (7781 glass fabric reinforced)
- Composite version of sheet metal processing.
  - Locally heat area and then bend material to form box.
  - Use thermoplastic welder tool to join seams.
- Larger stowage boxes will use bonded angles of same material to provide strengthening at corners.

Initial Stowage Box Projects

- Brow Chain Rail Stowage Box (DDG 51 class)
- Telephone Headset Stowage Box (fleet wide)
- Rescue and Assist Box (fleet wide)

LPD 17 Stern Gate Control Panel (In Development)

Develop a form, fit and function replacement for metallic enclosure

- **Current Drawing Requirements**
  - NEMA Grade 4 enclosure
    - Watertight
  - Temperature : 50C
  - Shock: Grade A, Type I
  - Torque to Bulkhead 90 lb-ft
  - Weight – 101 lbs (metallic)
  - MIL-C-2212H

- **LPD 17 Stern Gate Control Panel contains:**
  - 3 terminal boards
  - 5 Push Buttons, Flush Mounted Contacts
  - 17 Lights, Flush Mounted Indicating
  - Heater w/thermostat

Munition Sun Shield (FY16)

- **NAVSEA 05 Painting Center of Excellence has selected the Composite Munition Sun Shield for funding in FY16.**
- **Legacy steel sun shields are rust formers and require frequent maintenance.**
- **This project will develop a composite material based sun shield.**
- **Initial material selection is a COTS product that is a white colored glass fabric reinforced polyetherimide (PEI) composite material.**
  - Material is currently used in aircraft applications and has very low flame spread, smoke density and toxicity properties.

Components for Demonstration

- **NSWCCD is always looking for components that could be converted to composite materials to reduce the maintenance burden.**
- **NSWCCD has some composite electrical enclosures in stock that are available for ships that are looking to try out the technology.**
  - Glenair typically will also provide on-site training regarding installation of their products.
- **NSWCCD is currently soliciting for points of contacts within the surface ship community for future trial demonstrations of composite deck drain inserts as these components transition to the fleet.**

NAVSEA
WARFARE CENTERS
Carderock Division

Summary

- **Composite materials based components have been shown to reduce the required maintenance due to corrosion in topside applications.**
- **A standard methodology has been established to take new ideas from the fleet through the development process.**
- **The preferred path to Institutionalization for new components is developed through interactions with Technical Warrant Holders (TWH), In-Service Engineering Agents (ISEA), fleet and program office.**
- **It is imperative that all logistics development (Allowance parts list (APL), Coordinated Ship Allowance List (COSAL), NSN, Planned Maintenance System (PMS) occurs during development to ensure a smooth transition to the fleet.**

Contact Information

Dr. Maureen Foley
maureen.foley@navy.mil
Naval Surface Warfare Center, Carderock Division
Structures and Composites Division, Code 65
301-227-5040

Mr. Richard Park
richard.y.park@navy.mil
Naval Surface Warfare Center, Carderock Division
Materials Division, Code 61
301-227-4973