

# Qwik Connect

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*Super  
Solutions  
to*  
**MEGA  
RUST**



*Glenair*®

**M**ega Rust is an annual event that began in June 2005 and rotates among several locations to reach a broader audience and to best meet the needs of the U.S. Navy. Mega Rust combines five annual meetings and conferences:

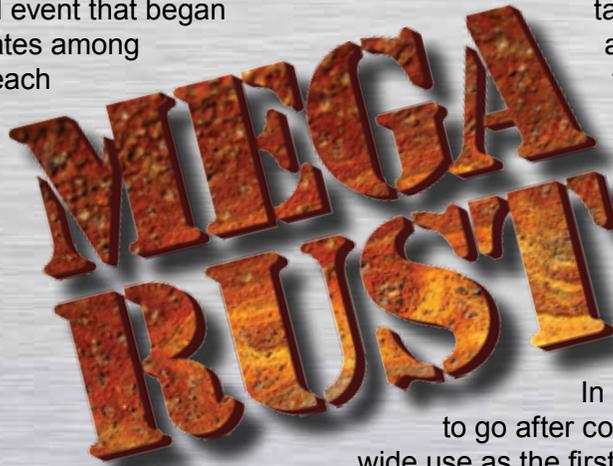
- ***U.S. Navy and Industry Corrosion Technology Exchange, “Rust” Conference***
- ***Commander, U.S. Fleet Forces Command’s Fleet Corrosion Control Forum***
- ***Naval Shipyard Coatings Group Meeting***
- ***USCG Coatings & Corrosion Control Tiger Team Meeting***
- ***U.S. Navy Submarine Preservation Conference***

This conference brings together government, military, owners, operators, shipyards, research facilities, and coatings manufacturers and suppliers to discuss issues pertinent to the preservation industry.

**Goals:**

To present the Fleet and industry’s needs in areas of preservation, and highlight new and innovative preservation technologies methods, successful applications of new products, research and development preservation of materials, environmentally compliant processes and lessons learned.

The idea behind “just do it” is that various corrosion solutions that have already been tested/ validated need to be identified and implemented fleet-wide. Potential obstacles include the time it



takes to identify the solution, raise awareness of it throughout the fleet, and indentify sufficient funding for its implementation. This group will focus only on solutions that have been previously tested or implemented and do not require any additional effort to prove the concept or for research and development.

In fact, the group has been directed to go after composites and increase their fleet-wide use as the first “just do it.”

After the group gets going on composites, we will take on other ideas. Unfortunately, we will not be a conduit for helping companies get their products “approved for Navy use.” However, some of the members of the group may be willing to go down that path separately and outside of the WG. An excellent example of a “just do it” is the use of nickel alloy 625 in DDG-51 Class destroyer exhaust duct fasteners instead of CRES 316 fasteners that have a high rate of failure. This prevented the ongoing corrosion problem, and was a very simple solution once it was reached.

The cost of corrosion control for U.S Navy ships is high and consumes approximately 20-25% of the Fleet budget. Reducing the cost continues to be a significant priority. Also, achieving full service life of coatings is one of keys to extending dry docking periodicity. The CNO continues to strive for a 313 ship Navy by extending the life of ships in service and investigating how savings at all levels of ship overhaul, ship repair maintenance, and Navy personnel can be achieved. Keeping this in perspective, during this past year, there were several MEGA RUST government/industry working groups looking at issues with the goal of reducing the cost of preservation. These Working Groups (Graduated Quality Assurance, Paint Warranties and Navy Preservation Cost/Technical) provided presentations and group reports that included recommendations

for cost savings and continued improvements. These presentations and Executive Group actions are included on the National Treatment Center website [www.NSTCenter.com](http://www.NSTCenter.com). This site is authoritative for U.S. Navy coatings and corrosion control.

Based on presentations and discussions at the conference, four new working groups were established. These groups will again be structured with the government and industry being joint and equal partners. Lean principles and methodologies are applied for all working groups. The new Working Groups (WG) are as follows:

- **Paint/Structures MRG WG**
- **Heavy Metals WG**
- **Global Cost of Corrosion WG**
- **“Just Do It” WG**

**The goals of the  
“Just Do It”  
Working Group:**

Take existing solutions that have been tested and validated on individual ships and submarines and proven to work, take other solutions so implementation funding may be obtained, and apply them fleet-wide.

Develop and maintain an infrastructure to provide essential feedback loops between the Fleet

and industry that will facilitate the transfer of technologies presently available. Focus on partnership opportunities between the Fleet and industry. Provide training opportunities to Fleet and industry.



**T**he importance of corrosion to the maintenance of the infrastructure and industry of the United States became manifest with the publication of a Department of Transportation Study in 1998 that found that the nation spent \$276 billion per year, or 3.1 percent of GDP, on maintenance due to corrosion related degradation. Due to the inherent difficulty with estimating the cost of corrosion, it was further concluded that indirect costs were equal to the direct cost, due to factors such as lost time and productivity when bridges were closed for (corrosion related) repairs. The cost of corrosion attributed to the Department of Defense in this study was estimated as being about \$20B per year<sup>1</sup>. A recently completed study conducted by the Department of Defense Office of Corrosion Policy and Oversight confirmed the veracity of this early estimate with a more refined corrosion cost of \$17B per year<sup>2</sup>.

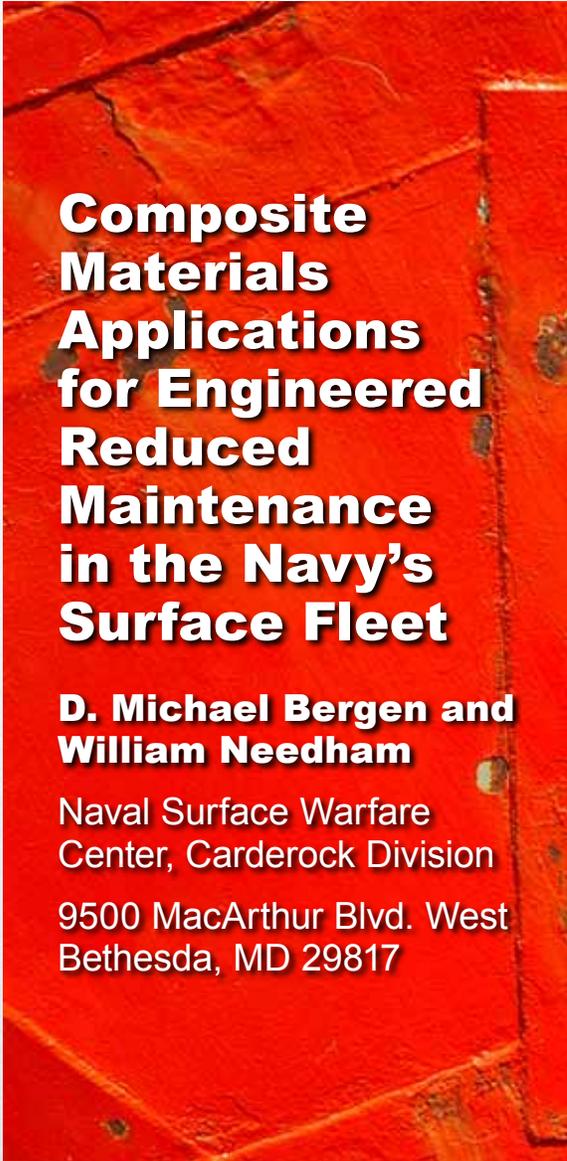
The cost of corrosion for Navy ships was determined to be \$2.43B per year<sup>3</sup>. Navy ships are a major corrosion problem. They operate in the marine environment that consists of saline water and salt spray, excellent electrolytes for corrosion cells. Navy ships are made primarily of various alloys of steel due to the need for adequate strength at an affordable cost. However, steel is made primarily from iron which is generally highly susceptible to corrosion; red rust is iron oxide.

As ships are enclosed vessels, the interior spaces are largely shielded from the effects of sea water with the exception of the numerous tanks and voids that are used for storage and ballasting with fluids and the various heat exchangers that use the ocean as a heat sink. The external hull and superstructure, however, are continuously exposed to the harsh marine environment. It is not coincidental that one of the main corrosion tests that is used for the evaluation of new materials employs a salt spray environment<sup>4</sup>. While underwater hull maintenance is under the purview of depot level maintenance activities where dry docking facilities are available, the topside superstructure and freeboard areas are largely left to the ship's crew to maintain.

The weather decks on US Navy ships are well known to be the worst corrosion environment as it is subject to the harsh marine environment and open weather exposure. Consequently, a large proportion of shipboard labor is dedicated to corrosion control.

One of the primary problems associated with topside corrosion in Navy ships is the use of materials that were not designed for salt spray environments. This is generally a matter of common ship design practices. When a ship is built, there is a great deal of pressure to minimize costs, as there is always a mandate for higher performance at a lower cost.

Because of this, compromises must be made with respect to materials used in fabrication and in the complexity of the processes used to install them. Consequent to this, carbon steel components that are inadequately protected by barrier coatings are the primary materials used for fasteners, brackets, cable runs, and other weather deck system hardware and outfitting. Part of the problem is that protective barrier coatings that have historically proven effective have been shown to be either a health hazard to people or an environmental problem. Cadmium is an excellent corrosion resistant coating for fasteners and often is post treated with hexavalent chromium. Both are known health and environmental hazards and there are restrictions



## **Composite Materials Applications for Engineered Reduced Maintenance in the Navy's Surface Fleet**

**D. Michael Bergen and William Needham**

Naval Surface Warfare Center, Carderock Division

9500 MacArthur Blvd. West  
Bethesda, MD 29817

for their use. Recently the Office of the Under Secretary of Navy issued a directive to eliminate the use of hexavalent chromium in the Navy due to environmental considerations<sup>5</sup>.

Another major problem with topside materials is the nature of the work environment that they are subject to. Ship operations and maintenance



evolutions typically involve the movement of personnel and heavy materials over decks and through hatches for deployment below decks. This movement results in the impact damage to topside components. One of the most effective methods of protecting carbon steel materials in a salt spray

environment is to coat them with a material that is more anodic than the base metal. A coating of aluminum, which corrodes preferentially to iron in a galvanic cell, is used to protect the steel substrate. The process is generically called galvanizing and the coating is referred to as anodized aluminum. However, the common use of anodized aluminum is easily compromised by impact of tools and equipment movement that damages the surface and exposes the substrate. Another method that has been used to minimize the effects of corrosion on the topside of Navy ships is the use of corrosion resistant materials for topside components.

There are two problems associated with this strategy for corrosion mitigation. Corrosion resistant metals with adequate strength for the specific application are prohibitively expensive, costing five to ten times more than the original<sup>2</sup> corroding component.

Since the corroding component can be replaced cheaply, the argument is that it is cheaper to replace an inexpensive corroding fastener every two or three years than it is to invest in an expensive permanent replacement. This misses the mark in that it does not take into account two significant issues. The first is running rust. When a small topside component begins to corrode, the corrosion products are washed down the side of the ship and stain the coating below.

The resultant appearance is highly unaesthetic and generally results in a premature reapplication of paint to cover the running rust stains. The application of cosmetic paint coatings due to running rust from metallic topside components is one of the most intractable problems faced by the ship's crew. The consequences are that many Sailors spend a lot of time painting over running rust, the ship OPTAR is reduced according to the need for the First Lieutenant to buy more paint, and the environment is subject to higher levels of volatile organic compounds that are used in paint formulation. Over time, the accumulating layers of paint build up to the extent that paint delamination occurs and the only remedy is to blast and paint the entire side of the ship. The

cost of repainting the freeboard of an aircraft carrier is about \$20M. The buildup of paint used to cover running rust accumulates to the extent that it results in a substantial weight penalty which detracts from the ship's hydrodynamic performance.

The second significant issue with running rust from carbon steel topside components is that they must be periodically replaced. While this sounds simple, the logistics of shipboard maintenance is not. A ship is a floating city that must make all of its own power, cook all of its own food, and dispose or store all of wastes. It must also carry all of the things that are necessary to operate the ship and feed the crew. There is not a lot of room for storage of repair parts. When it is determined that a topside component has corroded to the point that it needs to be replaced, it is not likely that a replacement component is readily available or even on board. Consequently, the problem is documented on a work request (4790/2K) and entered in the Current Ship's Maintenance Plan (CSMP)<sup>6</sup>.

At the ship's next maintenance availability, which could be up to six months after the original problem was noted, the ship's maintenance manager will screen the work, normally to ship's force. By the time a Sailor has the time and the proximity to logistics resources to work on the problem, the simple running rust fastener has degraded to the point that the entire bracket requires replacement. In the worst case scenario, the corrosion may have progressed to the point that structural damage has occurred. At this point, the original work request is rewritten, the scope expanded and reentered into the CSMP. The ship's maintenance manager then must screen the structural repair work to a depot level activity. Ultimately, the cost of the fifty cent carbon steel fastener has resulted in a twenty thousand dollar repair job.

Another issue with the use of corrosion resistant topside materials is that they are generally cathodic with regard to the surrounding carbon steel structure. All metals are ranked in a galvanic series according to their relative affinity of their electrons. A metal that is more anodic than another will supply electrons to the more noble cathodic metal, corroding in the process. What results with the application of noble metal alloys in the Fleet is that there is a galvanic reaction with the surrounding materials which leads

to severe pockets of localized corrosion. This is especially the case with topside enclosures that have noble metal components. Recent topside applications of titanium metal alloys on surface ships have shown that active corrosion products are still evident inside electrical enclosures. The only



***DDG Class Composite Fairwater***

currently available solution to rectify this problem is to require the installation of desiccant packets inside the enclosure to absorb all moisture so that there is no electrolytic coupling for the flow of electrons that is the essence of the electrochemical reaction. This of course requires that the desiccant bags be

periodically changed as they become saturated. The end result is a corrosion resistant enclosure, which reduces the corrective maintenance workload, but which requires periodic replacement on an annual basis, increasing the preventive maintenance workload.



### ***Composites for Topside Shipboard Applications***

One of the methods that have proven to be effective in dealing with topside metallic components has been the use of composite materials. Successful

corrosion control can be realized through the use of fiber reinforced composite materials on board fleet combatants. This technology has proven to require less maintenance and significantly extend life cycle over the metal alloys commonly used for weather deck and hull applications below the water line.

This report discusses the effort to identify “off the shelf” commercial composite products suitable for the replacement of the current metal components on fleet surface ships. Qualification and selection of these families of materials was done through their response to fire, strength under in-service loads and exposures common to the marine environment. Further evaluation involved impact toughness and installation schemes for the various configurations. Early in the program this technology was applied specifically to the weather decks, radar platforms, HVAC weather openings and propulsion running gear. Each of the applications required some material development from the off-the-shelf form as a result of the strict performance requirements that the Navy has for their ships.

Historically, the aircraft carrier community (Planning and Estimating for Repair Activity for Aircraft Carriers, or PERA-CV) desired to address the chronic corrosion issues through a program called Carrier Life Extending Repairs (CLER). Having established a working relationship with the Naval Surface Warfare Center Carderock Division, Annapolis Detachment, on ship hull husbandry initiatives, PERA-CV approached NSWC to provide solutions for topside corrosion.

Several projects were undertaken as a part of that early effort to address chronic maintenance problems on the weather decks. Our initial efforts were undertaken as a part of PERA CV’s Corrosion Engineered for Reduced Maintenance (CERM) Program where life cycle costs were expected to be reduced while material condition was enhanced. The CERM process originally championed by PERA-CV, served as one of the models for and an early contributor of NAVSEA’s Engineered for Reduced Maintenance (ERM) initiated in 1996. The PERA-CV engineered applications are far greater than the scope of the applications discussed here. These evaluations and developments have resulted in the NAVSEA approval for fleet wide installation on naval surface combatants.

**Applications**

Though composite technology is being applied to the weather decks in numerous applications, there is still a requirement for fire hardening especially in and around flight OPS and ventilation areas. Special consideration has to be given toward V-22 Osprey and the F-35 Joint Strike Fighter.

It is very important for due diligence with employing these materials as a simple material substitution. As these materials are orthotropic in nature, their material properties dominate in specific layers opposed to homogeneous properties of isotropic materials, such as metals. The user is cautioned with the reminders that, as with all materials and processes, composite materials are not the panacea! The designer / engineer needs to be very sensitive to the end application, and not installing them in the same manner as metallic components.

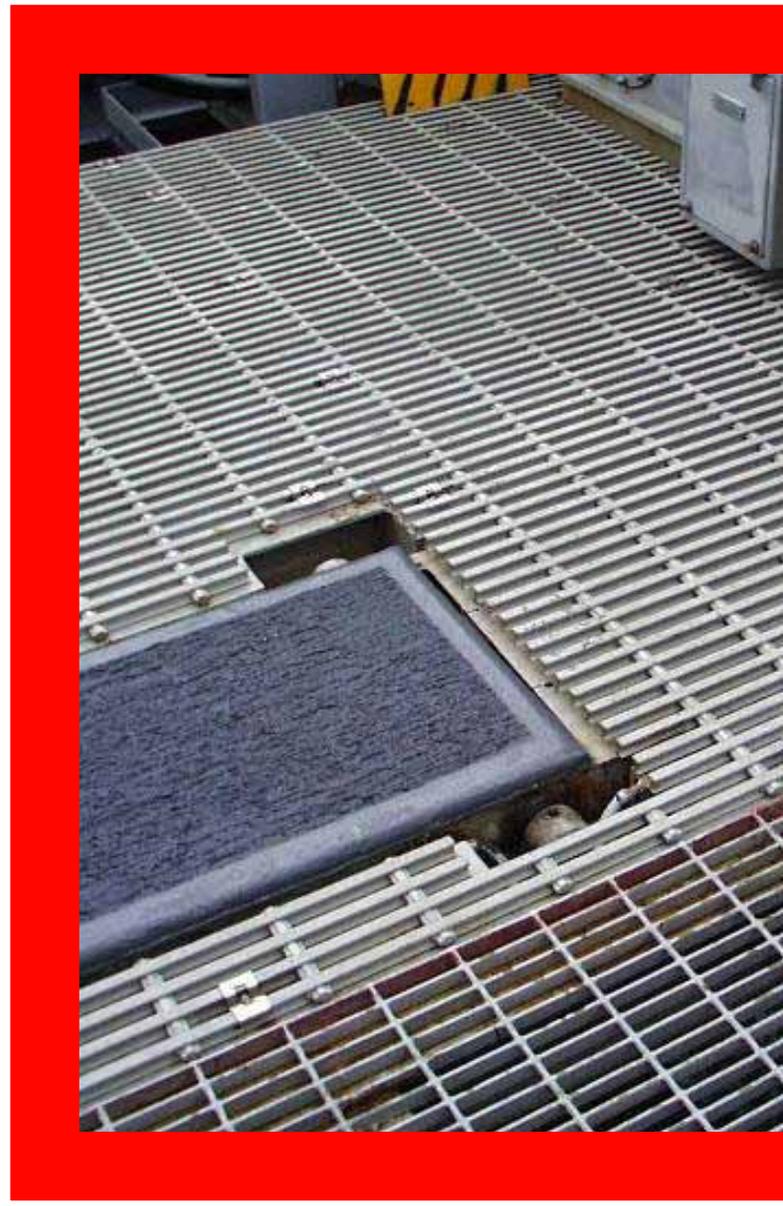
**Waterborne Applications**

The Navy’s aircraft carriers must operate at high speeds to provide adequate wind velocity for the launch of high performance jet aircraft. Navy surface combatants must not only keep up with the aircraft carrier to afford battle force protection, but also to deploy rapidly to world hot spots. The propulsion train and shaft line components have been engineered to provide the necessary thrust.

To reduce drag and to protect these components, propulsion running gear fairings are used to smooth transition joints in the assembly. These fairing components have traditionally been welded in place in the dry dock during ship construction or maintenance cycles. These fairings are technically not removable following launching. Heat affected zones, from the installation welding process, result in anodic areas that lead to eventual failure of the fairing to remain in place.

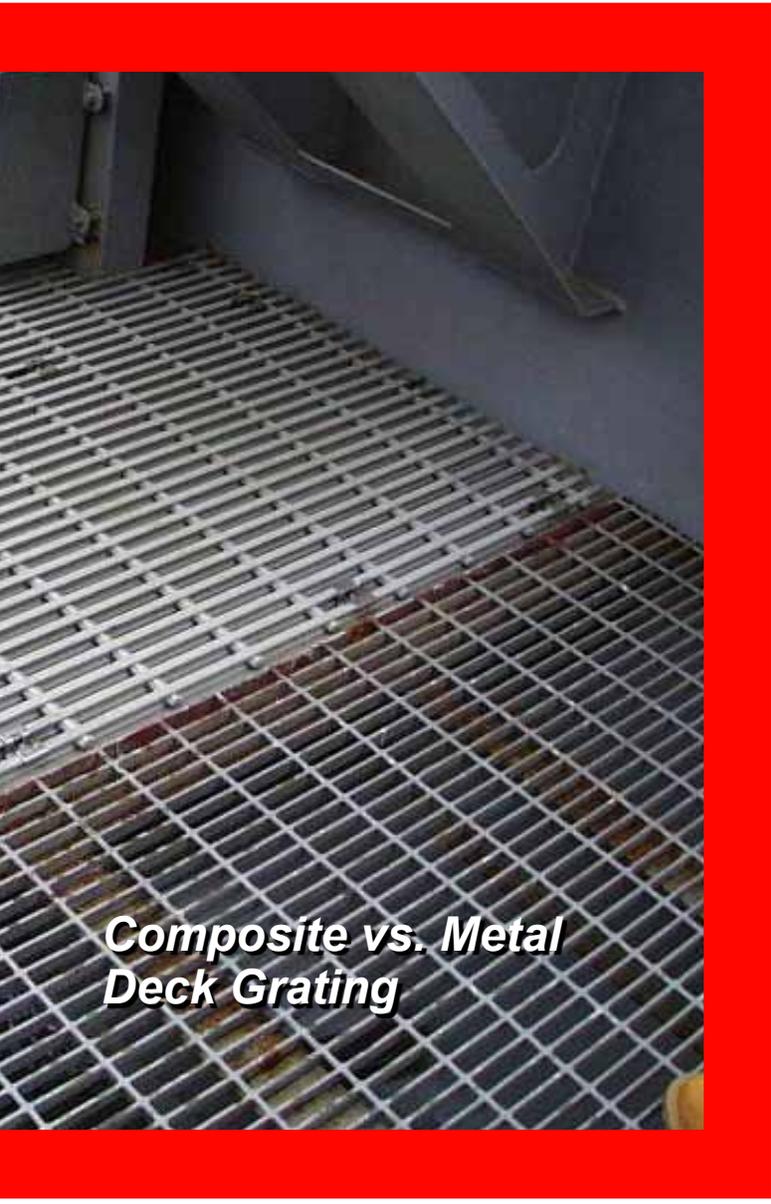
The repair of the failed fairings is a major maintenance issue that must be done in drydock due to the weight and the complexity of the removal process. Specifically the legacy metallic rope guards were made from carbon steel to enable waterborne

repair procedures in the event of fouling, and replacement of sacrificial anodes and the occasional stove bearing replacement. For the copper-nickel metal fairwaters, the waterborne maintenance issues are exacerbated as there is no Navy approved underwater welding procedure for nickel based alloys.



Composite Fairwaters and Rope guards are an ideal alternative for these components, as they provide low cost, low maintenance service over an extended interval. Since they are relatively light weight and attached with removable fasteners,

they can be removed and replaced by divers pier-side. Composite materials enable the engineer to design for extend service life to meet 12 year dry docking goal. The design also allows waterborne or pier side maintenance. Custom features can be incorporated which support diver activities such as



simple inspection accesses for zinc anode and stave bearing assessment, removable by common hand tools and lighter weight for diver rigging and handling. Most notable is that they are noncorrosive. A typical DDG-51 class installation is illustrated on the preceding page.

## ***Weather Deck Applications Catwalk and Deck Grating in Many Navy Ship Applications***

It is necessary to access to the side of the ship's hull for purposes of inspection and safety. Suspended walkways known as catwalks are provided for this purpose. Normally they are of a grated construction to minimize weight and to allow for full inspection. For example, aircraft carriers have catwalks around the flight deck for personnel access during flight operations and amphibious ships have cat walks along the interior of the well decks to monitor and control boat operations. In that these gratings are subject to almost continuous salt spray, they corrode very rapidly.

Maintenance managers are acutely aware of the life cycle issues with steel deck grating due to this corrosivity. The current grating deck surfaces are hot zinc coated carbon steel or quarter inch thick punch plate and require frequent replacement. Galvanized bar grate is installed by cutting sections from sheet stock and welding it into place. The cut ends and heat affected zones around welds no longer have the protective anodic zinc coating for the galvanic protection and so they degrade quickly. In addition, the support structure is not easily accessed and it is difficult to maintain a proper preservation schedule. The qualification of a suitable commercial grate would solve these problems. Further ship checks on aircraft carriers revealed that flight deck detergents are spilled in handling and collect on the decking support structure. Dirt and contaminants collected in these areas hold moisture resulting in accelerated corrosion to the support structure. Composite deck gratings provide a corrosion resistant, light weight, easily installed alternative to the galvanized steel gratings.

The Navy's efforts have been focused on developing a low cost fire resistant composite by qualifying commercially available composite products that can replace the steel deck grating. Fire resistance is necessary as Navy ships are inherently in danger of fire due to the proximity of flammable liquids and heated surfaces. The commercial composite product line was engineered with the substitution of a more suitable acrylic based resin featuring alumina tri-hydrate to yield excellent fire

properties and still retain the necessary strength. The successful result was the qualification of a fire hardened pultruded decking for high traffic areas, meets Grade-B shock.

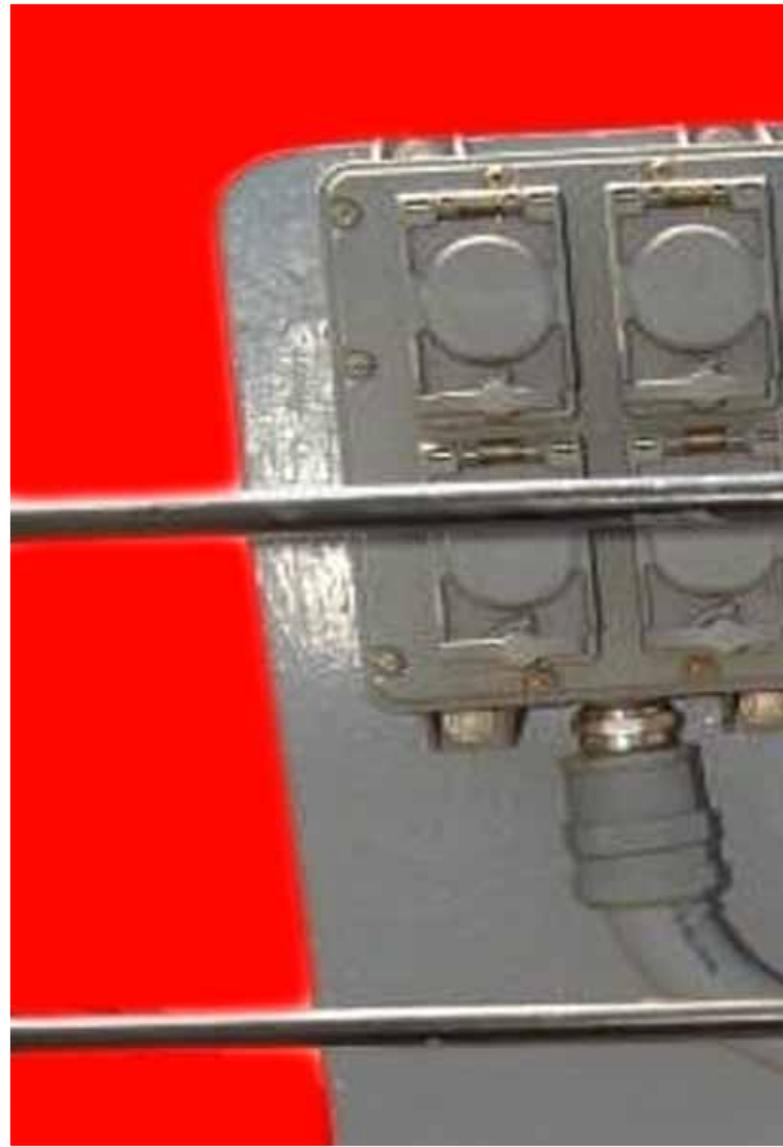
Molded product is qualified for radar platforms. Following development of a suitable alternative composite material, it was necessary to address the maintenance process associated with grating repairs. An installation procedure developed and a NAVSEA standard drawing was published for the institutionalization of product. The installation of the composite grating was engineered so that it could be readily maintained in the field by non-depot level personnel or even by ship's force. To ensure adequate strength of the attachment points without introducing a source of running rust, Type 316 corrosion resistant steel (CRES) fasteners were specified.

The extent of the hot work is a simple procedure of welding threaded studs in place with a stud gun. This installation scheme results in a removable deck system which now permits access to the support structure for preservation. A 60% reduction in weight (7.5 lb/ft<sup>2</sup> versus 2.8 lb/ft<sup>2</sup>) is an additional bonus. All of these improvements were institutionalized in a standard NAVSEA Drawing for documentation of the process and the materials.<sup>7</sup>

### **Composite Vent Screens**

Each ship has ventilation openings in various shapes and sizes; there is no standard configuration. Traditionally, the protective screens in these openings are made from galvanized or CRES wire mesh screen. This mesh screen was typically framed by a one inch steel angle and then held in place by carbon steel fasteners. All suffer from running rust which precipitates a maintenance and cosmetic problem. The objective of this effort was to develop a replacement for the metallic screen with a fire resistant, low smoke, nontoxic combustion gas composite solution. The composite screen is a molded fiberglass product whose resin matrix, developed under the deck grating program, includes fire retardant additives. When subjected to fire insult, no toxic combustion products are produced. This type of performance is desired for the HVAC applications. A fastening scheme was developed

using all 316 stainless steel components. The material is haze gray to match the adjacent hull coating and features UV inhibitors so that it does not need to be painted. The end result was a successful fire hardened composite material which does not corrode due to general corrosion and which does not result in galvanic corrosion due to the coupling of an anodic and a cathodic metal. The program

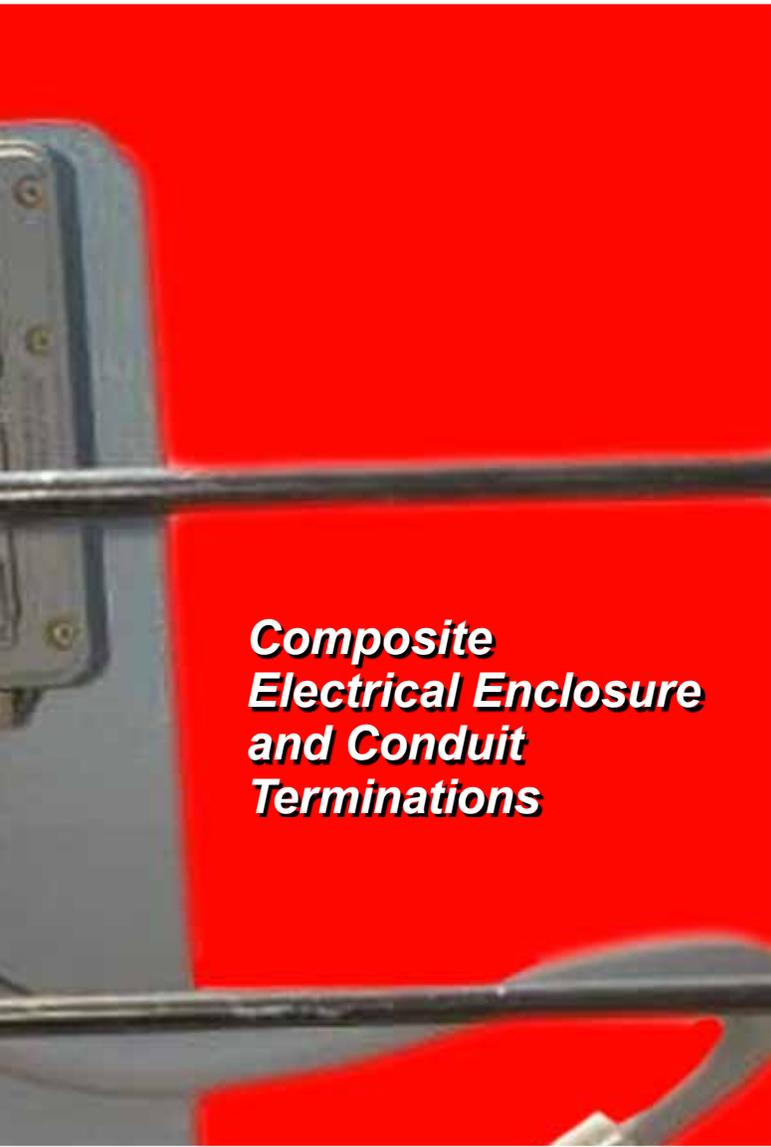


has been so successful that a significant proportion of the square footage installed on aircraft carriers, amphibious ships and surface combatants is now installed with the composite vent screens. Further guidance for proper preservation of the areas in and

around these openings are provided in the project peculiar documentation in accordance with NAVSEA preservation Process Instruction 63101-005<sup>8</sup>.

### ***Composite Electrical Enclosures***

Brass electrical enclosures have been widely used on the weather decks of surface ships ever since their original design implementation just after



World War II. These legacy topside components do not hold up to the corrosive marine environment and typically degrade such that they need replacement about every 5 years. There are chronic internal and external corrosion issues that result in ship's

force dedicating an inordinate amount of resources replacing and repairing equipment that has faltered or failed.

The composite program objectives were to eliminate chronic internal and external corrosion issues, to develop technologies that are corrosion free by eliminating galvanic couples internally and to the surrounding mounting areas, and, to develop a product which is fire hardened providing extended service life from current antiquated designs. Shipboard inspection and interviews with maintenance personnel led to desired attributes were incorporated into the NAVSEA design That systems approach was taken for the redesign of the electrical enclosures which resulted in a corrosion free composite enclosure which features and 316L alloy standoff mounting system providing trouble free service.

Also, it is a true watertight design and the composite material also reduces the thermal cycling problematic of the steel, brass, and titanium boxes. Also, spring loaded lid design enhances the corrosion and water resistance and eliminates the 'lid on a leash'. This technology has provided greater system reliability and significantly reduced maintenance work load. Further refinements resulted from two years of OPEVALs on CVN-71, DDG-52, LSD 47 and CG-72 led to the development of a standard NAVSEA Drawing<sup>9</sup> for composite boxes in order to institutionalize these components.

### ***Composite Conduit and Box Termination End Fittings***

The most recent application of composites has been in their use for electrical conduit and the termination fittings that attach the conduit to the already developed electrical boxes. The problem of conduit is most evident in the well deck areas of amphibious ships, where the salt spray combined with the heated exhaust of Landing Craft Air Cushioned (LCAC) units destroys the current system in a matter of months. A commercially available ribbed conduit made from Poly Ether Ether Keytone (PEEK) was identified to solve this problem. The use of composites for termination end fittings was more problematic due to the need to ensure that appropriate grounding was maintained between the conduit, the enclosure and the ship's hull.

Electrical systems on ships are subject to Electromagnetic Interference (EMI) which must be accounted for in all electrical cable runs. Essentially, the problem is one of physics – any current carrying conductor generates a magnetic field that can then generate an interfering current on any conductor within the range of that field. In order to prevent EMI signals from disrupting the original signal, a ground path must be established to shunt these stray currents along the conduit, through the termination fitting, onto the electrical enclosure to the ship’s ground. Since composites are non-metallic by definition, they do not conduct electricity and cannot therefore provide a ground path. The design challenge was addressed by using electroless nickel as a conductive coating to engineer a ground path for the EMI currents. The resultant composite termination fitting is not only corrosion resistant, but has less than half the weight of the original metallic fittings.

***Aircraft Elevator Safety Stanchions***

Aircraft elevator (ACE) stanchions provide deck edge safety for personnel and equipment during elevator operations. ACE stanchions extend and retract as needed to afford personnel protection; they extend with the lowering of the elevator and retract as it is raised. As the result of corrosion, the carbon steel stanchions were replaced with corrosion resistant steel. However, the new and improved stanchions were subject to the same deformation due to impact during routine Flight Deck operations as the original carbon steel stanchions.

This resulted in the unsatisfactory condition when their jamming caused restriction or inoperability of aircraft elevators. In the 1990’s NSWCCD began the development of fiber reinforced urethanes for applications as machinery mounts and ballistic panels. Upon learning of the stanchion problems from the aircraft carrier maintenance communities, a tube was fabricated using filament winding technology. However, this technology was an expensive alternative for this application due to the time required to wind the filaments into the desired cylindrical shape. Therefore, an alternative methodology was evaluated in which a solid composite three inch diameter stanchion was fabricated.

Pultrusion promised to be the most cost effective

process and a Small Business Innovation Research (SBIR) proposal was issued by the NAVSEA PEO Carriers Office for the development, with technical support provided by NSWCCD. At the completion of the Phase 2 SBIR effort the technology was matured which resulted in a product which withstood bending loads to a 45° deflection, with no loss of strength, and still meeting the required load-deflection requirements



for this equipment. Sixteen prototypes were subject of a 24 month successful in-service evaluation on the USS Nimitz, CVN-68. The end result of the ten year development is a robust, corrosion free, fiber reinforced urethane replacement for the metallic stanchions which is lighter and more cost effective. A ship change

document is in process to make the technology available to the Fleet.

### **Composite Deck Edge Safety Nets**

Deck edge safety nets have not withstood the rigors and demands of the harsh operational environment and have generally lasted for less than eighteen months in service. From the years 1994 to



2004 there were a total of 311 failures recorded in the DDG-51 class alone. This high failure rate is due to the fact that their current fabrication methods and materials are not sufficient to prevent damage due to a combination of high impact operational use, dipping and the attendant corrosion damage; they are a

significant major maintenance cost. The original design was powder coated carbon steel net frames.

This design failed due to chipping of the protective coating due to impact. The use of corrosion resistant steel is not a very practical due to the cost compared to the carbon steel system and the need to double the thickness of the material to compensate for the decrease in strength. This results in a system that is very heavy and not easily folded into the stowed position by ship's force. Utilizing the technology that was developed attendant to the aircraft elevator stanchion SBIR offers a material system that attenuates the energy applied through tug boat strikes or sea dipping. Impact recovery of this fiber reinforced urethane composite technology has demonstrated damage resistance of the framing to meet static and dynamic load criteria during recent structural testing. This composite alternative design is being actively pursued by NAVSEA.

### **Summary:**

The judicious and appropriate application of composite components to the corrosion problems in the Navy can pay big dividends in reduction of ownership costs by work load reduction on ship's force and dry docking deferrals. Caution and good engineering judgment must be exercised in determining appropriate application candidates. This technology has excellent dual use application to the commercial shipping industry and to other weapons systems of the Army and the Air Force.

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**SERIES 14**

# **COST SAVER**

## **EMI/RFI Composite Junction Boxes**

*Lightweight ♦ Corrosion-Free ♦ Shielded ♦ Sealed*



**G**lenair Series 14 CostSaver Composite EMI/RFI Junction Boxes can be specially designed and outfitted for any application requirement. We offer a dozen standard sizes that can be equipped with your selection of feedthrough fittings, connectors, grounding devices, terminal boards—you name it. For complete information please see our composite products catalog or visit our website, [www.glenair.com](http://www.glenair.com)



1211 Air Way • Glendale, CA 91201-2497 • Tel: 818-247-6000 • Fax: 818-500-9912 • E-Mail: [sales@glenair.com](mailto:sales@glenair.com)

**NAVSEA APPROVED  
COMPOSITE ELECTRICAL ENCLOSURES**  
Junction Boxes - Electrical Boxes - Sound Powered-Phones

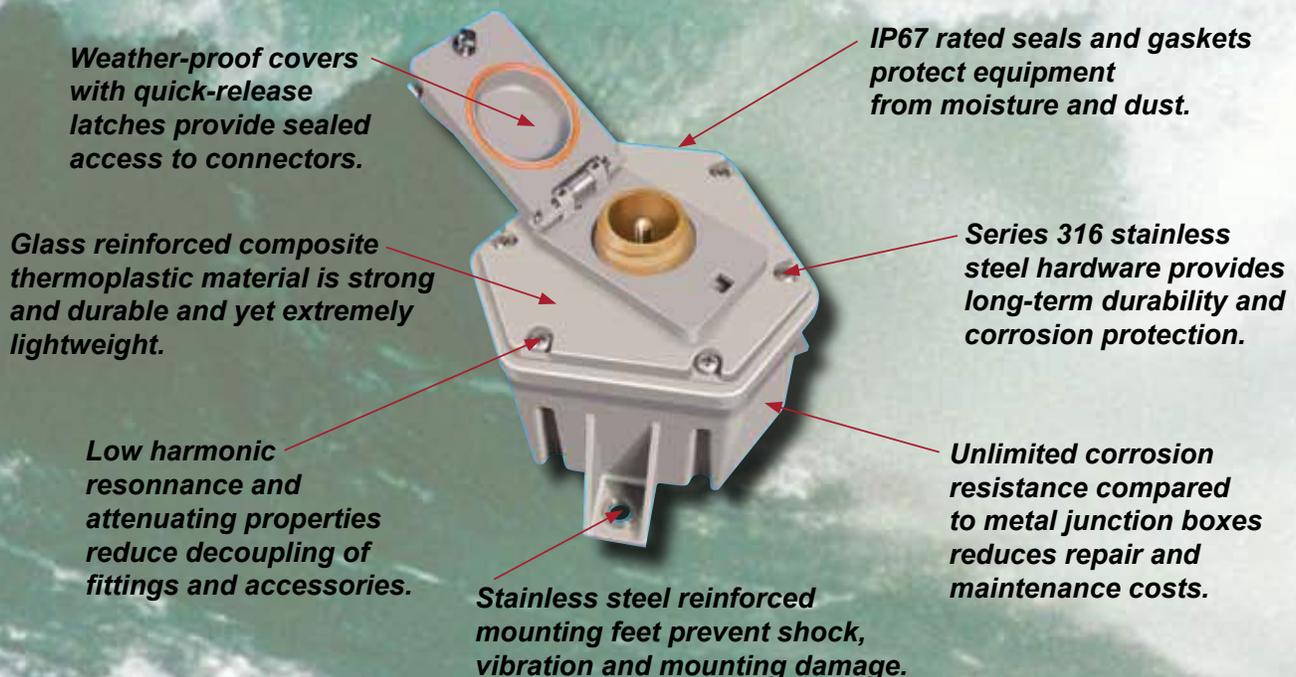
# Advanced Corrosion Control for U.S. Navy Surface Ships— Freighters, Gators and Shooters

**M**etal junction boxes are a maintenance nightmare. Between salt spray, sun, fuel exhaust and rain, most above-deck junction boxes are ready for replacement before they've seen even two years of service. Despite the most aggressive maintenance program, metal boxes will corrode to pieces under the harsh environmental conditions of a ship at sea.

Glenair's corrosion-free composite junction boxes are different. NAVSEA approved for use in U.S. Navy surface ships, Glenair composite electrical boxes can withstand years of harsh

environmental abuse without degradation. That's right: No rust, no corrosion, no paint, no maintenance nightmare. The boxes thrive in environments where resistance to EMI, corrosive fluids, exhaust gasses, high temperatures, shock and vibration are critical operational requirements.

OPEVALs on CVN/DDG/LHD/CG class ships have proved these boxes extend ship service life and reduce maintenance budgets. NAVSEA estimates wholesale adoption of the boxes throughout the fleet would produce \$64.5M of labor and material cost savings.



## TESTED AND APPROVED MATERIALS DESIGNS AND APPLICATIONS

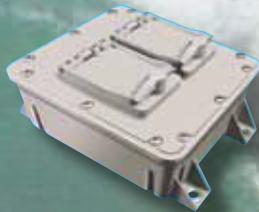
### Junction Boxes - Electrical Boxes - Sound Powered-Phones

**G**lenair Composite Boxes are made from polyetherimide (PEI), a 30% glass-fiber filled amorphous thermoplastic. Polyetherimide offers outstanding high heat resistance, high strength and broad chemical resistance. The material is inherently flame resistant with low smoke emission and zero halogen outgassing. PEI is radiation-resistant, microwave transparent, naturally flame-retardant, and may be plated for EMI resistance and grounding, making it an ideal replacement for aluminum, brass, steel and other metals.

**Series 140-060 Junction Box** is designed for use with standard jacketed cable and M24758 conduit fittings—all NAVSEA approved and available from Glenair.



**Series 140-020 Dual Gang Electrical Box** provides corrosion-free electrical access in both below deck and topside applications.



#### Glenair Standard US Navy Composite Boxes

| Stock Code  | Box Descriptions   |
|---|--|
| CDNWC<br>655-03-001<br>(NAVSEA umbrella stock code for the Glenair Electrical Junction Box Series). | Junction Box, with or without terminal blocks, four sizes                                  |
|   | Electrical Box, 115V, 15 Amp, two sizes, single and dual receptacle                        |
|   | Sound Powered Telephone Box with Glenair composite jack receptacle; single, dual and quad. |

**Series 140-060 Junction Boxes** may be supplied by Glenair equipped with indicator lights, switches, controls and other modifications.



**Lids and Covers:** Two styles of environmental flop lids protect electrical outlets in shipboard and severe weather deck applications.



#### NAVSEA Composite Box Performance Requirements

| Test            | Issue                    | Requirement                                   |
|-----------------|--------------------------|---|
| MIL-S-901       | Shock                    | Grade A, Class A, No Failure                  |
| MIL-STD-167-1   | Vibration                | 2-Hour Test, No Failure                       |
| MIL-STD-1344    | Impact/Random Drop       | Six Times, 4 ft Drop, No Failure              |
| MIL-STD461/1310 | EMI/EMP                  | 2 Frequency Ranges                            |
| MIL-STD-810     | Salt Fog                 | 96 Hour Wet/Dry, No Corrosion                 |
| MIL-STD-810     | High and Low Temperature | -28 F to 149 F, 3 Days, Function, No Cracking |
| MIL-STD-108     | Spash Proof, Watertight  | Hose Spray, 5gpm., No Liquid Penetration      |
| MIL-STD-810     | Solar Radiation          | 56, 24 Hour Cycles, No Color Change           |
| ASTM E 162      | Flame Spread/Dripping    | 25, Self Extinguish, No Drip                  |
| ASTM E 1354     | Smoke/Heat Release       | Cone 25, 50, 75 kW/m <sup>2</sup>             |
| ASTM E 662      | Smoke Density            | Smoke < 200                                   |
| NAVSEA          | Fire Containment         | 2.5 KW for 3.5 Minutes                        |

#### Basic Box Envelope

| Part Number        | Length | Width | Height |
|--------------------|--------|-------|--------|
| Small: 140-060-01  | 6.0    | 5.2   | 3.4    |
| Medium: 140-060-01 | 6.8    | 5.9   | 4.3    |
| Large: 140-060-02  | 9.0    | 9.0   | 4.5    |
| Round: 140-060-05  | 4.8    | 4.8   | 2.9    |

Dimensions in inches, consult factory for details

**Color and Finish:** All box exteriors are unplated and colored to standard US Navy Ship Grey (Glenair XO finish). An optional XMS finish is available for EMI applications which adds electroless nickel plating to all interior box surfaces. Please consult our factory or NAVSEA for details.

## TESTED AND APPROVED MATERIALS DESIGNS AND APPLICATIONS

### Junction Boxes - Electrical Boxes - Sound Powered-Phones

The NAVSEA family of corrosion-free composite boxes (NAVSEA Stock Code CDNWC 655-03-001) currently includes four different functional styles: A versatile junction box equipped with an internal mounting plate; a terminal box which incorporates NAVSEA-specified terminal blocks; an electrical box in single- and dual-outlet configurations; and a sound-powered phone box with single, dual or quad hook-ups. All boxes are made from corrosion-free composite thermoplastic and are equipped with CRES 316 hardware and o-ring sealed tongue and groove lids. Stainless reinforced standoffs provide trouble-free mounting.

#### Junction Box Series (Glenair Series 140-060)

Designed for use in harsh environmental (weatherdeck, up-mast) applications which require EMI/RFI protection for data transmission cables. Junction boxes are available in four different sizes and are conductively plated (internally) for EMC. A mounting plate is pre-installed for convenient attachment of terminal blocks, indicator lights and other electrical/electronic hardware.

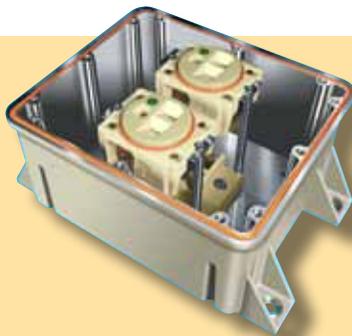
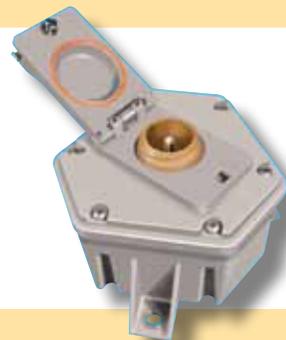


#### Terminal Box Series (Glenair Series 140-060T)

These internally plated composite junction boxes are available in four sizes—small round, and small, medium and large rectangular. They are pre-equipped with terminal blocks for convenient installation and routing of electrical media.

#### Sound Powered Phone Series (Glenair Series 147-021 and 022)

This specialized series of composite boxes is ready for turnkey application servicing single, dual and quad sound powered phone hookups. Custom designed flop-lids seal tight when not in use to prevent water ingress. The boxes, which do not require EMI protection, are shipped unplated.



#### Electrical Box Series (Glenair Series 147-020, 023, 032, and 033)

This box series distributes electrical power outlets where and when they are needed in both harsh, weatherdeck applications and general-purpose shipboard applications. The corrosion-free boxes are available in single and dual outlet configurations. Internal plating facilitates grounding and prevents the generation of EMI. Custom designed flop-lids seal tight when not in use.

**How to Order Glenair NAVSEA Approved Composite Junction Boxes**

| Box/Part Type   | Glenair Series Part Number | Navy Symbol Number |
|---|----------------------------|--------------------|
| <b>Junction Boxes</b>                                     |                            |                    |
| Small Round   | 140-060XMS-05              | -                  |
| Small Rectangular   | 140-060XMS-01              | -                  |
| Medium Rectangular  | 140-060XMS-02              | -                  |
| Large Rectangular   | 140-060XMS-03              | -                  |
| <b>Electrical Boxes</b>                                   |                            |                    |
| Small Round Box, Single Gang, 115V, Flop Lid              | 147-023XMS-01              | 735.3              |
| Small Round Box, Single Gang, 115V, Collar Mate, Flop Lid | 147-023XMS-02              | 1099.1             |
| Small Round Box, Single Gang, MS3402 Connector, Flop Lid  | 147-033XMS-0003            | 1098.1             |
| Small Round Box, Single Gang, 125V, 400Hz, Threaded Cap   | 147-032XMS-0005G           | 1101               |
| Small Rectangular Box, Dual Gang, 115V, Flop Lid          | 147-020XMS-02              | -                  |
| Medium Rectangular Box, Dual Gang, 115V, Collar Mate      | 147-020XMS-05              | -                  |
| <b>Sound Powered Phone Box</b>                            |                            |                    |
| Small Round Box, Single Gang, Flop Lid                    | 147-022XO-01               | 2841               |
| Small Rectangular Box, Dual Gang, Flop Lids               | 147-021XO-02               | 2842               |
| Medium Low Profile Box, Quad, Flop Lids                   | 147-021XO-03               | 2843               |
| <b>Terminal Boxes</b>                                     |                            |                    |
| Small Round   | 140-060XMS-05T2            | 5201               |
| Small Round   | 140-060XMS-05T4            | 400                |
| Small Rectangular   | 140-060XMS-01T3            | 435.1              |
| Small Rectangular   | 140-060XMS-01T4            | 528                |
| Small Rectangular   | 140-060XMS-01T6            | 444                |
| Large Rectangular   | 140-060XMS-03T1            | 432.1              |
| Large Rectangular   | 140-060XMS-03T2            | 434                |
| Large Rectangular   | 140-060XMS-03T5            | 529                |
| Large Rectangular   | 140-060XMS-03T9            | 433.1              |
| Large Rectangular   | 140-060XMS-03T10           | 522.1              |
| Large Rectangular   | 140-060XMS-03T11           | 446                |
| Large Rectangular   | 140-060XMS-03T12           | 525                |
| <b>Replacement Parts and Fittings</b>                     |                            |                    |
| Composite Feedthrough Adapter*                            | 637B094XB02102CB           | -                  |
| Composite Sound-Power Receptacle Connector                | 227-059XO04W               | -                  |
| Replacement Sound-Power Flop Lid Cover Assembly           | 630-038XO-02K              | -                  |
| Replacement Electrical Flop Lid Cover Assembly            | 630-038XO-01K              | -                  |
| Replacement Collar Mate Flop Lid Assembly                 | 630-038XO-04K              | -                  |
| Replacement Cover Screwkit                                | 687-499-1                  | -                  |
| <b>Turnkey Box/Panel Assemblies</b>                       |                            |                    |
| LSD41 Class Ship Stern Gate Control Panel Assembly        | 149-003                    | -                  |
| LSD49 Class Ship Stern Gate Control Panel Assembly        | 149-004                    | -                  |
| CVN Nimitz Class Elevator Control Communication System    | 147-038XMS-002             | -                  |

\* Universal composite feedthrough fitting includes sizing grommets for various cable sizes

**NAVSEA Approval:** Glenair advanced, corrosion-control composite electrical boxes are now NAVSEA approved for deployment around the fleet. All testing has been completed and NAVSEA is working with NAVSUP Mechanicsburg to introduce the individual boxes and replacement parts to the stock system. For NAVSEA contact information or for the latest procurement information on these CDNWC 655-03-001 NAVSEA Stock Code products please contact Glenair, Inc. at 818-247-6000.

**New projects:** Glenair is also working closely with NAVSEA on the ongoing development of additional panel installations and new box configurations including an LED deck lighting system built around the Glenair composite box design.

**Glenair salutes** and extends its thanks to the many officers and sailors who participated in sea trails to evaluate and perfect the NAVSEA composite box conversion project, including the men and women of the:

- USS George Washington (CVN-73)
- USS Theodore Roosevelt (CVN-71)
- USS Barry (DDG-52)
- USS Comstock (LSD-45)
- USS Vella Gulf (CG-72)
- USS Rushmore (LSD-47)
- USS Enterprise (CVN-65)
- USS Dwight D. Eisenhower (CVN-69)
- USS Curtis Wilbur (DDG54)
- USS John S. McCain (DDG56)

## GLENAIR COMPOSITE BOX NATIONAL STOCK NUMBERS

Glenair composite boxes have passed all shock, fire and EMI testing requirement. SCD-6922 authorizes the use of composite boxes on surface ships. NASEA standard drawing 803-6983506 Rev-A “*Electrical Enclosures, Composite, Installation*

*and Details*” provides box installation details and instructions.

The following national stock numbers have been established for these Navy approved, corrosion-proof composite boxes:

**Glenair Composite Box National Stock Numbers**

| Part Number Ref No. | FLIS Nomenclature         | New Composite NSN | Eq. Brass Box NSW | Part/Symbol Number     | Description |
|---------------------|---------------------------|-------------------|-------------------|------------------------|-------------|
| 147-021XMS-02       | Enclosure, Composite      | 5935-01-572-6657  | 5935-00-552-6790  | SYMBOL 2842            | Dual SPT    |
| 147-021XMS-03       | Enclosure, Composite      | 5935-01-572-5631  | 5935-00-355-4739  | SYMBOL 2843            | Quad SPT    |
| 147-022XMS-01       | Enclosure, Composite      | 5935-01-572-5487  | 5935-00-552-6791  | SYMBOL 2841            | Single SPT  |
| 140-060XMS-01       | Junction Box, Composite   | 5975-01-556-7957  | 5975-00-122-6048  | MIL-E-24142/1          | Small       |
| 140-060XMS-02       | Junction Box, Composite   | 5975-01-557-2672  | 5975-00-357-0974  | MIL-E-24142-/4-001     | Medium      |
| 140-060XMS-03       | Junction Box, Composite   | 5975-01-557-2679  | 5395-01-185-3693  | ENC6X9                 | Large       |
| 140-060XMS-05       | Junction Box, Composite   | 5975-01-556-7948  | None              | No NSN Identified      | Small Round |
| 140-060XMS-01T4     | Junction Box, Composite   | 5940-01-556-9434  | 5940-00-351-2223  | SYMBOL 528             | Small       |
| 140-060XMS-01T6     | Junction Box, Composite   | 5940-01-556-9443  | NICN: LLCA42632   | SYMBOL 444             | Small       |
| 140-060XMS-05T4     | Junction Box, Composite   | 5940-01-557-2712  | 5940-00-024-0128  | SYMBOL 400.1           | Small Round |
| 140-060XMS-05T2     | Junction Box, Composite   | 5940-01-557-2579  | 5940-00-351-0000  | M24558/1-520.1         | Small Round |
| 140-060XMS-03T1     | Junction Box, Composite   | 5940-01-556-9489  | 5940-00-215-5962  | SYMBOL 432.1           | Large       |
| 140-060XMS-03T2     | Junction Box, Composite   | 5940-01-557-2564  | 5940-00-080-3931  | SYMBOL 434             | Large       |
| 140-060XMS-03T5     | Junction Box, Composite   | 5940-01-557-2578  | 5940-00-503-4204  | SYMBOL 529             | Large       |
| 140-060XMS-03T9     | Junction Box, Composite   | 5940-01-557-2582  | 5940-00-215-5963  | SYMBOL 433.1           | Large       |
| 140-060XMS-03T10    | Junction Box, Composite   | 5940-01-556-9494  | 5940-00-2226      | SYMBOL 522.1           | Large       |
| 140-060XMS-03T11    | Junction Box, Composite   | 5940-01-557-2563  | 5940-01-387-4412  | M24558/8-446           | Large       |
| 140-060XMS-03T12    | Junction Box, Composite   | 5940-01-556-9499  | 4940-00-351-2225  | M24558/9-525           | Large       |
| 140-060XMS-01T3     | Junction Box, Composite   | 5975-01-556-7967  | 5940-00-215-5959  | SYMBOL 435.1           | Small       |
| 147-023XMS-02       | Electrical Box, Composite | 5940-01-557-2667  | 5935-00-086-8922  | SYMBOL 1099.1          | Single 115V |
| 147-023XMS-01       | Electrical Box, Composite | 5940-01-557-2645  | 5935-00-720-0527  | SYMBOL 35.1            | Single 115V |
| 147-032XMS-0005G    | Electrical Box, Composite | 5940-01-557-2719  | 5935-01-145-3182  | MILR2726-71 SYMBOL 101 | Single 125V |
| 147-033XMS-0003     | Electrical Box, Composite | 5940-01-557-2725  | 5935-01-415-0883  | SYMBOL 1098-1          | Single 115V |
| 147-020XMS-02       | Junction Box, Composite   | 5975-01-556-9504  | None              | No NSN Identified      | Dual 115V   |
| 147-020XMS-05       | Electrical Box, Composite | 5940-01-557-2634  | None              | No NSN Identified      | Dual 115V   |

**GLENAIR COMPOSITE BOX LID REPLACEMENT  
NATIONAL STOCK NUMBERS**

**Glenair Composite Box Lid National Stock Numbers**

| <b>Part Number<br/>Ref No.</b> | <b>FLIS Nomenclature</b> | <b>New Composite NSN</b> | <b>Eq. Brass<br/>Box NSW</b> | <b>Use With<br/>Part Number</b>                            | <b>Description</b>                    |
|--------------------------------|--------------------------|--------------------------|------------------------------|--|---------------------------------------|
| 140-XMS-05                     | Cover, Terminal Box      | 5935-01-572-5480         | None                         | 147-021XMS-02  | Lid, Composite                        |
| 140-065XMS-06                  | Cover, Terminal Box      | 5935-01-572-5483         | None                         | 147-021XMS-03  | Lid, Composite                        |
| 140-065XMS-14                  | Cover, Terminal Box      | 5940-01-557-2622         | None                         | 140-060XMS-05,<br>05T2 and 05T4                            | Lid, Composite                        |
| 140-065XMS-01                  | Cover, Terminal Box      | 5940-01-557-2612         | None                         | 140-060XMS-01,<br>01T3, 01T4 and 01T6                      | Lid, Composite                        |
| 140-065XMS-03                  | Cover, Junction Box      | 5975-01-556-9522         | None                         | 140-060XMS-02  | Lid, Composite                        |
| 140-065XMS-12                  | Cover, Terminal Box      | 5935-01-572-5845         | None                         | 147-022X0-01   | Lid, Composite                        |
| 630-038X0-02K                  | Cover, Junction Box      | 5975-01-556-9582         | None                         | 022X0-01,<br>147-021X0-02 and 147-021X0-03                 | Cover, Composite<br>with Spring Latch |
| 140-065XMS-15                  | Cover, Terminal Box      | 5940-01-557-2626         | None                         | 140-060XMS-03, 03T1, 03T5<br>03T9, 03T10, 03T11, AND 03T12 | Lid, Composite                        |
| 140-065XMS-17                  | Cover, Terminal Box      | 5940-01-557-2616         | None                         | 147-023XMS-02  | Lid, Composite                        |
| 630-038X0-04K                  | Cover, Junction Box      | 5975-01-556-9627         | None                         | 147-023XMS-02<br>and 147020XMS-05                          | Cover, Composite<br>with Spring Latch |
| 140-065XMS-13                  | Cover, Terminal Box      | 5940-01-557-2585         | None                         | 147-023XMS-01  | Lid, Composite                        |
| 140-065XMS-08                  | Cover, Terminal Box      | 5940-01-557-2573         | None                         | 147-020XMS-02  | Lid, Composite                        |
| 630-038X0-01K                  | Cover, Junction Box      | 5975-01-556-9621         | None                         | 147023XMS-01<br>and 147-023XMS-02                          | Cover, Composite<br>with Spring Latch |
| 140-065XMS-16                  | Cover, Terminal Box      | 5940-01-557-2587         | None                         | 147-020XMS-05  | Lid, Composite                        |
| 227-059X004                    | Connector, Sound Powered | 5935-01-558-3700         | None                         | 147-022X0-01<br>and 147-021X0-02                           | SPT Jack,<br>Composite Panel          |

✓ Ideal for  
All Rugged  
Environmental  
Applications

## QUALIFIED MIL-DTL-28840 CONNECTORS AND ACCESSORIES FOR SHIPBOARD APPLICATIONS



***MIL-DTL-28840 connectors were developed for the Navy for use in shipboard applications. They are a high density, environmental, circular connector series utilizing a high shock, threaded coupling system with front release crimp contacts.***

**T**he standard connector and backshell series for shipboard use, MIL-DTL-28840 offers high-density insert arrangements and high-shock performance. Glenair's qualified product line is fully tooled and highly available, including many part numbers in our Same Day Inventory!

The MIL-DTL-28840 features RFI/EMI shielding, scoop-proof shells and corrosion resistant materials and finishes. In addition

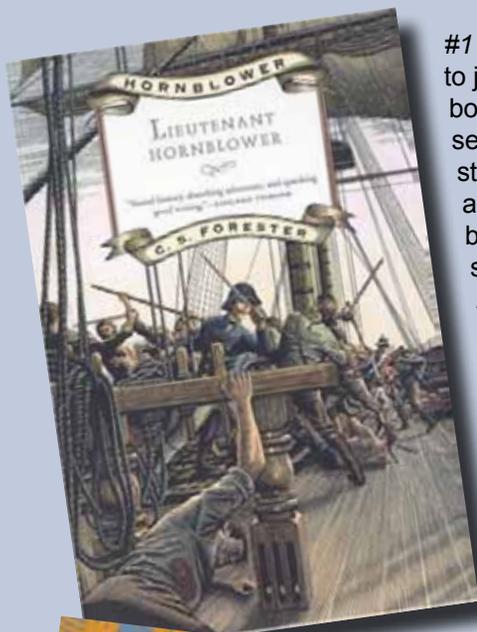
to all the connector types and styles, Glenair makes all the backshell accessory slash numbers as well. The addition of the MIL-DTL-28840 connector product line is part of Glenair's total commitment to meeting all your shipboard interconnect requirements. So, if a rugged, environmental M28840 solution is in your future, think Glenair—from connectors to accessories.

New MIL-DTL-28840 plating options are available now at Glenair: Pure electrodeposited aluminum, Nickel fluorocarbon polymer, and Zinc nickel.

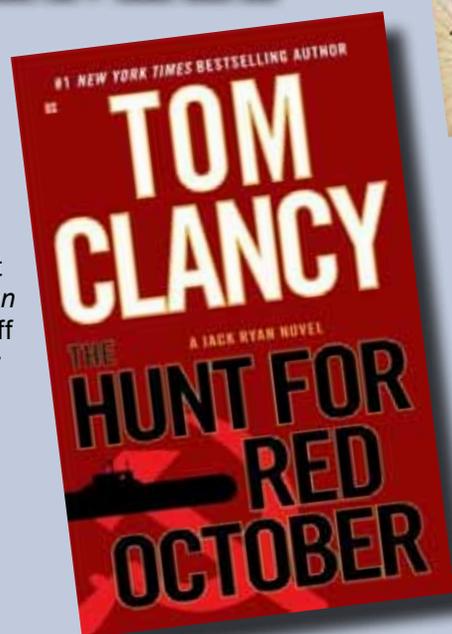
MIL-DTL-28840 backshells, adapters, strain reliefs, protective covers and other accessories are also available with full slash sheet coverage in our Same Day inventory.

Glenair also offers additional Glenair commercial part numbers and custom designs with features not available in the Mil-Spec.

# THE 10 BEST SEA STORIES OF ALL TIME



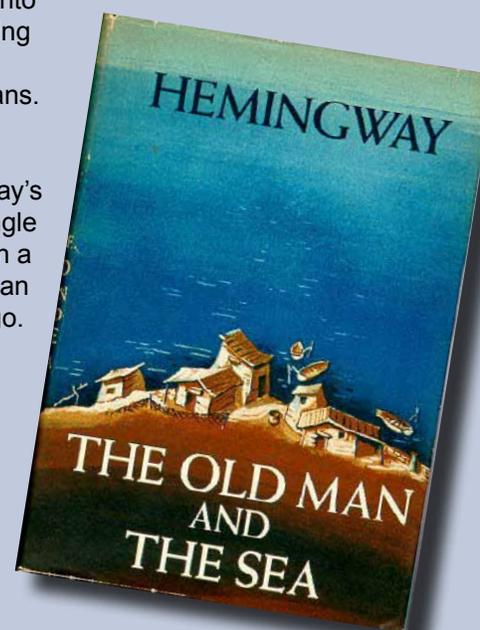
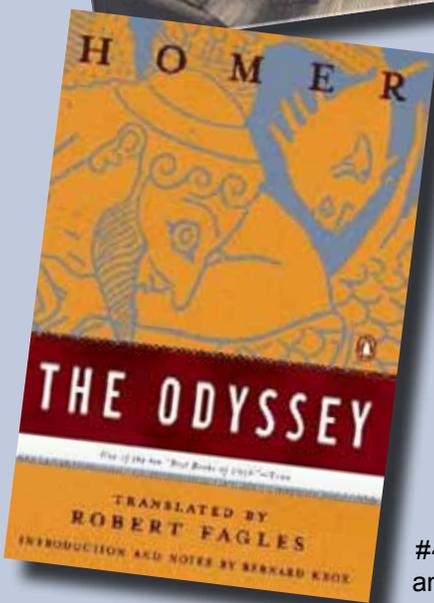
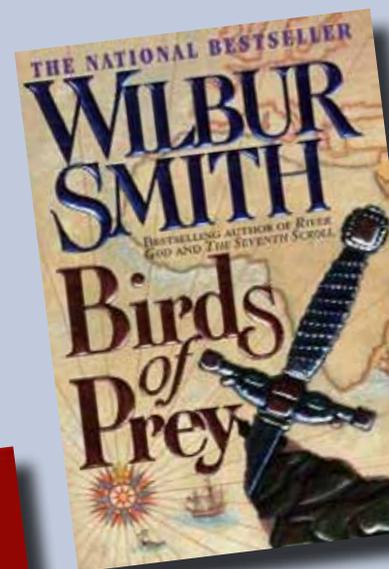
#1 It would be tempting to just present all eleven books in the Hornblower series as 'the best sea stories of all time.' They are that good. The saga begins with a set of short stories in *Mr. Midshipman Hornblower*, but takes off in earnest in *Lieutenant Hornblower*, in which our hero overcomes a mad captain, captures a Spanish fort, and foils an attempt by prisoners to overtake the ship.



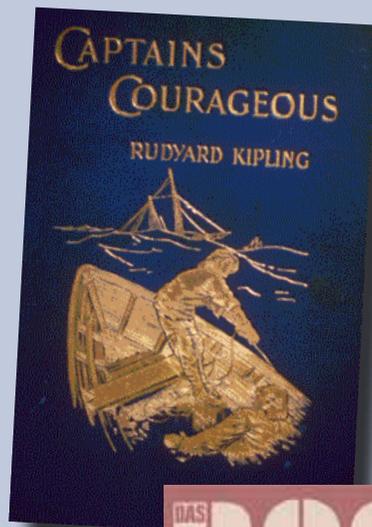
#2 *The Hunt for Red October* is Tom Clancy's first and arguably best novel—especially if you are into technology-rich Cold War submarine thrillers. Clancy turns SONAR and the many other arcane navy technologies into rich additions to the fascinating plot of a defecting Soviet boat Captain with plans to deliver his revolutionary sub into the hands of the Americans.

#3 *The Old Man and the Sea* was Hemingway's last major work of fiction. The story covers a single day and night of fishing: an epic battle between a magnificent Marlin and an aged but noble fisherman named Santiago.

#4 *The Odyssey*: The battle for Troy won, Odysseus and his men sail home for Ithaca, aided by Athena and opposed by Hyperion (god of the sun) and Poseidon (god of the sea). The obstacles they must face, including the Cyclops and the Sirens, are but nothing compared to the realization that their beloved Ithaca has so changed as to be lost to them forever. *The Odyssey* is the story of the wanderer and voyager for whom the greatest challenge is often the return home.

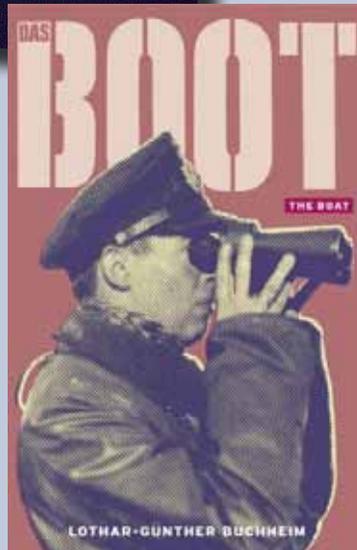


#5 It is 1667 and the mighty naval war between the Dutch and the English still rages. Sir Francis Courtney and his son Hal, in their fighting caravel, are on patrol off Southern Africa, lying in wait for a galleon of the Dutch East India Company returning from the Orient. The battle is joined and doesn't quit for 600+ pages. If you do not like ship-to-ship battles, brutal sword fights, daring captures and escapes, torid love scenes, and all the other features of a classic historical action-adventure novel, then *Birds of Prey* is not for you. If you do, then you are in for a ride.

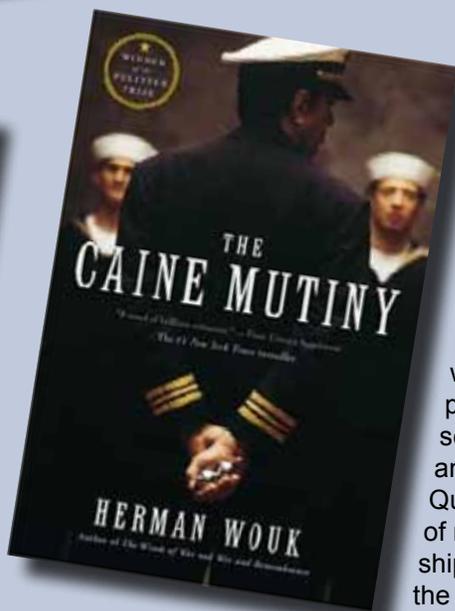


#8 Rudyard Kipling's *Captains Courageous* should be every boy's favorite sea story. When spoiled brat Harvey Cheyne falls off an ocean liner in the North Atlantic fishing grounds, he is rescued by the "We're Here" out of Gloucester, Mass. In the predictable but endearing story, Harvey gradually learns what it takes to be a man in the unforgiving world of the commercial fisherman—and of course returns to the arms of his parents as the mature and self-reliant son they always wanted.

#6 Captain Blood is the tale of Peter Blood, an Irish-born doctor and adventurer with unusual sense and principles. Students of business and management will enjoy Blood's unconventional views on how to run a successful privateering campaign and how to view the world with objective sense and principled conviction: "You may define our positions as you please, said Captain Blood to M. de Rivaroli. But I'll remind you that the nature of a thing is not changed by the name you give it."

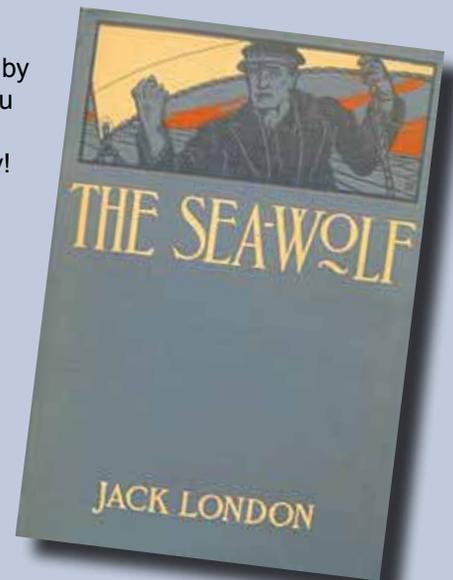


#9 *Das Boot* or "The Boat" by Lothar-Günther Buchheim depicts the brutal life of the submariner in the Atlantic theater during World War II. Buchheim's account of one great captain and his crew is as funny, sweaty, gritty, and frightening as any in the annals of sea literature. You'll empathize with the Germans (the captain has no love for Hitler) as the hunters become the prey, lurking on the bottom of the Strait of Gibraltar, afraid to lower a toilet seat for fear of being heard, unable to keep a cigarette lit as the oxygen wanes...the expression "you could cut the tension with a knife" could have been coined for this book.



#7 *The Caine Mutiny* is Herman Wouk's 1951 Pulitzer Prize-winning novel. The story begins as we meet the newly assigned and inexperienced officers of the decrepit World War II minesweeper, the *Caine*, who must struggle with the psychological challenges of service under the paranoid and cowardly Captain Queeg. Queeg's arbitrary enforcement of naval discipline leads the ship's officers reluctantly down the path of conspiracy. The Pacific typhoon that triggers the mutiny is a whopper.

#10 *The Sea Wolf* by Jack London. If you love sea stories, this one is a doozy! Sealer captain Wolf Larsen is an obsessed figure who conducts a psychological battle with Humphrey von Weydon, a castaway rescued at sea by Larson's sealer *Ghost*, bound for the Bering Strait. The run amok Captain and von Weydon embark on a psychological battle of wits which culminates in a tug-of-war for the rescued man's soul. Ambrose Bierce wrote, "Wolf Larsen... the hewing out and setting up of such a figure is enough for a man to do in one lifetime."



# GLENAIR'S COMPLETE SELECTION OF QUALIFIED MIL-DTL-28840 CIRCULAR CONNECTORS AND ACCESSORIES MARCHES ON AND...ON AND...ON AND...ON...



MIL-DTL-28840 connectors are designed for severe environments, primarily for shipboard applications above and below deck. Applications include missile fire control systems, power supplies, guidance systems, radar, cable runs, ship to shore cable assemblies, and land based shelters.

Glenair is your one-stop choice for qualified MIL-DTL-28840 connectors, backshells, adaptors and accessories, with comprehensive slash sheet coverage. The standard for shipboard use, MIL-DTL-28840 connectors offer high density, scoop proof insert arrangements with front-release crimp contacts that accommodate 3 wire sizes (20, 26 and 28 AWG), ideal for use with Navy MIL-C-915 shipboard cable and MIL-W-16978 wire. Conferring excellent environmental and EMI resistance, MIL-C-28840 connectors provide high-shock performance in plugs and flange mount, jam-nut, and in-line receptacles with keyed, threaded-coupling. Choose from nine shell sizes, 11 to 33, with 7 to 155 contacts. These rugged connectors are optimized for resistance to fluids, corrosion, high shock and

sustained vibration, while providing excellent EMI/RFI protection. Additionally, the connectors have shell to shell grounding prior to any electrical contact engagement. Straight, 45° and 90° connector and adapter assemblies are also available.

Glenair also specializes in custom connectors intermatable to MIL-DTL 28840. For instance, we've designed many versions for printed circuit board mounting, as well as variations to accommodate unusual panel thicknesses.

Glenair is ready with the new plating options for MIL-DTL-28840. All are available now:

- Pure electrodeposited aluminum (conductive) -65°C to +175°C.
- Nickel fluorocarbon polymer over a suitable underplate (conductive) -65°C to +175°C.
- Zinc nickel over a suitable underplate (conductive) -65°C to +175°C.

Best of all, many MIL-DTL-28840 connector, accessory and connector saver part numbers are available for immediate shipment from our extensive Same-Day Inventory.

# MIL-DTL-28840

## SHIPBOARD ELECTRIC CONNECTORS

### PERFORMANCE SPECIFICATIONS, CLASS AND FINISHES

#### PERFORMANCE SPECIFICATIONS

|  |  |
|--|--|
| Current Rating (Maximum)                       | Size #20 Contact; 20AWG 7.5A, 22AWG 5.0A, 28AWG 1.5A, 30AWG 1.0A           |
| Test Voltage (Dielectric Withstanding Voltage) | 1000 VAC RMS at sea level. Test per EIA-364-20                             |
| Insulation Resistance                          | 5000 megohms minimum (at ambient temperature) per EIA-364-21               |
| Contact Resistance                             | Per SAE-AS39029  |
| Operating Temperature                          | -55° C. to +200° C.  |
| Immersion                                      | per test method EIA-364-09   |
| Shock  | in accordance with MIL-S-901 grade A                                       |
| Vibration                                      | per EIA-364-28 test procedure  |
| Magnetic Permeability                          | 2.0 $\mu$ (Aluminum), 5.0 $\mu$ (Stainless Steel) maximum; ASTM-A342/A342M |

#### MATERIALS AND FINISHES

|   |   |
|---|---|
| Shells, Coupling Nuts, Jam Nuts               | Aluminum alloy per ASTM B211, or stainless steel per AMS-QQ-S-763   |
| Contacts                                      | Copper alloy, 50 $\mu$ Inch gold plated per ASTM B488 Type 3, Code C, Class 1,27 over nickel underplate per QQ-N-290 Class 2. Socket contact hood: stainless steel, passivated. |
| Insulators                                    | High Grade Engineering Plastic per ASTM D5948   |
| Contact Retention Clip                        | Beryllium copper  |
| Shells, Coupling Nuts, Jam Nut Plating Finish | Stainless Steel, Black Cadmium plated   |
| Grommet, Seal                                 | Blended elastomer, 30% silicone per ZZ-R-765, 70% fluorosilicone per MIL-R-25988  |

| Contact Code | Type   | Contact Spec.      | Contact Size | Acceptable Wire Size | Outside Diameter of Finished Wire |                |
|--------------|--------|--------------------|--------------|----------------------|-----------------------------------|----------------|
|              |        |                    |              |                      | Minimum                           | Maximum        |
| F            | Pin    | SAE-AS39029/83-508 | 20-20        | 24                   | .040<br>(1.02)                    | .070<br>(1.78) |
| G            | Socket | SAE-AS39029/84-509 |              | 22                   |                                   |                |
| P            | Pin    | SAE-AS39029/83-450 | 20-22        | 26                   |                                   |                |
| S            | Socket | SAE-AS39029/84-452 |              | 24                   |                                   |                |
| D            | Pin    | SAE-AS39029/83-451 |              | 22                   |                                   |                |
| E            | Socket | SAE-AS39029/84-453 | 20-28        | 32                   |                                   |                |
|              |        |                    |              | 30                   |                                   |                |
|              |        |                    |              | 28                   |                                   |                |

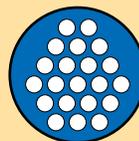
# MIL-DTL-28840 STANDARD INSERT ARRANGEMENTS



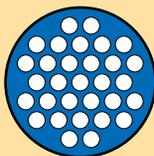
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7 Contacts



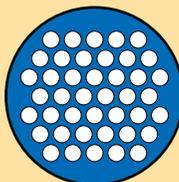
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12 Contacts



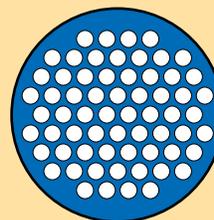
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21 Contacts



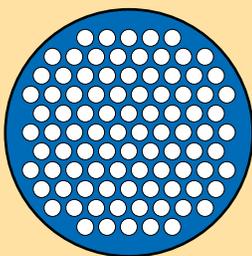
Shell Size 17  
31 Contacts



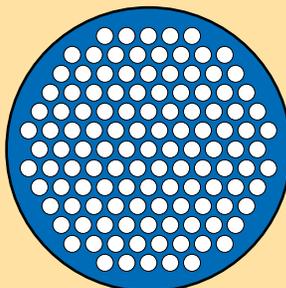
Shell Size 19  
42 Contacts



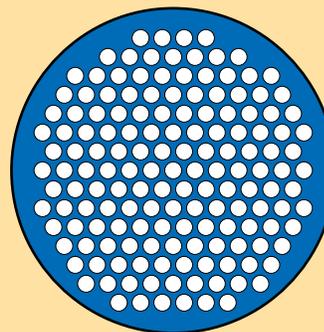
Shell Size 23  
64 Contacts



Shell Size 25  
92 Contacts



Shell Size 29  
121 Contacts



Shell Size 33  
155 Contacts



# MIL-DTL-28840C PERFORMANCE REQUIREMENTS

## **Fungus Resistance**

Materials used in the construction of these connectors are fungus inert per Method 508.6 of MIL-STD-810.

## **Magnetic Permeability**

The relative magnetic permeability of aluminum and stainless steel connectors and accessories is less than 2.0  $\mu$  and 5.0  $\mu$ , respectively, conforming to ASTM-A342/A342M.

## **Thermal Shock**

There is no evidence of damage detrimental to the operation of the connector after being subjected to the temperature extremes

per MIL-STD-202, method 107, condition A, with temperature extremes as specified:

## **Contact Retention**

The axial displacement of contacts does not exceed 0.012 inch with contacts retained in their inserts when subjected to an axial load of 20 pounds.

## **Dielectric Withstanding Voltage (sea level)**

Connectors show no evidence of breakdown or flashover when subjected to 1000 volt EMS applied between each adjacent contact and

## **Temperature Extremes**

| Extremes | Degrees °C | Degrees °F |
|----------|------------|------------|
| Low      | 0          | 0          |
|          | -55        | -67        |
|          | -3         | -5         |
| High     | 3          | 5          |
|          | 200        | 392        |
|          | 0          | 0          |

between all peripheral contacts and the shell, before and after fluid immersion, in accordance with test procedure EIA-364-20.

## **Vibration**

Mated connectors are not be damaged and there is no loosening of parts due to vibration. Counterpart connectors are retained in full engagement, with no interruption of electrical continuity of one microsecond or longer when tested per EIA-364-28, test condition III and also in accordance with MIL-STD-167-1, endurance test.

## **High Impact Shock**

Mated connectors are not damaged and there is no loosening of parts, nor is there an interruption of electrical continuity one microsecond or longer during the exposure to mechanical shock when tested to MIL-S-901, grade A.

## **Contact Resistance**

Contacts in the mated condition meet the ambient (25°C) contact resistance requirements in accordance with SAE-AS39029.

## **Durability with Coupling Rings**

Counterpart connectors show no mechanical or electrical defects detrimental to the operation of the connector after 100 cycles of coupling and uncoupling in. The connectors withstand 50 cycles, before and after the corrosion test.

## **Salt Spray (corrosion)**

Connectors show no exposure of basis material due to corrosion when evaluated as specified in SAE-AIR 4789 following test procedure EIA-364-26, test condition C.

## **Insulation Resistance**

At ambient temperature: the insulation resistance at 25°C (77°F) is greater than 5,000 megohms. At elevated temperature - (long time): the insulation resistance is 1000 megohms at 200°C. Per test procedure EIA-364-21.

## **Insert Retention**

Inserts subjected to axial loads in each direction are not dislocated from their original positions or damaged when they are subjected to the specified pressures in test procedure EIA-364-35

***Humidity***

Mated connectors with any rear accessory hardware assembled maintain an insulation resistance of 100 megohms or greater at 25°C after being subjected to the humidity test in procedure EIA-364-31.

***Water Pressure***

Mated connectors assembled with backshells exhibit an insulation resistance of 1.00 megohms or greater following immersion in tap water to a depth of 6 feet for 48 hours. Cable adapters show no evidence of entrance of water following immersion in tap water to a depth of 6 feet for 48 hours.

***Fluid Immersion***

The connectors meet the requirements for coupling torque and dielectric withstanding voltage for the following fluids following immersion per test procedure EIA-364-10.

- Hydraulic fluid, per MIL-H-5606
- Turbine fluid, grade JP-8, per MIL-DTL-83133 (NATO Type 34)
- Lubricating oil, per MIL-L-7808
- Lubricating oil, per MIL-PRF-23699
- Defrosting fluid, per MIL-A-8243
- Cleaning compound, diluted for cleaning, per MIL-PRF-87937 type I alkaline base
- Gasoline, per ASTM-D-4814
- Gasohol, per A-A-52530
- One part isopropyl alcohol, per TT-I-735, grade A or B; and 3 parts mineral spirits, per A-A-2904, type II, grade A or P-D-680, type
- Coolant, dielectric fluid, synthetic silicate ester base MIL-PRF-47220 (Coolanol 25) or equivalent

***Cable Pull-Out***

Cables do not pull out when tensile loads ranging from 50 to 100 pounds (depending on shell size) are applied nor does slippage exceed .125 inch.

***External Bending Moment***

Connectors exhibit no evidence of damage, as revealed by inspection with 3X magnification, when stressed under 300 to 750 inch pounds (depending on shell size).

***Shell Conductivity (connectors only)***

Mated connectors are electrically conductive from the plug accessory thread to the receptacle mounting flange or to the accessory thread on the cable connecting receptacle. The overall DC resistance does not exceed 0.005 ohms when measured by the volt meter-ammeter method. When tested with accessory, dc resistance shall not exceed 0.010 ohms.

***Maintenance Aging (contact installing and removal force)***

The forces required to install and remove unlocked contacts do not exceed 10 pounds maximum.

***Impact***

There is no breaking or cracking of inserts, bending of pins or any other damage which prevents the connectors from being mated or renders them unfit to when connector plugs with straight strain relief clamps and protective covers are subjected to ten drops from a height of six feet (1.829 meters), per test procedure EIA-364-42.

***EMI Shielding***

The EMI shielding capabilities of mated connectors are not less than that specified in the table below at the specified frequencies.

***EMI Shielding Effectiveness***

| Frequency<br>(Megahertz) | Attenuation<br>(Decibels) |
|--------------------------|---------------------------|
| 100                      | 60 min.                   |
| 200                      | 50 min.                   |
| 400                      | 45 min.                   |
| 600                      | 45 min.                   |
| 800                      | 35 min.                   |
| 1000                     | 40 min.                   |

***Pin Contact Stability***

Total displacement of reference point on the contact tip end does not exceed .030 inch maximum with a one-half pound force applied.

***Coupling Torque***

The coupling torque for mating of the counterpart connectors and protective covers survive maximum engagement and disengagement forces of 12 to 53 inch-pounds (depending on shell size).

***Safety Wire Holes***

Safety wire holes do not pull out when 30 ± 2 lbs is applied.

# MIL-DTL-28840C in Our Same Day Inventory

875 Part Numbers and Growing Every Day!

Bagged, Tagged and Ready for Immediate Shipment

| PART NUMBER       | DELIVERY           | FINISH | PART NUMBER    | DELIVERY           | FINISH | PART NUMBER    | DELIVERY           | FINISH |
|-------------------|--------------------|--------|----------------|--------------------|--------|----------------|--------------------|--------|
| M28840 Connectors |                    |        | M28840/10AG1P4 | 1-10 PCS 1 DAY ARO | NF     | M28840/11BF1S1 | 1-10 PCS 1 DAY ARO | ZU     |
| M28840/10AA1G1    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AG1P6 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1G1 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AA1P1    | 1-25 PCS 1 DAY ARO | NF     | M28840/10AG1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AA1G2 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AA1P2    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AG1S3 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1P1 | 1-25 PCS 1 DAY ARO | NF     |
| M28840/10AA1P3    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AH1P1 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AA1P2 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AA1P4    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AH1S1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1P3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AA1P5    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AH1S2 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1S1 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AA1P6    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AJ1F1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1S2 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AA1S1    | 1-25 PCS 1 DAY ARO | NF     | M28840/10AJ1G1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1S3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AA1S2    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AJ1G3 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1S4 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AA1S4    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AJ1G5 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AA1S5 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1F1    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AJ1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AA1S6 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1F2    | 1-2 PCS 1 DAY ARO  | NF     | M28840/10AJ1P4 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AB1G1 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AB1G1    | 1-10 PCS 1 DAY ARO | NF     | M28840/10AJ1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AB1G2 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1G2    | 1-5 PCS 1 DAY ARO  | NF     | M28840/10BB1F1 | 1-10 PCS 1 DAY ARO | ZU     | M28840/12AB1P1 | 1-25 PCS 1 DAY ARO | NF     |
| M28840/10AB1G3    | 1-5 PCS 1 DAY ARO  | NF     | M28840/10BC1P1 | 1-10 PCS 1 DAY ARO | ZU     | M28840/12AB1P2 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1P1    | 1-25 PCS 1 DAY ARO | NF     | M28840/10BC1S1 | 1-2 PCS 1 DAY ARO  | ZU     | M28840/12AB1P3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1P2    | 1-10 PCS 1 DAY ARO | NF     | M28840/10BC1S3 | 1-2 PCS 1 DAY ARO  | ZU     | M28840/12AB1P4 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1P3    | 1-10 PCS 1 DAY ARO | NF     | M28840/10BC1S5 | 1-2 PCS 1 DAY ARO  | ZU     | M28840/12AB1P5 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1P4    | 1-10 PCS 1 DAY ARO | NF     | M28840/10BF1S1 | 1-10 PCS 1 DAY ARO | ZU     | M28840/12AB1P6 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1P5    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AA1F1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AB1S1 | 1-25 PCS 1 DAY ARO | NF     |
| M28840/10AB1P6    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AA1G1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AB1S2 | 1-25 PCS 1 DAY ARO | NF     |
| M28840/10AB1S1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AA1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AB1S3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1S2    | 1-2 PCS 1 DAY ARO  | NF     | M28840/11AA1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AB1S4 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AB1S3    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AA1S5 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AB1S5 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1P1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AA1S6 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AB1S6 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1P2    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AB1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AC1D1 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1P3    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AB1S1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AC1F1 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1P4    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AB1S3 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AC1F3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1P5    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AB1S4 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AC1F6 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1S1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AB1S5 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AC1G1 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AC1S2    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AB1S6 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AC1P1 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1S3    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AD1G1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AC1P2 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AC1S4    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AD1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AC1P3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AC1S6    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AD1P2 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AC1P4 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AD1P1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AD1P3 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AC1P5 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AD1S1    | 1-5 PCS 1 DAY ARO  | NF     | M28840/11AD1P4 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AC1P6 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AD1S2    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AD1P5 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AC1S1 | 1-25 PCS 1 DAY ARO | NF     |
| M28840/10AD1S3    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AD1P6 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AC1S2 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AD1S4    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AD1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AC1S3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AE1P1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AD1S3 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AC1S4 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AE1P2    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AE1G1 | 1-2 PCS 1 DAY ARO  | NF     | M28840/12AC1S5 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AE1P3    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AE1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AC1S6 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AE1P5    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AE1P5 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1D2 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AE1S1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AE1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AD1D4 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AE1S2    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AF1F4 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1E1 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AE1S3    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AF1G1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1E2 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AF1P1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AF1G2 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1E5 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AF1P2    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AF1G3 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AD1F3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AF1P3    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AF1G4 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1G1 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AF1S1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AF1P2 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1G2 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AF1S2    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AF1S2 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1P1 | 1-25 PCS 1 DAY ARO | NF     |
| M28840/10AF1S3    | 1-5 PCS 1 DAY ARO  | NF     | M28840/11AG1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AD1P2 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AF1S4    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AG1P3 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AD1P3 | 1-5 PCS 1 DAY ARO  | NF     |
| M28840/10AF1S5    | 1-5 PCS 1 DAY ARO  | NF     | M28840/11AG1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AD1P4 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AF1S6    | 1-5 PCS 1 DAY ARO  | NF     | M28840/11AH1B1 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1P5 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AG1A1    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AH1G1 | 1-5 PCS 1 DAY ARO  | NF     | M28840/12AD1P6 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AG1D5    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AH1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AD1S1 | 1-25 PCS 1 DAY ARO | NF     |
| M28840/10AG1F1    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AJ1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AD1S2 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AG1G1    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AJ1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/12AD1S3 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AG1P1    | 1-25 PCS 1 DAY ARO | NF     | M28840/11AJ1S2 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1S4 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AG1P2    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AJ1S3 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1S5 | 1-10 PCS 1 DAY ARO | NF     |
| M28840/10AG1P3    | 1-10 PCS 1 DAY ARO | NF     | M28840/11AJ1S4 | 1-10 PCS 1 DAY ARO | NF     | M28840/12AD1S6 | 1-10 PCS 1 DAY ARO | NF     |







| PART NUMBER     | DELIVERY           | FINISH | PART NUMBER  | DELIVERY            | FINISH | PART NUMBER  | DELIVERY           | FINISH |
|-----------------|--------------------|--------|--|---------------------|--------|--------------|--------------------|--------|
| 900-016NF17-1S2 | 1-10 PCS 1 DAY ARO | NF     | 900-016NF33-1S2  | 1-10 PCS 1 DAY ARO  | NF     | M28840/24AB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF17-1S3 | 1-10 PCS 1 DAY ARO | NF     | 900-016ZU11-1S1  | 1-5 PCS 1 DAY ARO   | ZU     | M28840/24BA  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF17-1S4 | 1-10 PCS 1 DAY ARO | NF     | 900-016ZU13-1F1  | 1-10 PCS 1 DAY ARO  | ZU     | M28840/24BB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF17-1S5 | 1-5 PCS 1 DAY ARO  | NF     | 900-016ZU15-1S1  | 1-5 PCS 1 DAY ARO   | ZU     | M28840/24CA  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF17-1S6 | 1-5 PCS 1 DAY ARO  | NF     | 900-016ZU23-1F2  | 1-5 PCS 1 DAY ARO   | ZU     | M28840/24CB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1F1 | 1-10 PCS 1 DAY ARO | NF     | 900-016ZU23-1P1  | 1-5 PCS 1 DAY ARO   | ZU     | M28840/24DA  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1G1 | 1-10 PCS 1 DAY ARO | NF     | 900-016ZU25-1G1  | 1-10 PCS 1 DAY ARO  | ZU     | M28840/24DB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1G2 | 1-10 PCS 1 DAY ARO | NF     |  |                     |        | M28840/24EA  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1G3 | 1-10 PCS 1 DAY ARO | NF     |  |                     |        | M28840/24EB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1G4 | 1-10 PCS 1 DAY ARO | NF     | M28840 Connectors with Backshells                                    |                     |        | M28840/24FA  | 1-25 PCS 1 DAY ARO | NO     |
| 900-016NF19-1G5 | 1-10 PCS 1 DAY ARO | NF     | M28840/17AA1S1   | 1-10 PCS 1 DAY ARO  | NF     | M28840/24FB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1G6 | 1-10 PCS 1 DAY ARO | NF     | M28840/17AF1S1   | 1-10 PCS 1 DAY ARO  | NF     | M28840/24GA  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/17AF1S2   | 1-10 PCS 1 DAY ARO  | NF     | M28840/24GB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1P2 | 1-10 PCS 1 DAY ARO | NF     | M28840/17AF1S3   | 1-5 PCS 1 DAY ARO   | NF     | M28840/24HA  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1P3 | 1-10 PCS 1 DAY ARO | NF     | 901-017NF11-1S1  | 1-10 PCS 1 DAY ARO  | NF     | M28840/24HB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1P4 | 1-10 PCS 1 DAY ARO | NF     | 901-017NF13-1S1  | 1-10 PCS 1 DAY ARO  | NF     | M28840/24JA  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1P5 | 1-10 PCS 1 DAY ARO | NF     | 901-017NF23-1S1  | 1-10 PCS 1 DAY ARO  | NF     | M28840/24JB  | 1-50 PCS 1 DAY ARO | NO     |
| 900-016NF19-1P6 | 1-5 PCS 1 DAY ARO  | NF     | 901-017NF23-1S2  | 1-10 PCS 1 DAY ARO  | NF     | M28840/501WB | 1-10 PCS 1 DAY ARO | NF     |
| 900-016NF19-1S1 | 1-25 PCS 1 DAY ARO | NF     | 901-017NF23-1S3  | 1-5 PCS 1 DAY ARO   | NF     | M28840/502WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF19-1S2 | 1-10 PCS 1 DAY ARO | NF     | 901-02921131B-AP1  | 1-25 PCS 1 DAY ARO  | Z1     | M28840/503WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF19-1S3 | 1-10 PCS 1 DAY ARO | NF     | 901-02921131D-AP1  | 1-10 PCS 1 DAY ARO  | Z1     | M28840/504WA | 1-10 PCS 1 DAY ARO | NF     |
| 900-016NF19-1S5 | 1-10 PCS 1 DAY ARO | NF     |  |                     |        | M28840/505WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1B1 | 1-10 PCS 1 DAY ARO | NF     | M28840 Backshells, Adapters, Protective Covers and Other Accessories |                     |        | M28840/508WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1B2 | 1-10 PCS 1 DAY ARO | NF     | M28840/13AAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/508WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1F1 | 1-10 PCS 1 DAY ARO | NF     | M28840/13ABW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/511WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1F2 | 1-10 PCS 1 DAY ARO | NF     | M28840/13BAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/514WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1F3 | 1-10 PCS 1 DAY ARO | NF     | M28840/13BAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/518WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1F4 | 1-10 PCS 1 DAY ARO | NF     | M28840/13BBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/521WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1G2 | 1-10 PCS 1 DAY ARO | NF     | M28840/13CAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/524WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1G3 | 1-10 PCS 1 DAY ARO | NF     | M28840/13CBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/601WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1G4 | 1-10 PCS 1 DAY ARO | NF     | M28840/13CBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/601WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1G5 | 1-10 PCS 1 DAY ARO | NF     | M28840/13DAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/602WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/13DBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/602WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1P2 | 1-10 PCS 1 DAY ARO | NF     | M28840/13DBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/603DA | 1-10 PCS 1 DAY ARO | ZU     |
| 900-016NF23-1P3 | 1-10 PCS 1 DAY ARO | NF     | M28840/13EAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/603WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1P4 | 1-10 PCS 1 DAY ARO | NF     | M28840/13EAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/603WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1P5 | 1-10 PCS 1 DAY ARO | NF     | M28840/13EBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/604WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1P6 | 1-10 PCS 1 DAY ARO | NF     | M28840/13FAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/604WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/13FBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/605WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1S2 | 1-10 PCS 1 DAY ARO | NF     | M28840/13GAW   | 1-50 PCS 1 DAY ARO  | NF     | M28840/605WB | 1-10 PCS 1 DAY ARO | NF     |
| 900-016NF23-1S3 | 1-10 PCS 1 DAY ARO | NF     | M28840/13GAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/606WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF23-1S6 | 1-10 PCS 1 DAY ARO | NF     | M28840/13GBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/606WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1B1 | 1-5 PCS 1 DAY ARO  | NF     | M28840/13HAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/607DA | 1-5 PCS 1 DAY ARO  | ZU     |
| 900-016NF25-1F1 | 1-5 PCS 1 DAY ARO  | NF     | M28840/13HBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/607WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1G1 | 1-10 PCS 1 DAY ARO | NF     | M28840/13JAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/607WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1G3 | 1-10 PCS 1 DAY ARO | NF     | M28840/13JAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/608WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/13JBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/608WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1P2 | 1-10 PCS 1 DAY ARO | NF     | M28840/15AAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/609WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1P3 | 1-10 PCS 1 DAY ARO | NF     | M28840/15ABW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/609WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1P4 | 1-10 PCS 1 DAY ARO | NF     | M28840/15BAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/610WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1P5 | 1-10 PCS 1 DAY ARO | NF     | M28840/15BAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/610WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1P6 | 1-10 PCS 1 DAY ARO | NF     | M28840/15BBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/611WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/15CAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/611WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1S2 | 1-10 PCS 1 DAY ARO | NF     | M28840/15CAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/612WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1S3 | 1-5 PCS 1 DAY ARO  | NF     | M28840/15CBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/612WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1S5 | 1-10 PCS 1 DAY ARO | NF     | M28840/15DAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/613WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF25-1S6 | 1-10 PCS 1 DAY ARO | NF     | M28840/15DBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/613WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF29-1F3 | 1-5 PCS 1 DAY ARO  | NF     | M28840/15EAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/614WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF29-1G1 | 1-10 PCS 1 DAY ARO | NF     | M28840/15EBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/614WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF29-1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/15FAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/615WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF29-1P2 | 1-10 PCS 1 DAY ARO | NF     | M28840/15FBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/615WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF29-1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/15GAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/616WA | 1-50 PCS 1 DAY ARO | NF     |
| 900-016NF29-1S3 | 1-10 PCS 1 DAY ARO | NF     | M28840/15GBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/616WB | 1-50 PCS 1 DAY ARO | NF     |
| 900-016NF33-1F1 | 1-10 PCS 1 DAY ARO | NF     | M28840/15HAW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/617WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF33-1G1 | 1-10 PCS 1 DAY ARO | NF     | M28840/15HBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/617WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF33-1P1 | 1-25 PCS 1 DAY ARO | NF     | M28840/15JAW   | 1-10 PCS 1 DAY ARO  | NF     | M28840/618WA | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF33-1P2 | 1-5 PCS 1 DAY ARO  | NF     | M28840/15JBW   | 1-25 PCS 1 DAY ARO  | NF     | M28840/618WB | 1-25 PCS 1 DAY ARO | NF     |
| 900-016NF33-1S1 | 1-25 PCS 1 DAY ARO | NF     | M28840/23AW  | 1-25 PCS 1 DAY ARO  | NF     | M28840/619DA | 1-10 PCS 1 DAY ARO | ZU     |
|                 |                    |        | M28840/23BW  | 1-25 PCS 1 DAY ARO  | NF     |              |                    |        |
|                 |                    |        | M28840/23CW  | 1-25 PCS 1 DAY ARO  | NF     |              |                    |        |
|                 |                    |        | M28840/23DW  | 1-100 PCS 1 DAY ARO | NF     |              |                    |        |
|                 |                    |        | M28840/23EW  | 1-25 PCS 1 DAY ARO  | NF     |              |                    |        |
|                 |                    |        | M28840/23FW  | 1-25 PCS 1 DAY ARO  | NF     |              |                    |        |
|                 |                    |        | M28840/23GW  | 1-25 PCS 1 DAY ARO  | NF     |              |                    |        |
|                 |                    |        | M28840/23HW  | 1-25 PCS 1 DAY ARO  | NF     |              |                    |        |
|                 |                    |        | M28840/24AA  | 1-50 PCS 1 DAY ARO  | NO     |              |                    |        |



The Glenair logo is located in the top left corner, featuring the brand name in a stylized font with a registered trademark symbol.

# BLUEJACKET

**“ONLY RIGID CONDUIT AND  
CONDUIT SYSTEMS THAT MEET THE  
PERFORMANCE REQUIREMENTS OF  
MIL-PRF-24758A ARE APPROVED  
FOR TOPSIDE USE...”**

**– U.S. DEPARTMENT OF THE NAVY**



When we set out to design an innovative conduit system to meet the requirements of the new MIL-PRF-24758A specification, we had a simple goal in mind: create a conduit system which was easy to install, easy to maintain and tough enough to perform in even the harshest ocean environments. The results couldn't be better. Our new qualified MIL-PRF-24758A Conduit system with its "BlueJacket" weatherproof jacketing exceeds the performance specifications for improved waterproof sealing, improved corrosion protection, and improved electromagnetic shielding. In fact, we believe no other conduit system can match the quality and performance of our new "Bluejacket" system. The U.S. Navy has cast its vote: Glenair's MIL-PRF-24758A conduit systems are the first products approved by the Navy under the new specification for topside use in new ship construction, new installations, future repairs, overhauls and modernization. The reference message is COMNAVSEASYS COM 2713107 December 06.

Glenair's "BlueJacket" weatherproof conduit is halogen free, flame resistant, and functional to 260°C. "BlueJacket" far surpasses the accelerated solar weathering standards under IEC 60068-2-5. Glenair's "BlueJacket" tested to 56 accelerated days, equivalent to 53 years of solar exposure. Our new fittings and adapters are equally impressive. The nickel plated 316L stainless steel components are equipped with rotatable couplings to simplify field installation. The design also offers improved environmental sealing and improved metal-to-metal termination of EMI shielding.



The Glenair **BlueJacket** Conduit System

*At a Glance...*

- Qualified to MIL-PRF-24758A(SH)
- Brass Metal-Core Conduit with EMI Shielding and Durable Glenair "BlueJacket" Covering
- Innovative Stainless Steel Fittings with Advanced Environmental Sealing, EMI Shield Termination and Rotatable Coupling Nut
- Available Adapters for all Shipboard Interfaces
- Fully Compatible with Legacy MIL-C-24758 Conduit Systems and Adapters (Still Available from Glenair)
- Corrosion-Resistant 316L Stainless Steel Eliminates Maintenance Cycles and Reduces Assembly Time



# BLUEJACKET

## MIL-PRF-24758A(SH) Qualified Flexible Waterproof Shielded Shipboard Conduit



Shipboard interconnect systems are subjected to harsh environmental challenges. Even in such difficult conditions, the Navy expects interconnected electronics to operate flawlessly—minor failures can result in loss of life and property. It is not surprising, therefore, that Navy installation, maintenance and performance standards are among the most rigid and demanding found in any industry. These standards are designed to protect electronics from extremes in vibration, shock, immersion, temperature, pressure, chemical exposure, as well as electromagnetic and radio frequency interference. In addition to these exposures, modern shipboard standards call for minimization of corrosion and reduction of weight.

Glenair is the premier manufacturer of high-reliability shipboard interconnect hardware, with all the key military standard approvals. Our application engineers work directly with military and merchant shipbuilders worldwide to design our highly specialized line of shipboard interconnect hardware. Navy, shipboard and marine interconnect solutions from Glenair's including our new "BlueJacket" Qualified MIL-PRF-24758A Conduit Systems and Fittings resist even the most severe environmental conditions. The rugged products offer outstanding abrasion-protection, flexibility, and temperature protection. The conduit systems can be assembled and

repaired in the field or at our factory. A qualified supplier of NAVSEA RP2000 and GR2000 series fittings, Glenair continues to design and manufacture many additional M24758 style products to meet specific customer and industry needs for a wide range of applications.

### **New MIL-PRF-24758A Metal Core Conduit and Fittings**

As mentioned above, Glenair is proud to announce its qualification to the new MIL-PRF-24758A Conduit and Fitting Specification. Glenair's "BlueJacket" conduit systems are now approved by the Navy for all topside use in new ship construction, new installations, overhauls and modernization, and Glenair is currently a qualified provider.

"BlueJacket" far surpasses the accelerated solar weathering standards under IEC 60068-2-5—the standard calls for 10 accelerated days (equal to approximately 10 years) of solar exposure. Glenair "BlueJacket" tested to 56 accelerated days, equivalent to 53 years of solar exposure. "BlueJacket" also meets the low smoke index per NES 711 (11.75), and the toxicity index per NES 713 (1.9). Further, "BlueJacket" conduit protects wiring from fuel,



# ET

## e System

hydraulic fluid, lube oil, cleaners, solvents, de-icers, coolants, refrigerants, and fire extinguisher foams. Gray color (Fed Std 595B 26270) matches standard U.S. Navy hull color for easy deployment and reduced maintenance.

“BlueJacket” installation is easy—new fittings eliminate termination compression leaks as braids terminate with metal-to-metal contact and jacketing with rubber-to-rubber contact. Another major enhancement to termination fittings is the addition of rotatable couplings to simplify field installations. Glenair is also able to offer a complete range of factory-terminated versions with lightweight solder fittings qualified to MIL-PRF-24758A. Both styles mate to all legacy MIL-C-24758 adapters and connectors.

Glenair “BlueJacket” conduit and fittings are perfectly suited for topside applications, including shipboard weapons, communications, and radar. “BlueJacket” is also suited for use in areas exposed to the extreme heat of gas turbine exhaust. The product is equally appropriate for use in non-maritime applications that require durable and reliable performance, sealing and improved corrosion protection. Glenair’s “BlueJacket” design combines the best high temperature conduit with new backshell style sealing features. “BlueJacket” weatherproof conduit is also halogen free and flame resistant.

### *Legacy MIL-C-24758 Waterproof Flexible EMI/EMP Conduit Systems and Fittings Still Available*

Glenair continues to offer cable and wire protection solutions for shipboard applications that call for qualified MIL-C-24758 conduit products. The MIL-C-24758 series is compatible with virtually every type of electrical connector and interconnect system, and can be supplied completely wired and terminated—ready for use—or as component elements. A complete range of fittings, transitions, adapters, shielding, overbraiding, and jacketing satisfies the most complex and demanding applications—from test equipment, robotics, and missile launch systems to shipboard warning systems and naval avionics.

For superior shielding performance and crush resistance, Glenair standard M24758/1 conduit offers a brass inner core with a bronze overbraid, sealed from the weather by a neoprene outer jacket. The brass conduit may also be ordered with a compressed inner core for increased flexibility. For applications where crush resistance is not required, Glenair offers a fluorocarbon (FEP) inner core with two, tin-over-copper braids and a neoprene outer jacket.

Glenair’s complete range of conduit, tubing and fittings have been tested and approved to all applicable Mil-Spec standards. Both the new and legacy systems provide optimal EMI, EMP, and RFI shielding across all frequencies including H and E fields, TEMPEST and lightning strike.



**Glenair BlueJacket MIL-PRF-24758A**

# Conduit Component Selection in Three Easy Steps

This selection guide is designed to assist you with the selection of components and planning for installation of MIL-PRF-24758A(SH) conduit and fittings. Per current U.S. Navy policy, only MIL-PRF-24758A qualified systems are now approved for topside use. To cross over part numbers from other manufacturers or the original MIL-C-24758 specification, please contact the factory at (818) 247-6000.

Each point-to-point conduit assembly will require a length of bulk conduit, 2 conduit fittings (M24758-2, -3, or -4) and 2 adapters (M24758-9 through M24758-25). You have three basic options for putting all these parts together:

- (1) Specify user installable components (bulk lengths of conduit, fittings and adapters designed for field assembly),
- (2) Select made-to-order conduit assemblies built at the factory according to your exact size, length and routing requirements, or
- (3) Use a combination approach in which one end of the conduit is terminated at the factory with lightweight solder fittings, while the other end is terminated in the field with user installable fittings and adapters.

**Step 1: Select Correct Conduit Size**

Conduit size is identified by its inside diameter (ID). The ID is referenced with a size code. The range of available sizes includes .25 inch (M24758-A) through 3.0 inch (M24758-L).

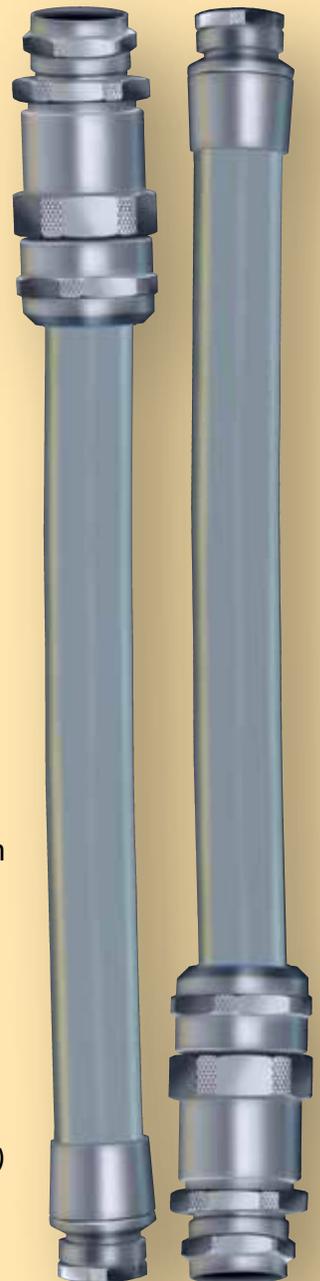
Conduit is normally filled at up to 90% of it's inside diameter. Verify the cable diameter

used before selecting the conduit diameter. Low smoke shipboard cable (MIL-C-24643) may have a thicker jacket material than regular (MIL-C-915 and MIL-C-24640) cables and require larger diameter conduit and fittings, so be sure to take this into account.

The shipboard interface, i.e., the diameter of the stuffing tube on the ship the conduit assembly will attach to, is the other key data point for conduit size selection. In a well-designed system, the diameter of the conduit, fitting, adapter and stuffing tube all need to be the same. For example, a size code "D" (1 inch) conduit would be selected when the stuffing tube on the ship is also 1 inch in diameter.

**NOTE 1:** The color of Mil-PRF-24758A conduit is standard US Navy haze gray in accordance with Fed Std 595B #26270. If other colors are desired, contact the factory at (818) 247-6000.

**NOTE 2:** Conduit internal dimensions 3/8", 5/8", and



3" have been omitted from the MIL-PRF-24758A specification.

# Guide

Products using these dimensions, built to the same standards, are still available from Glenair.

**NOTE 3:** The operating temperature variant of the M24758A jacket material used on the conduit is -70°C to + 200°C. For higher temperature materials, contact the factory.

## Step 2: Select Conduit Fittings

The function of the M24758 conduit fitting is to terminate M24758 flexible shielding conduit and to provide a standard thread for attaching M24758-9 through M24758-24 adapters. Fittings are supplied in straight, 45° and 90° configurations to facilitate the routing of the conduit into and out of kick-pipes and other interfaces to the ship. Selection is a simple matter of matching the size code in the part number with the size code of the selected conduit. Your selection of a straight, 45° or 90° angled part will depend on the routing requirements of your system.

**NOTE 1:** All conduit fittings and adapters feature a combination of hex wrench flats and knurls to minimize the need for special installation tools.

**NOTE 2:** Glenair recommends the use of torque wrenches to ensure conduit fittings and adapters are mated with the optimal amount of torque. Torque wrenches required for installation are available from Glenair. Please see page 55 for tool order information.

All conduit fittings and adapters are matte finished, nickel plated, 316L stainless steel. If other materials are desired, contact the factory.

## Step 3: Select Appropriate Adapters

As noted, the conduit fittings selected in step 2 provide a standard thread for the attachment of various adapters. The adapters are used to mate the conduit assembly to the many interfaces found on the ship, such as stuffing tubes or kick-pipes with tapered NPT threads. Adapters are also available to facilitate mating of the conduit assembly to various military standard cylindrical connectors.



## Stainless Steel Fittings

Stainless steel M24758 fittings for field termination and assembly are supplied in straight, 45° and 90° designs. Glenair MIL-PRF-24758A qualified fittings feature unique metal-to-metal shield termination, robust environmental sealing, and a rotatable coupling for easy attachment of M24758 series adapters. Both the environmental sealing and EMI shielding functions incorporate design ideas adapted from military standard backshells, including environmental o-rings, cable-sealing glands and cone-and-ring style shield terminations.



## Factory Terminated

Factory terminated conduit fittings provide the ultimate flexibility in system specification. The lightweight solder fittings mate to all M24758 adapters and offer a maintenance-free alternative to user installed fittings.



## Bulk Conduit

Flexible bulk conduit is supplied with a brass metal core, phosphorus bronze metal overbraiding and Glenair "BlueJacket" outer jacketing material which has been optimized for shipboard and other harsh application environments.

**The following are a selection of the standard adapters covered by MIL-PRF-24758A and supplied by Glenair:**

**1. Stuffing tube adapter (AKA swage tube or kick pipe adapter):** These adapters are identified by the stuffing tube size and conduit diameter. See the M24758-15 drawing.

**2. Panel adapter (AKA junction box adapter or interconnecting box adapter):** These adapters are identified by the conduit size. The required mounting hole size is shown on M24758-19 and 25 adapters.

**3. NPT adapter (AKA tapered pipe thread adapter):** These adapters are identified by the NPT thread size and conduit size. See the M24758-17.

**4. NPSM adapter (AKA National Pipe Thread Standard adapter):** These adapters are identified by the NPSM thread and conduit size. See the M24758-18 drawing.

**5. Splice (AKA conduit union adapter):** These adapters are used, in conjunction with M24758-2 fittings, to join two sections of conduit together. See the M24758-23 drawing.

**6. MS3100 Series MIL-C-5015 Connector adapter:** These adapters are used with the obsolete MS3100 series solder style connectors. See the M24758-9 drawing.

**NOTE 1:** Do not use the M24758-9 series adapters for MS3400 and MS3450 crimp contact connectors. See item 10 below.

**NOTE 2:** Glenair recommends replacing MS3100 series connectors (and M24758-19 adapters) with the MS3400 series connectors and M24758-13 series adapters.

**7. Triaxial connector adapter:** These adapters connect the conduit fitting to triaxial connectors. Contact the factory for the order information.

**8. Coaxial connector adapter:** These adapters connect the conduit fitting to coaxial RF connectors. See the M24758-11 drawing.

**9. MIL-C-26482 connector adapter:** These adapters connect the conduit fitting to the obsolete MIL-C-26482, series 1 connectors. See the M24758-12 drawing.

**NOTE 1:** Glenair recommends replacing MS312X series connectors (and M24758-12 adapters) with the MIL-C-26482 series 2, MS347X connectors (and M24758-13 series adapters).

**10. MIL-C-5015, MIL-C-26482, MIL-C-81703 and MIL-C-83723 series crimp contact connector adapter:** These adapters connect the conduit fitting to MS3400, MS3450 and other MIL-C-5015 crimp style connectors, and MS347X, MIL-C-26482 series connectors. See the M24758-13 drawing.

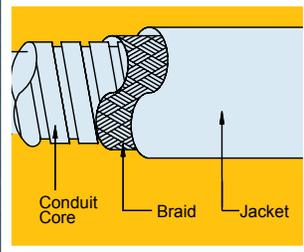
**11. MIL-C-28840 connector adapter:** These adapters connect the conduit fitting to MIL-C-28840 series connectors. See the M24758-14 drawing.

**12. MIL-D-38999 series connector adapters:** These adapters connect the conduit fitting to MS 27XXX, series 1 and 2, and D38999 series III and IV connectors. See the M24758-20 drawing.

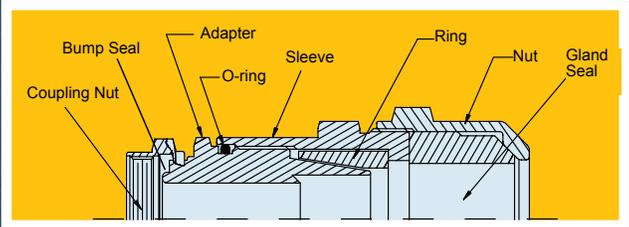
**13. MIL-C-22992 series connector adapters:** These adapters connect the conduit fitting to M1734X connectors. See the M24758-21 drawing. Contact factory for MIL-C-22992 Class L connector adapters.

**14. Glenair Series 22 adapter:** These adapters connect the conduit fitting to Glenair Series 22 connectors. See the M24758-22 drawing.

**15. Multiple shield termination adapters:** These adapters provide a shield termination mechanism for individual wire shields. See the M24758-24 drawing.



**Glenair  
MIL-PRF-24758A(SH)  
Qualified  
Conduit-to-Conduit  
Fitting  
Termination  
Instructions**



## GLENAIR "BLUEJACKET" MATERIAL SPECIFICATIONS

Temperature rating: -70°C to +200°C (with excursions to 260°C)

Halogen free per IEC 60614-1. Less than 5mg of HCl per 1 gm of product tested.

Accelerated Weathering (Solar) per IEC 60068-2-5; 56 days exposure

Flame Resistant per IEC 60614-1; Material does not sustain combustion when the source of flame is removed.

Low Smoke Index per NES 711 (11.75); Minimum standard is 25. The Glenair tested level is 11.75. This makes the material acceptable for interior applications as well as topside.

Smoke Density Class F1 Per NF F 16-101 IAW DIN EN 60695-2-11:2001

Toxicity Index per NES 713 (1.9); Minimum standard is 5. The Glenair tested level is 1.9. This makes the material acceptable for interior applications as well as topside.

Colorable to Fed Std 595B

Markable IAW MIL-PRF-24758A

Oxygen Limiting Index = 45.1 Per EN ISO 4589-2:1999; Minimum is 28.

12 Sec Vertical Burn: (Pass) Per 14CFR Part 25.853(a) amdt 25-116 App F Part 1 (a)(1)(ii)

Fluids Per MIL STD 810F, Method 504

Fuel (MIL-T-83133): JPG

Hydraulic Fluid (MIL H 5606): ROYCO 756

Lube Oil (MIL-L-23699): ROYCO-500

Cleaner (MIL-C-85570): CALLA-855

Solvent (Isopropyl Alcohol): TT-I-735

De Icer (AMS-1432): E36 Runway Deicer

Coolant (MIL-C-87252): Coolanol 25R

Fire Extinguishant Foam: AMEREX AFFF

### Tools:

- Tin snips or scissors capable of trimming conduit and braid
- Hacksaw, chop saw or tubing cutter
- Anti Seize Compound such as NSN 8030-01 450 4009 Tef Gel
- Razorblade
- Adjustable wrench (Rigid E110 or similar)
- Silicone O-ring lube
- Vice or second wrench
- Needle-nose pliers

**Preassembly instructions:** Disassemble fitting and ensure all thread engagements are smooth and burr free. Lubricate gland and O-ring with silicone lube.

1. Measure conduit to desired length (better long than short) and cut to length.
2. Using snips, trim end of conduit, braid and jacket. Ensure all bent edges are removed or smoothed.
3. Slide sleeve, nut and gland seal up conduit (out of way).
4. Using ring as a guide, cut jacket back 1/4" (6.35mm) wider than ring.
5. Slide ring over braid to edge of jacket.
6. Insert cone portion of adapter under braid and ring over conduit core. Apply anti seize to threads.
7. Slide sleeve down conduit and engage threads on adapter. Tighten sleeve until it bottoms out against adapter. O-ring should not be visible.
8. Slide gland seal and nut down to engage thread on sleeve. Tighten until only a small portion of blue gland 1/32" (.793mm) seal is visible above nut.



# Whatever Happened to the MIL-C-24758 EMI/EMP Conduit System?

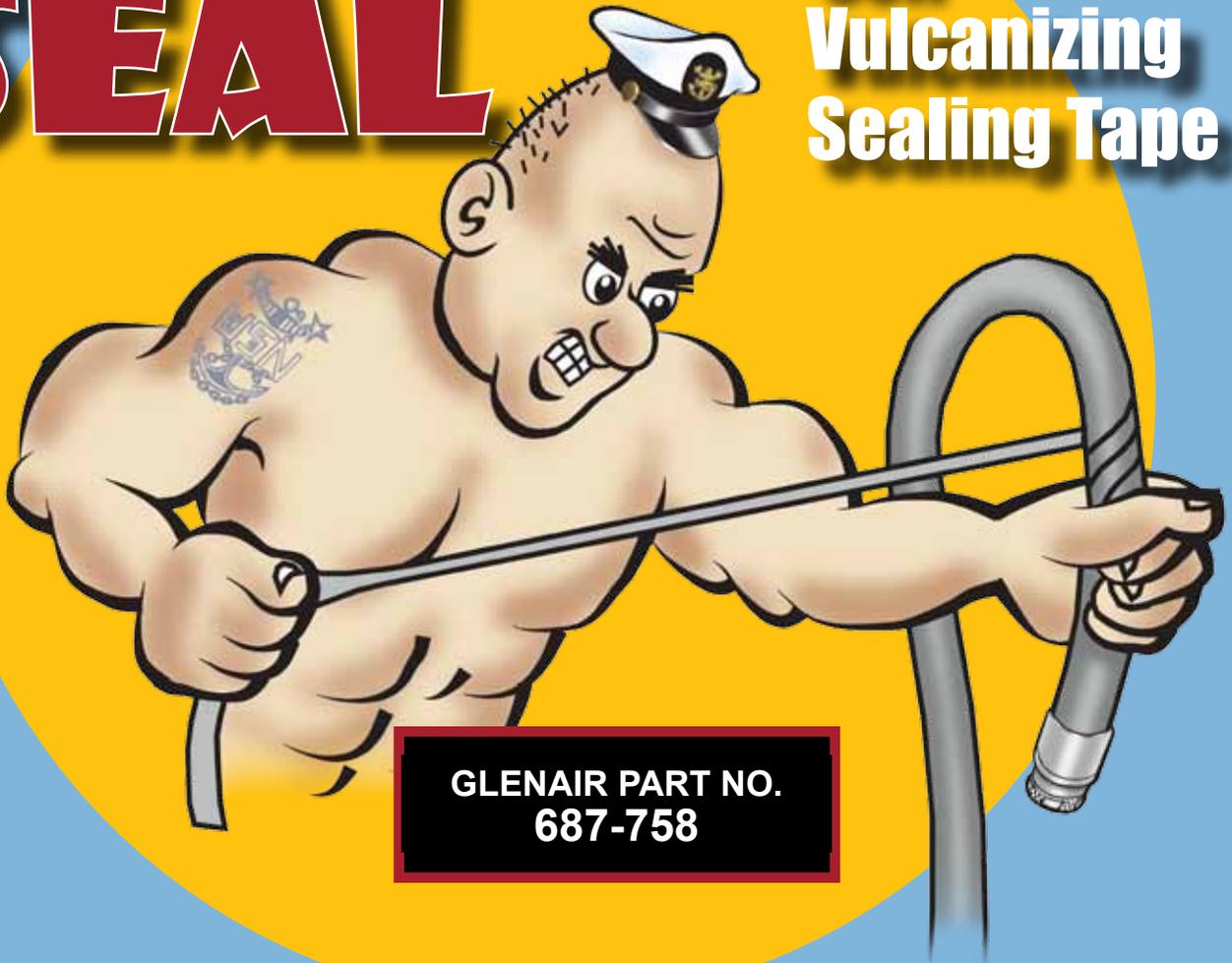


**Answer:** This venerable metal-core conduit wire routing and protection system has been *superseded* by the new MIL-PRF-24578A(SH) standard. For all new applications, the U.S. Navy requires engineers to specify only MIL-PRF-24578A(SH) conduit, fittings and adapters. But for repair of existing systems, Glenair still manufactures and stocks the complete line of MIL-C-24758 conduit products. For complete order information on any of the parts listed below, please visit our website: [www.glenair.com](http://www.glenair.com).

- M24758/1 EMI/EMP Shielding Conduit
- M24758/2 Straight Conduit Fitting
- M24758/3 45° Conduit Fitting
- M24758/4 90° Conduit Fitting
- M24758/5 Conduit-to-Panel Fitting
- M24758/6 Conduit-to-Threaded Pipe Fittings
- M24758/7 Conduit-to-Stuffing Tube Fitting
- M24758/8 Conduit-to-Conduit Fitting
- M24758/9 Adapter for MIL-DTL-5015 Series 3100 Connectors
- M24758/10 Adapter for Triaxial Connectors
- M24758/11 Adapter for Coaxial Connectors
- M24758/12 Adapter for MIL-C-26482 Series I Connectors
- M24758/13 Adapter for Connectors with MS3155 Interface
- M24758/14 Adapter for MIL-C-28840 (EC) Backshells
- M24758/15 Adapter for MIL-C-24235 Stuffing Tubes
- M24758/16 Adapter for Miscellaneous Fittings
- M24758/17 Adapter for Tapered Pipe Thread
- M24758/18 Adapter for Straight Pipe Thread
- M24758/19 Adapter for Panel Termination

# MASTER SEAL

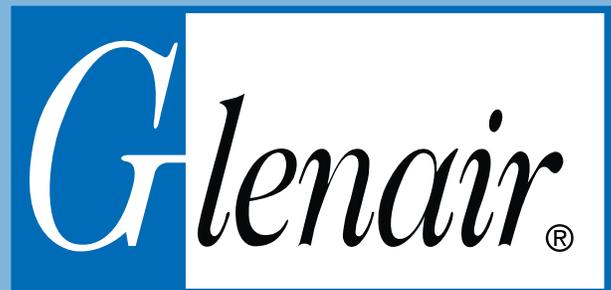
**Self-  
Vulcanizing  
Sealing Tape**



**GLENAIR PART NO.  
687-758**

## **Halogen Free!**

*“BlueJacket” material sealing tape designed for temporary repairs to topside conduit; Stops water incursion into conduit until a permanent repair using MIL-PRF-24758A components can be made.*



1211 Air Way  
Glendale, California 91201-2497  
Telephone: 818-247-6000 · Facsimile: 818-500-9912 · E-Mail: [sales@glenair.com](mailto:sales@glenair.com)

United States · United Kingdom · Germany · Nordic · France · Italy · Spain · Japan  
[www.glenair.com](http://www.glenair.com)

## We Take Mil-Specs Seriously!

**L**ike other Mil/Aero interconnect providers, Glenair bases many of its product offerings on Mil-Specs—United States Defense Standards governing interoperability and reliability of covered items. Non-defense government organizations and commercial product providers also use Mil-qualified interconnect parts, or parts designed to intermate with Mil-Spec items.

Most *QwikConnect* readers are well-acquainted with Mil-Specs, but for those who may be new to our world, a brief review: The Defense Department assigns to its various units (such as the Navy, Air Force, and Army) the responsibility to ensure companies providing systems and component parts meet exacting qualification standards, including extensive mechanical and electrical testing. Once qualified, these vendors are placed on the qualified products list (QPL) or the qualified manufacturers list (QML) for the specific Mil-Spec. Manufacturers are required to re-qualify periodically, typically at 18- or 24-month intervals, to remain on the QPL or QML.

Glenair is on the QPL/QML for dozens of Mil-Specs (see our website for a complete listing). We take our responsibility seriously to provide parts meeting Mil-Spec requirements, and to keep current with our Mil-Spec qualifications. In fact, you may not be able to point to a single day on the calendar that at least one factory team is not engaged in a Mil-Spec qualification process—either for new Mil-Spec items or to renew existing qualified products.

We recently qualified new plating options under the MIL-DTL-83513 Micro-D connector Mil-Spec. A little over a year ago, we qualified MIL-PRF-29504/14 and /15 fiber optic termini that “light up” the Navy’s MIL-PRF-28876 connectors. We were also the first in our industry to qualify the complete range of MIL-PRF-24758 conduit systems and fittings that are featured in this issue of *QwikConnect*. It’s hard work to keep up with these rigorous Mil-Spec qualifications, but it’s an important part of our commitment to provide quality products to the systems engineers, designers, and integrators who count on Glenair every day for proven interconnection solutions.

Now, as most of you know, I recently suffered through—and in fact am still recovering from—a serious medical event. Happily, I am on the mend and will soon be returning to full-time duties at Glenair. I may have more to say in the future, but for now I just want to express my heartfelt thanks for all the cards, letters and prayers. You can only imagine how much they meant to me!



*Chris Toomey*

### Publisher

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### Executive Editor

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D. Michael Bergen

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### Distribution

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### GLENAIR, INC.

1211 AIR WAY  
 GLENDALE, CA 91201-2497  
 TEL: 818-247-6000  
 FAX: 818-500-9912  
 EMAIL: [sales@glenair.com](mailto:sales@glenair.com)  
[www.glenair.com](http://www.glenair.com)

